

CBCS (Choice Based Credit System) Syllabus Vivekanand college (Autonomous) Kolhapur



B.Sc. Part -I Biotechnology (Entire)

to be implemented from June 2018 onwards

CHOICE BASED CREDIT SYSTEM SYLLABUS For Bachelor of Science Part - I BIOTECHNOLOGY (Entire)

1. TITLE : Biotechnology-Entire

2. YEAR OF IMPLEMENTATION:- CBCS Syllabus will be implemented from June, 2018 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students at first year of three years of B.Sc. degree course. Students learn Biotechnology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER:

1) To make the students knowledgeable with respect to the subject and its practicable

Applicability.

2) To promote understanding of basic and advanced concepts in Biotechnology.

3) To expose the students to various emerging areas of Biotechnology.

4) To prepare students for further studies, helping in their bright career in the subject.

- 5) To expose the students to different processes used in industries and in research field.
- 6) To prepare the students to accept the challenges in life sciences.
- 7) To develop skills required in various industries, research labs and in the field of humanhealth.

5. DURATION

- **The course shall be three year full time course.**

6. PATTERN:-

Pattern of theory Examination will be Semester. Practical examination will be annual

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

3) OTHER FEATURES :

(A) LIBRARY :

Reference and Text Books, Journals and Periodicals, Reference Books. – List Attached

(B) LABORATORY SAFETY EQUIPMENT :

- 1) Fire extinguisher
- 2) First aid kit
- 3) Fumigation chamber
- 4) Stabilized power supply
- 5) Insulated wiring for electric supply.
- 6) Good valves & regulators for gas supply.
- 7) Operational manuals for instruments.
- 8) Emergency exits.

Index

Sr.No.	Name	Page No.
1.	B.Sc. I CBCS Biotechnology Entire Pattern	
2.	Syllabus	
3.	Nature of Question paper	
4.	Scheme of marking	
5.	Subject Code	
6.	BoS List	

Semester - I

Sr.No	Course Title	Theory
1	DSC-A-Chemistry	40+10
2	DSC-A-Biochemistry	40+10
3	DSC-A-Plant Science	40+10
4	DSC-A-Mathematics	40+10
5	DSC-A-Computer	40+10
6	DSC-A-Bio techniques&Instrumentation	40+10
7	DSC-A-Microbiology	40+10
8	DSC-A-Physics	40+10
9	AECC-1A English for Communication	40+10

Semester - II

Sr.No	Course Title	Theory
1	DSC-B-Chemistry	40+10
2	DSC-B-Biochemistry	40+10
3	DSC-B-Animal Science	40+10
4	DSC-B-Statistics	40+10
5	DSC-B-Computer	40+10
6	DSC-B- Cell Biology	40+10

7	DSC-B-Microbiology	40+10
8	DSC-B-Physics	40+10
9	AECC-1B English for Communication	40+10

<u>Sr. No</u>	<u>Course Name</u>	<u>Practicals (Annual)</u>
1	Practical-I---Techniques in Chemistry and Biochemistry	50
2	Practical-II---Laboratory Exercise in Microbiology and Instrumentation	50
3	Practical-III---Laboratory Exercise in Plant Science and Animal Science	50
4	Practical-IV---Methods in Mathematics, Statistics and Computer Application in Biotechnology	50

Semester - I DSC-A Chemistry (Credit-2)

Units	Lectures(30)
<p style="text-align: center;">Unit - I</p> <p>Basics Concepts in Chemistry Introduction- Definition and Explanation of important basic terms of following, Solutions – Problems based on Normality, Molarity, Mole Fraction, Mixed Solution, ppb, ppm, Milli moles Exercises Acids and Bases - Lowry–Bronsted and Lewis concepts, strong and weak acids and bases, Ionic product of Water, pH, pKa, pKb, Hydrolysis of salts. Buffers - Solutions concept, types, Henderson equation for acid and basic buffers, Buffer action and buffer capacity. Analytical and Industrial Chemistry- Introduction, Importance of Analysis, Analytical processes (Qualitative and Quantitative) Classification of Analysis, sampling of solids, liquids, gases. Reaction Kinetics Introduction-Meaning and definitions of- rate constant, order and molecularity of reaction, activation energy, Integrated rate expressions for zero, 1st and 2nd order reactions, Characteristics of 1st order reactions, Catalysis- Definition, types of catalysis with example, characteristics of catalysis, Thermodynamics Introduction- Reversible and irreversible processes, internal energy, Enthalpy, heat of reaction and its types, First Law- Statement and mathematical expression, Hess law, Measurement of ΔH, Trouton's rule, Kirchoff's equation, Second law- Statement, concept of entropy (Criteria for spontaneous and non-spontaneous processes), Third law- Absolute entropies and their uses, Gibbs and Helmholtz free energy functions-Criteria for thermodynamic equilibrium and spontaneity, ΔG and K, ΔG and work function, Relation between ΔH and ΔG (Gibbs-Helmholtz equation), Phase equilibria- Clapeyron-Clausius equation and</p>	15

	its applications, Numerical problems.	
	Unit - II	
	<p>Structure and Bonding.</p> <p>Introduction- Types of bonds. Ionic covalent bond, Co-ordinate bond, Metallic bond, hydrogen bond, Electrostatic Interaction, Vanderwaal's forces. formation of ionic and covalent bond with examples, e.g. NaCl, KCl, HCl, CH₄, Cl₂, H₂.</p> <p>VBT- Postulates.</p> <p>Concept of Hybridization, sp, sp², sp³ hybridization with respect to BeCl₂, BF₃, SiCl₄ (Along with consequences with respect to bond length, bond angle, bond energy and shape of the molecule.</p> <p>Dipole moment- Definition and significance.</p> <p>Hydrogen Bonding- Definition, intra and intermolecular hydrogen bonding with suitable example (Water, Proteins, alcohols, Hydroxy acids, Zhenols).</p> <p>Ionic solids- Definition and general characteristics, comparison between, ionic and covalent compounds.</p> <p>Coordination Complexes</p> <p>Definition and formation of Co-ordinate bond in BF₃ ← NH₃ & NH₄⁺, Distinction between double salt and complex salt, Description of terms Ligand, Co-ordination number (CN), Coordination sphere, Essential and trace elements in biological process, Metallo porphyrins, w.r.t. Hemoglobin and Myoglobin, Metalloenzymes (Zn, Mg, Mn)</p>	15

References-

- 1) *University general chemistry - C. N. R. Rao, Macmillan.*
- 2) *Physical chemistry - R. A. Alberty, Wiley Eastern Ltd.*
- 3) *Quantum chemistry including molecular spectroscopy- B. K. Sen.*
- 4) *Organic chemistry - D. J. Cram and G. S. Hammond (Mcgraw-Hill).*
- 5) *A Guide-book to mechanism of organic chemistry-Peter Sykes-6th Edition.*
- 6) *Theoretical principles of inorganic chemistry- G.S. Manku*
- 7) *Physical chemistry by Sharma and Puri*
- 8) *Instrumental methods of chemical analysis- Chatwal & Anand*
- 9) *Instrumental methods of chemical analysis- B. K. Sharma*
- 10) *Organic chemistry VOL-II 5th Edition- I. L. Finar*
- 11) *An introduction to electrochemistry- Samuel Glassstone*
- 12) *The elements of physical chemistry – P.W. Atkins.*
- 13) *Essential of physical chemistry- B .S. Bahel. & G. D.Tuli.*
- 14) *Principels of physical chemistry – S.H Maron & Pruton*
- 15) *Concise in inorganic chemistry*
- 16) *Organic chemistry – Morrison & Boyd*

DSC-A - Biochemistry (Credit-2)

	Units	Lectures(30)
	<p style="text-align: center;">Unit- I</p> <p>Origin of life: - Basic concept ,A.I. Oparin concept, Urey Miller's experiment, Concept of Biomolecules- in general about Carbohydrate, protein, lipid just definition with at least one example. p^H, pka value definition, H-H Equation, Biological Buffer Systems- e.g. Phosphate, Bicarbonate, Haemoglobin buffer system, Protein buffer system</p> <p>Nucleic acids: Nucleosides, nucleotides, polynucleotide, DNA and its different forms with properties. (A, B, C, D, & Z), RNA and its types.- m-RNA, t-RNA. r-RNA Forces Stabilizing nucleic acid structure.</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Carbohydrates: Classification, glyceraldehyde, simple aldoses & ketoses, confirmation of D-glucose, biological importance of carbohydrates, reactions of monosaccharide (Oxidation, reduction, osazone), glycosidic bond, disaccharides (Sucrose, maltose, lactose), polysaccharides - homo polysaccharides, e.g. Starch, glycogen, Cellulose.</p> <p>Lipids: Classification, Simple lipid - Triacyl glycerol & waxes. Compound lipid- Phospholipid, e.g- Phosphatidyl choline, ethanolamine Glycerolipid, Sphingolipids, e.g. Sphingomyelin, cerebrosides, gangliosides.</p> <p>Physical properties,- state, color, odour, melting point, solubility, specific gravity, geometric isomerism, insulation, emulsification, surface tension.</p> <p>Chemical properties- saponification value, acid value, iodine no., rancidity; Derived lipid- Cholesterol, lipoprotein - LDL, VLDL, HDL, Chylomicrons. Liposome.</p>	15

References:-

- 1) *Biochemistry – Nelson & Cox*
- 2) *Biochemistry - Stryer*
- 3) *Enzymes - Trevor Palmer*
- 4) *Biochemistry - Voiet & Voiet*
- 5) *Biochemistry - J. L. Jain*
- 7) *Biochemistry - Powar and Chatwal*
- 8) *Protein Purification- Harris and Angel*
- 9) *Principles of Biochemistry - T. N. Pattabriraman.*
- 10) *Biochemistry 3rd Edition – Hames & Hopper.*
- 11) *General Biochemistry – J. H. Well.*
- 12) *Biochemistry – J. H. Ottaway & D. K. Apps*
- 13) *Biochemistry – U. Satyanarayanan*

DSC-A - Plant Science (Credit 2)

	Units	Lectures(30)
	UNIT-I	
	<p>Plant Diversity Outline of General Classification of Plant Kingdom. Algae – General characters and economic importance Fungi – General characters and economic importance Lichens -General account and economic importance Bryophytes – General characters and economicimportance Pteridophytes – General characters and economic importance Gymnosperms – General characters and economicimportance Angiosperms – General characters and economic importance</p> <p>Taxonomy of Angiosperms Taxonomy :- Definition, Aims, objectives and functions, Binomial nomenclature and its significance, Categorize of plant species as per IUCN, Methods of conservation, study of Outline of Bentham & Hookers System of classification of plants.</p>	15
	Unit II	15
	<p>Sexual Reproduction in Angiosperms:- Structure of Typical Flower – Floral whorls and functions:- Calyx,corolla, Androecium, Gynoecium. Fertilization:- Definition, Double fertilization and its significance Fruit - Definition, formation, Types: a) Simple, b) Aggregate, c) Composite. Seed –Definition and its types, Dormancy of seed- Definition, Causes and Breaking of seed dormancy, Seed germination- Concept, Types- Epigeal and Hypogeal, factorsaffecting seed germination. Plant Anatomy, Tissues- Simple and complex (Xylem and Phloem) Meristem its types and functions.</p>	

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Reference Books:

- 1) Devlin R.M. *Fundamentals of plant physiology* (MacMillan)
- 2) Malik C.P. *Plant physiology*, Kalyani publishers
- 3) Dube H.C. *Text of fungi, bacteria and viruses*.
- 4) Bold H.C. *The Plant kingdom*, Prentice - Hall India
- 5) Chopra G.L. i. *Class book of algae*, ii. *Class book of fungi*
- 6) Dutta A.C. *A Class book of botany*, Oxford University Press
- 7) Kumar H.D. *Biodiversity and sustainable development* (Oxford & IBH)
- 8) Mukherji H. *Plant groups* (New central book depot)
- 9) Parihar N.S. *An Introduction to embryophyta* (Central book depot)
- 10) Vasishtha P.C. *Botany for degree students-Gymnosperms*
- 11) Naik V.N. *Taxonomy of angiosperms*
- 12) Lawrence G.H. *Taxonomy of flowering plants*
- 13) Chopra G.L. *Angiosperms (Systematic and life cycle)*
- 14) Shivarajan V.V. *Introduction to principles of taxonomy*.
- 15) Pandey B.P. *Text book of angiosperms*
- 16) Eames A.J. and Daniels L.H. *An introduction of plant anatomy*, Mac Daniels L.H.
- 17) Esau K. *Anatomy of seed plants*
- 18) Esau K. *Plant anatomy*
- 19) Fahn A. *Plant anatomy*
- 20) Mathur R.C. *Systematic botany*

DSC-A - Mathematics (Credit 2)

	Units	Lectures (30)
	Unit I	
	<p>Complex Numbers Introduction, Operations on complex numbers, Complex conjugate, Modules and argument of complex number and simple examples on it, DE MOIVRE'S Theorem, Simple examples on above theorem</p> <p>Matrices Definition and types of Matrices, Algebra of Matrices (addition, subtraction, scalar multiplication and multiplication of matrices), Examples on operation of Matrices, Characteristic Polynomial Equation; Caley Hamilton theorem with proof. Inverse of matrix using Caley Hamilton Theorem, Rank of a Matrix (Definition) and examples, System of Linear equation - i) Non homogenean, ii) Homogenean, With examples, Eigen values and eigen vectors with simple examples.</p>	15
	Unit II	
	<p>Differential equation Definition of ordinary differential equation and degree, order of differential equation, Exact differential equation with simple examples.</p> <p>Linear differential equation $\frac{dy}{dx} + py = Q$ method of solution with simple examples. Bernoulli's differential equation with examples. Application of differential equation i) Growth and decay problems ii) Newton's law of cooling with examples</p> <p>Partial differentiation Introduction, Simple examples on evaluation of partial</p>	15

	derivatives, Composite function with examples, Homogenous function (Definition), Euler's theorem for first and second order, Simple examples on above theorems, Maxima and Minima (Two variables)	
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References:

- 1) *Mathematics for biologists by Sujata Tapare (vision publication).*
- 2) *Algebra and geometry by G. V. Khumbojkar.*
- 3) *Calculus and differential equation (Phadake prakashan).*
- 4) *Prof. L. G. Kulkarni, Dr. P. B. Jadhav*

DSC-A - Computer (Credit 2)

	Units	Lectures (30)
	<p>Unit I</p> <p>Computer basics: Definition, Block Dig.(I/O/Secondary storage), Applications, Generations, Types of computer, Numbering system (binary to decimal & decimal to binary)</p> <p>Operating System: Definition, functions, process management, multiprogramming, multitasking, multiprocessing, time sharing, memory management, uniprogramming, memory model, multiprogramming, memory model, virtual memory, security, some popular O.S. Ms-DOS, Microsoft Windows, Unix</p> <p>Office Operation: Microsoft Word-concept of toolbar, character, paragraph & document formatting, drawing toolbar, Header, Footer, Document editing, Page setup, short cut Keys, Text and graphics Microsoft Excel-Concept of spreadsheet, Creating worksheet, Well formatted documents, concept of row, column, cell and formula bar, using function, using shortcuts, charts, conditional formatting PowerPoint-Slide presentation, slide layout, Design, custom animation.</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Database Management System-Need of database, data models- Hierarcical, Network, Relational, Object Oriented, Main components of DBMS-DDL, DML.</p> <p>Basic of Bioinformatics-Internet, World wide web, Web browser, Search Engine (Google), Searching data from Search Engine, Bioinformatics Introduction - Nature of Biological data, characteristics of data, Tools for protein function analysis -Homology and similarity, structure analysis, sequence analysis, BLAST, FASTA, EMBOSS, Clustalw, Applications & scope of</p>	15

Reference Books

- 1) *Computer Fundamentals* by P. K. Sinha
- 2) *C Application programs and Projects* by Pramod Vasambekar
- 3) *Use of Computer from Vision Publication*
- 4) *Let Us C* by Kanetkar
- 5) *Ansi C* by Balgurusami

DSC-A - Biotechniques & Instrumentation (Credit 2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit - I</p> <p>Protein Purification: Method of cell disruption (Blenders, grinding with abrasives, presses, enzymatic method, sonication); Salt participation- Salting in, salting out, organic solvent precipitation, dialysis, ultra filtration.</p> <p>Centrifugation- Basic principles, RCF, Sedimentation coefficient, Svedberg's constant, Types of centrifuge: Desktop, High speed and Ultracentrifuge, Preparative centrifugation: Differential and density gradient centrifugation</p>	15
	<p style="text-align: center;">Unit II</p> <p>Microscopy a) General principles of microscopy- Image formation, magnification, numerical aperture (Uses of oil immersion objective), resolving power of microscope and working distance. b) Ray diagram, special features, applications and comparative study of compound microscope and Electron Microscope (Scanning and Transmission Electron Microscope).</p> <p>UV-Visible Spectroscopy Introduction to spectroscopy, properties of electromagnetic radiation (UV and Visible range, Electromagnetic spectrum, Electronic Transitions, Principle, Instrumentation with respect to colorimeter and single beam spectrophotometer. Principle, Instrumentation, Applications of UV and Visible spectrophotometer and colorimeter Lambert-Beer's law,</p> <p>Basic Laboratory Instruments: Introduction, Principle and applications of electrophoresis- Supporting media- Agarose, PAGE. Construction & Working of pH meter, Autoclave,</p>	15

References:-

- 1) *Biophysical Chemistry* by Nath and Upadhyaya.
- 2) *Practical biochemistry principles and techniques* by Wilson and Walker.
- 3) *Instrumental methods of chemical analysis* by Chatwal and Anand.
- 4) *Lab Manual in Biochemistry* by J. Jayaraman.
- 5) *Chromatography: Concepts and Contrasts- 1988* James Miller, John Wiley and Sons, Inc.
- 6) *Analytical Biochemistry* by Holme.
- 7) *Spectroscopy* by B.P. Straughan and S. Walker
- 8) *Introduction to HPLC* by R.J. Hamilton and P.A. Sewell

DSC-A- Microbiology (Credit 2)

	Units	Lectures(30)
	Unit-I	
	<p>Microbiology : Definition, History, Introduction to types of Microorganisms – Bacteria, Algae, Fungi, Protozoa and Viruses, Beneficial and harmful activities of microorganisms, Applied branches of Microbiology, major microbiological institutes in India.</p> <p>Morphology and cytology of Bacteria Morphology of Bacteria – i) Size, ii) Shape, iii) Arrangements Cytology of Bacteria – Structure and functions of :i) Cell wall, ii) Cell membrane, iii) Capsule and slime layer, iv) Flagella, v) Pilli, vi) Nuclear material, vii) Mesosome, viii) Ribosome</p> <p>Viruses- General characteristics and Cultivation, lytic cycle of T₄-bacteriophage.</p> <p>Bacterial taxonomy: General principles of bacterial nomenclature.-a) Taxonomic ranks, b) Common or Vernacular name, c) Scientific or International name, Criteria for bacterial classification- Morphological, cultural, biochemical & serological characters, Concept of bacterial species & strain.</p> <p>Microbial nutrition Nutritional requirements of microorganisms : Water; Micronutrients; Macronutrients; Carbon, Energy source; Oxygen and Hydrogen; Nitrogen, Sulphur and Phosphorous and growth factors- auxotroph, prototroph and fastidious organisms.</p>	15

	Nutritional types of microorganism based on carbon and energy sources - a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs, e. Photoautotrophs f. Chemoautotrophs g. Photoheterotrophs, h. Chemoheterotrophs.	
	<p style="text-align: center;">Unit- II</p> <p>Concept of Sterilization:- Definitions of: Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Asepsis, Sanitization. Methods of sterilization by- a) Physical agents: i) temperature-dry heat, moist heat ii) Radiation- U.V, Gamma radiation iii) Bacteria proof filter- membrane filter.b) Chemical agents:- Phenol & Phenolic compounds, Alcohol, Heavy metals(e.g. mercury).c) Gaseous agents- Ethylene oxide, formaldehyde</p> <p>Stains and staining procedures - Definition of dye and stain, Classification of stains – Acidic, Basic and Neutral, Principles, Procedure, Mechanism and application of staining, Procedures - i) Simple staining, ii) Negative staining, iii) Differential staining : Gram staining and Acid fast staining, iv) Special staining: Capsule staining, cell wall staining, endospore staining</p>	15

References:

- 1) *General Microbiology-Stanier*
- 2) *Introduction to Microbiology-Ingraham*
- 3) *Brock biology of Microorganisms-Madigan et al*
- 4) *Fundamentals of Microbiology-Frobisher*
- 5) *Microbiology-Pelczar*
- 6) *General Microbiology –Pawar & Dagainawala*
- 7) *Text book of microbiology-Ananthanarayan & Panikar*

DSC-A - Physics(Credit 2)

	Units	Lecture (30)
	Unit I	
	<p>Elasticity: Introduction, definitions of stress and strain in solids, types of strain and stress, Hooke's law, definition of Young's modulus (Y), bulk modulus (K) and modulus of rigidity (η), relation between Y, η, and K (without derivation), stress strain curve, importance of elasticity.</p> <p>Viscosity and Surface Tension Introduction, streamline and turbulent flows, concept of viscosity, coefficient of viscosity, effect of temperature and pressure on viscosity of liquids, concept of pressure energy and Bernoulli's theorem (without proof), Application of Bernoulli's Theorem venturimeter, Pitot's tube (working only), review of surface tension, surface energy, capillary action, angle of contact, wettability, relation between surface tension, excess pressure and curvature (without derivation), factors affecting surface tension, methods of measurement of surface tension- Jaeger's method (formula and working only), applications of surface tension.</p>	15
	Unit II	
	<p>Sound waves: Introduction, mechanical and electromagnetic waves, transverse and longitudinal waves with characteristics, principle of superposition of waves (Statement only), phenomenon of beats and expression for frequency of beats, application of beats, audible, ultrasonic and infrasonic waves, properties of ultrasonic waves and</p>	15

	their applications, Doppler effect and its applications Thermodynamics and Thermometry: Introduction, various temperature scales (Kelvin, Celsius, Fahrenheit, Reaumer and Rankin), thermal energy, platinum resistance thermometer-principle, construction and working,	
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References:

1. *Physics by Devid Hallday Roberet Resnik, (Vol-I and Vol-II) Wiley Eastern limited*
2. *Fundamental of mechanics, S. K. Saxena, Himalaya Publications*
3. *Perspectives of modern physics, Aurthur Beiser, McGrawHill Publication*
4. *Heat and thermodynamics, Zemansky, McGrawHill Publication*
5. *Fundamentals of optics, Jenkins white, McGrawHill Publication*
6. *Text book of optics, N. Subrahmanyam Brijlal, S. Chand and Company Limited*
7. *Optics by Ajoy Ghatak, Tata McGrawHill Publication*
8. *Properties of matter, D. S. Mathur, Sha, alal Charetible trust*
9. *Solar energy, Suhas Sukatme, Tata McGrawHill Publication*
10. *Principle of electronics, V. K. Mehta, S. Chand and Company Limited*
11. *Digital principles and application, Malvino and Leach, Tata McGrawHill Publication*
12. *Elements of spectroscopy, Gupta, Kumar, Sharma, Pragati Prakashan*
13. *Introduction to atomic spectra, H. E. White, McGrawHill Publication*
14. *Biophysics, Vastala Piralal, Dominent Publishers and Distributor*

Semester- II

DSC-B - Chemistry(Credit-2)

	Units	Lectures(30)
	<p align="center">Unit I</p> <p>Fundamentals and Mechanistic Basis of Organic Reaction - Introduction ,Reaction mechanism-Definition, curved arrow notation, substrate , Reagents, Types of reagents, types of reactions, Reactive intermediate Carbocation, Carbanion, Carbon Free radicals SN1 and SN2 mechanisms (Hydrolysis of t-butyl halide and primary alkyl halide) with energy profile diagram. Elimination reactions- E1 and E2 mechanisms (Dehydration of alcohol), Hoffman's and Saytzeff's rules- statements and justifications. Addition reactions- Electrophilic addition reactions in alkenes (Markovnikoff and anti-Markovnikoff additions), nucleophilic addition reactions of carbonyl compounds (cyanohydrin formation). Concept of aromaticity. Mechanism of SE reactions in benzene- Nitration, sulphonation, halogenation, diazotization, Friedel-Craft's alkylation and acylation reactions. Orientation effects as exemplified by- NO₂, OH functional groups.</p> <p>Stereochemistry - Geometrical isomerism in alkenes. Optical activity- Plane polarized light (PPL), Polarimeter, specific rotation, Chirality- Chiral molecules, symmetry elements, asymmetric carbon, compounds with one and two chiral centers, diastereomers, enantiomers, tartaric acid E-Z and R-S nomenclatures. Numerical Problems</p>	15
	Unit - II	
	Titrimetric Analysis and Gravimetric Analysis	15

	<p>Principle of volumetric analysis, titration, titrant, titrand, endpoint, Equivalence point, titration error, indicator. Primary and secondary standards, preparation of standard solutions Characteristics and examples. Theory of acid base indicators, choice and suitability of indicators. Types of titrations—acid base, redox, precipitation, complexometric, Titration curve and end-point evaluation Gravimetric analysis: solubility and precipitation, factors affecting solubility, nucleation, practical size, crystal growth, colloidal state, ageing or digestion of ppt Co precipitation and post precipitation, washing, drying and ignition of precipitate</p> <p>Chemistry of Natural Products</p> <p>Terpenoids-Isoprene rule, structure determinations of citral. Natural Pigments- Carotenoids and their functions in Plants, structural details of chlorophyll. Alkaloids- Basic structure, classification with suitable examples.</p>	
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References-

- 1) *University General Chemistry - C. N. R. Rao, Macmillan.*
- 2) *Physical Chemistry - R. A. Alberty, Wiley Eastern Ltd.*
- 3) *Quantum Chemistry Including Molecular Spectroscopy- B. K. Sen.*
- 4) *Organic Chemistry - D. J. Cram and G. S. Hammond (Mcgraw-Hill).*
- 5) *A Guide-book to Mechanism of Organic Chemistry-Peter Sykes-6th Edition.*
- 6) *Theoretical Principles of Inorganic Chemistry- G.S. Manku*
- 7) *Physical Chemistry by Sharma and Puri*
- 8) *Instrumental methods of chemical analysis- Chatwal & Anand*
- 9) *Instrumental methods of chemical analysis- B. K. Sharma*
- 10) *Organic Chemistry VOL-II 5th Edition- I. L. Finar*
- 11) *An introduction to electrochemistry- Samuel Glasstone*
- 12) *The elements of physical chemistry – P.W. Atkins.*
- 13) *Essential of physical chemistry- B .S. Bahel. & G. D.Tuli.*
- 14) *Principels of Physical Chemistry – S.H Maron & Pruton*
- 15) *Concisein Inorganic chemistry – J.D. Lee*

	Units	Lectures (30)
	<p style="text-align: center;">Unit- I</p> <p>Protein: Amino acid classification (Depending upon R group), structure of amino acids, single letter codes of amino acids, peptide bond, classification of protein based on composition - Simple, conjugate, derived. Determination of primary structure (Sanger's method, Edman's method, Dansylchloride), structural level organisation of proteins- Primary, Secondary- forces stabilizing secondary structure types - α - helix, β-sheets, Tertiary structure (Describe different bonds), w.r.t. Myoglobin. Quaternary structure w.r.t. Hemoglobin. Biological functions of Proteins.</p> <p>Chromatography : Introduction, Theory, Principle and applications of Thin layer chromatography, paper chromatography, column chromatography, size exclusion chromatography, Ion exchange chromatography, Affinity chromatography.</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Enzymes: Introduction, IUB classification, active site, energy of activation, transition state hypothesis, lock and key hypothesis, Induced fit hypothesis, enzyme inhibition- types competitive, non-competitive, un-competitive. M-M equation, Line weaver-Burk plot</p> <p>Co-enzymes: Thiamine, riboflavin, niacin, pyridoxol phosphate, (Introduction, structure, sources, daily requirement, biological functions deficiency)</p>	15

DSC-B - Biochemistry (Credit-2)

References:-

- 1) *Biochemistry – Nelson & Cox*
- 2) *Biochemistry - Stryer*
- 3) *Enzymes - Trevor Palmer*
- 4) *Biochemistry - Voiet & Voiet*
- 5) *Biochemistry - J.L.Jain*
- 6) *Basic Biophysics- M. Daniel*
- 7) *Biochemistry - Powar and Chatwal*
- 8) *Protein Purification- Harris and Angel*
- 9) *Practical biochemistry – Keith Wilson And Walker*
- 10) *Principles of Biochemistry - T. N. Pattabriraman.*

11) *Biochemistry 3rd Edition – Hames & Hopper.*

12) *General Biochemistry – J. H. Well.*

DSC-B - Animal Science(Credit 2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit- I</p> <p>Life concepts and characteristics of life. Cell theory, Understanding the diversity of life, 3 domain systems, Six kingdom system, General classification of animal kingdom.(up to classes), Non-chordates –Study of phylum Porifera, Ceolenterata,Platyhelmenthes, Nemathelmenthes, Arthropoda, Mollusca & Echinodermata – General characters with representative examples-Sycon, Hydra, Liver fluke/ Taenia, Earthworm / Nereis, Cockroach,Pearl oyster / Pila, Starfish</p> <p>Chordates:-Study of class Pisces, Amphibia, Reptilia & Mammalia – Generalcharacters with representative examples – Lebeo, Frog, Cobra,Alligator, Fowl and Rat</p> <p>Host Parasite Relationship</p> <p>Protozoan parasite- Plasmodium(Morphology,parasitic adaptations,Life cycle), Nematode parasite- Ascaris(Morphology,parasitic adaptations,Life cycle), Platehelminthes parasite- Liver fluke(Morphology,parasitic adaptations,Life cycle)</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Tissues - i) Epithelial ii) Muscular iii) Nervous iv) Connective tissue-Blood (Plasma, Serum, Clotting), Bone, Cartilage. Histological Architecture - i) Skin ii) Tooth iii) Liver iv) Kidney v) Uterus</p> <p>Applied zoology - Vermiculture, Apiculture, Sericulture, Pearl culture, Pesci culture</p>	15

References :

1. *Kotpal – Invertebrates*

2. *Kotpal – Chordates*

3. *Shukla and U. Pandey- Applied Zoology.*

DSC-B - Statistics(Credit 2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit-I</p> <p>Introduction to statistics and collection of data. Meaning of statistics, Scope of statistics in Biological and medical sciences, Primary and Secondary data, Classification of data, Inclusive and Exclusive methods, Discrete, and Continuous frequency Distribution. Cumulative frequencies , Graphical representation :- Histogram ,bar chart, line diagram, pie chart& ogive Curves Measures of central tendency and measures of dispersion, Concept of measures of central tendency, Definitions of A.M., Median, Mode, Quartiles, Examples on ungrouped and grouped data, Properties of A.M. (statement only), Methods of obtaining mode & quartiles graphically, Concept of measures of dispersion . Absolute and Relative measures, of dispersion, Definitions of Range, Q.D, S.D and variance ,coefficient of variation. Examples on grouped and ungrouped data</p>	15
	<p style="text-align: center;">Unit II</p> <p>Correlation and Regression, probability & testing of Hypothesis - Concept of correlation between two variables and types of correlation, Method of obtaining correlation i) by scattar diagram method ii)By Karl Pearson Correlation coefficient Properties of correlationcoefficient. Examples on ungrouped data, Concept of regression, Lines of regression Regression coefficientsand properties without proof. Examples on ungrouped data, Probability and Sampling Definition of sample space, Outcomes, events, exhaustive events,Mutually exclusive events, Equally likely events, certain eventsimpossible events.Definition of probability, Limits of probability. Probability ofcomplementary event, Additive law of probability. Simple illustrativeexamples.Definition of conditional probability, Multiplicative lawprobability, Independent events, Simple illustrative examples.Idea of population and sample. Simple Random Sampling andStratified Random sampling. Advantages and disadvantages of both the methods, Testing of hypothesis, Simple and composite hypothesis, Null andalternative hypothesis, types of errors, Critical region, Acceptanceregion, level of significance. Tests of significance: Chi square tests, t tests and F test</p>	15

References :

- 1) *Goon A. M., Gupta M. K. and Dasgupta B.: Fundamentals of mathematical statistics vol. I & II. World Press, Calcutta.*
- 2) *Gupta & Kapoor: Fundamental of mathematical statistics.*
- 3) *Thingale T. K. and Dixit P. G. (2003): A text book of paper- I for B.Sc. I, Nirali Publication, Pune.*
- 4) *Waiker and Lev: Elementary Statistical methods.*

- 5) *Rohatgi V. K. and Sauh A. K. Md E. (2002) An Introduction to probability and statistics (John Wiley & Sons-Asia)*
- 6) *Thigale T. K. and Dixit P. G. (2003): A text book Of paper II for B.Sc. I.*
- 7) *Meyer P. L. (1970): Introductory to probability and statistical Application. Addison wesly.*
- 8) *Cochran, W.G.: Sampling Techniques, Wiley Estern Ltd., New Delhi.*
- 9) *Des Raj : Sampling theory*

DSC-B - Computer(Credit- 2)

	Units	Lectures (30)
	Unit- I Introduction to Programming, Algorithm, Flowchart, Pseudocode Fundamentals of C, Character set, keywords, identifiers, data types, constants, symbolic, constants, escape sequences, variables. arithmetic, relational & logical operators, type conversions in expressions.	15
	Unit- II Input/output Printf(), scanf(), getchar(), putchar(), gets(), puts(), enum, sizeof() operator Formatting input/output. Control Structures & Array If, if..else, nested if, switch statement, while loop , do.. while loop , for loop, continue & break statement Array- declaration, initialization of One dimensional & twodimensional array, character array, strlen(), strcpy(), strcmp(), strcat().	15

Reference Books

- 1) *Computer Fundamentals* by P. K. Sinha
- 2) *C Application programs and Projects* by Pramod Vasambekar
- 3) *Use of Computer from Vision Publication*
- 4) *Let Us C* by Kanetkar
- 5) *Ansi C* by Balgurusami

DSC-B - Cell Biology(Credit 2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit-I</p> <p>Cell Structure - Discovery of Cell, Cell theory -Definition, discovery, three assumptions of cell theory,exceptions, organismal theory, protoplasm theory, Organization of Prokaryotic cell, Organization of Eukaryotic cell (plant and animal cell), Ultra structure & functions of cell organelles Mitochondria,Chloroplast, E.R., Golgi apparatus ,Lysosome, Peroxisome,Ribosomes. Cell membrane & Membrane transport, Cell membrane – components, Molecular models of cell membrane-Unit membrane model, Protein, crystal model, fluid mosaic model, Types of membrane transport, Passive transport-simple diffusion, facilitated diffusion, osmosis.Active transport-primary and secondary transport, Sodium pump,Na⁺-K⁺ ATPase pump, Bulk transport-endocytosis and exocytosis</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Nucleus - Introduction,morphology,occurrence,shape,size,number,positionUltra structure of nucleus-Nuclear membrane, nucleoplasm,nucleopore complex, nucleus. Chromosome structure- introduction, General features of Prokaryotic chromosome.General features of Eukaryotic chromosome-. Chromosomenumber, size, Chromosomal nomenclature & General structure</p> <p>Cytoskeleton assembly Introduction, Cytoskeleton elements, Microtubules- occurrence,structure,chemical composition,microtubule associated proteins, functions, Microfilaments- occurrence, structure, chemical composition, functions, Intermediate filaments(IF) - occurrence, structure, chemicalcomposition, types of IF, functions Organization of cilia and flagella</p>	15

References:-

- 1) *Molecular biology of cell-Albert*
- 2) *Molecular biology & cell biology – Lodish etal*

- 3) *Cell biology –De Robertis*
- 4) *Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal*
- 5) *Genes Lewin*
- 6) *Cell biology –Gerald karp*
- 7) *Practical biochemistry – Keith, Wilson and Walker*
- 8) *Cell Biology- C.B.Pawar*

DSC-B - Microbiology (Credits-2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit-I</p> <p>Culture media and pure culture techniques:Common components of media and their functions Peptone, Yeast extract, NaCl, Agar and Sugar Culture media - a) Living Media (Lab. animals, plants, bacteria, embryonated eggs, tissue cultures), b) Non living media – i) Natural, ii) Synthetic, iii) Semisynthetic, iv) Differential, v) Enriched, vi) Enrichment, vii) Selective.</p> <p>Methods for isolation of pure culture - i) Streak plate ii) Pour plate iii) Spread plate</p> <p>Microbial growth:Definition of growth, phases & growth curve - a] Continuous culture, b] Synchronous growth, c] Diauxic growth Effect of environmental factors on growth-temperature, pH., osmotic pressure, hydrostatic pressure, surface tension, heavy metals, ultraviolet light.</p>	15
	<p style="text-align: center;">Unit- II</p> <p>Water Microbiology – Sources of microorganisms in water, fecal pollution of water, Routine bacteriological analysis of water i) SPC ii) Tests for coliforms-Qualitative-detection of presence of coliforms by -Presumptive, confirmed, completed, differentiation of coliforms-IMViC Quantative: MPN technique.</p> <p>Air microbiology - Sources of microorganism in air, definition of (i) infectious dust, (ii) droplets (iii) droplet nuclei Sampling methods for microbial examination air, (i) solid impaction-sieve device (ii) liquid impingement – bead bubbler device Germ free and Gnotobiotic life-rearing germ free animals, vs normal animals, uses of germ free animals</p> <p>Medical microbiology Definition, Host, parasite, Saprophytes, Commensals, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomites, Incubation period, Carriers, Morbidity rate, Mortality rate, Epidemiology,</p>	15

	<p>Etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity. Virulence factor: Production of endotoxin, exotoxin, enzymes, escaping of phagocytosis. Types of diseases: Epidemic, Endemic, Pandemic, Sporadic. Types of infections: Chronic, Acute, Primary, Secondary, Reinfection, Iatrogenic, Congenital, Local, Generalized, Covert, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nasocomial. Mode of transmission of diseases: Air borne transmissions, Vehicle transmissions, Contact transmissions, Vector borne transmissions.</p> <p>General principles of prevention and control of microbial diseases</p>	
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References:

- 1) *General microbiology*-Stanier
- 2) *Introduction to microbiology*-Ingraham
- 3) *Brock biology of microorganisms*-Madigan et al
- 4) *Fundamentals of microbiology*-Frobisher
- 5) *Microbiology*-Pelczar
- 6) *General microbiology* -Pawar&Daginawala
- 7) *Text book of microbiology*-Ananthanarayan& panikar

DSC- B - Physics (Credit 2)

	Units	Lectures (30)
	<p style="text-align: center;">Unit-I</p> <p>Optics correlated with microscopy: Concept of interference and diffraction, Diffraction gratin (Description only), concept of polarization and plane polarized light, production of polarized light by absorption, reflection, refraction and scattering, Nicol prism, definition of optical activity, LASER- LASER action (Energy level diagram), properties of LASER, applications of LASER. Bioelectricity Introduction, electricity observed in living systems-examples, origin of bioelectricity, resting potential and action potential, Nernst equation, conduction velocity, origin of compound action potential, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electroculogram (EOG),</p>	15
	<p style="text-align: center;">Unit II</p> <p>Semiconductor Devices and Digital Electronics, Light Emitting Diode (LED), seven segment display, photodiode, optocoupler, spectral distribution of solar energy, solar cell construction, working efficiency and fill factor, applications of solar cell. Binary and BCD number system, Basic logic gates OR, NOR, AND, NAND and NOT, Demorgan's theorem Atomic structures and X-rays Introduction, J. J. Thomson atomic model, Rutherford atomic model and Bohr model, Limitations of Bohr atomic model, Energy level diagram of Hydrogen atom, Quantum numbers, Nuclear models and forces (Liquid drop model and shell model), production of x-rays and its properties, Continuous and characteristic X-ray spectrum, Bragg's law, Applications of X-ray</p>	15

References:

- 1) *Physics by David Halliday Robert Resnik, (Vol-I and Vol-II) Wiley Eastern limited*
- 2) *Fundamental of Mechanics, S.K.Saxena, Himalaya Publications*
- 3) *Perspectives of modern physics, Arthur Beiser, McGrawHill Publication*
- 4) *Heat and Thermodynamics, Zemansky, McGrawHill Publication*

- 5) *Fundamentals of optics, Jenkins white, McGrawHill Publication*
- 6) *Text book of optics, N.Subrahmanyam Brijlal, S.chand and Company Limited*
- 7) *Optics by Ajoy Ghatak ,Tata McGrawHill Publication*
- 8) *Properties of Matter, D.S.Mathur,Sha,alal Charetible trust*
- 9) *Solar Energy, Suhas Sukatme,Tata McGrawHill Publication*
- 10) *Principle of electronics, V.K.Mehta, S.chand and Company Limited*
- 11) *Digital Principles and application, Malvino and Leach,Tata McGrawHill Publication*
- 12) *Elements of Spectroscopy, Gupta,Kumar,Sharma, Pragati Prakashan*
- 13) *Introduction to Atomic spectra, H.E.White ,McGrawHill Publication*
- 14) *Biophysics, Vastala Piramal, Dominent Publishers and Distributor*

Practical-I Techniques in Chemistry and Biochemistry

Techniques in Chemistry :-

Sr No	Name of the Practical	Practicals
	Physical Chemistry- Major experiments	
1	To study the specific reaction rate of hydrolysis of methyl acetate in presence of HCl.	1
2	To study the reaction between potassium per sulphate ($K_2S_2O_8$) and potassium iodide (KI) in solution with equal concentration of reactants.	1
3	To determine the normality of given strong acid by titrating it against strong base, conductometrically.	1
4	To determine the normality of given strong acid by titrating it against strong base, potentiometrically.	1
	Physical Chemistry Minor Experiments	1
1	To determine the Heat of ionisation (ΔH_i) of weak acid.	1
2	To prepare and standardise HCl/ H_2SO_4 of commercial sample.	1
	Inorganic Chemistry Major Experiments	1
1	Estimation of amount of magnesium from talcum powder by complexometric titration.	1
2	To determine the percentage purity of given sample of soda ash.	1
3	Preparation of standard potassium dichromate ($K_2Cr_2O_7$) solution and determination of strength of ferrous ammonium sulphate solution $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$.	1
	Inorganic Chemistry Minor Experiments	1
1	Preparation of Ferrous ammonium sulphate $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$.	1
2	To prepare buffer solution and to measure their pH using pH meter.	1
	Organic Chemistry Major Experiments	1
1	Estimation of Vitamin-C.	1
2	Estimation of sap value of given oil sample.	1
3	To determine the strength in terms of g/lit or kg/dm^3 of given solution of aniline.	1
4	To determine the acetamide in given solution.	1
	Organic Chemistry Minor Experiments	1

1	Preparation of phthalimide from phthalic anhydride.	1
2	Preparation of p-Nitro acetanilide from acetanilide.	1

References:

1. *Textbook of practical organic chemistry (4th Edition, Longman) - A. I. Vogen*
2. *Organic Chemistry - Morrison & Boyd*

Techniques in Biochemistry :-

Sr. No.	Name of the Practical	Practical
	Biochemistry- Major experiments	
1	Estimation of Glucose(500 ug/ml) by DNSA method 6 tubes- Graphical)	1
2	Estimation of Protein by Biuret Method 6 tubes- Graphical) e.g- Casein - 5mg/ml	1
3	Estimation of Amino acid by Ninhydrin Method,6 tubes- Graphical) e.g- Leucine - 65ug/ml	1
4	Estimation of Cholesterol by Iron reagent 6 tubes- Graphical)	1
5	Estimation of Reducing sugar from apple juice by Benedict' method - Quantitatively.	1
6	Separation & purification of Lysozyme from egg yolk by Ion Exchange chromatography	1
	Biochemistry Minor Experiments	1
1	Preparation of Buffers- Phosphate, Acetate, and determination of pH with pH meter	1
2	General -Qualitative tests for carbohydrates and detection of carbohydrate from given mixture(Glucose, fructose, maltose, xylose, sucrose, starch)	1
3	General -Qualitative tests for Amino acids and detection of Amino acid from given mixture (Arginine, methionine, cystine, tyrosine, tryptophan, histidine)	1
4	Isolation and characterisation of Casein from Milk	1
5	Isolation and characterisation of Starch from Potato.	1
6	Qualitative assay of α -amylase using starch as a substrate (use of Iodine- visual detection by varying the time of enzyme substrate reaction.)	1
7	Separation and detection of Amino acid by Paper/ Thin layer chromatography	1
8	Separation of Biomolecules by Gel filtration Chromatography	1

References:

1. *Practical Biochemistry - J. Jayaraman,*

2. *Practical Biochemistry - David Plummer*

Practical-II

Laboratory Exercises in Microbiology & Instrumentation

Practicals in Microbiology :-

Sr. No.	Name of the Practical	Practicals
1)	Microscopic examination of bacteria by a. Monochrome staining. b. Gram staining c. Negative staining. d. Capsule staining. e. Cell wall staining. f. Endospore staining	6
2)	Mounting and identification of Mold. a) Aspergillus b) Penicillium	2
3)	Preparation of bacteriological culture media i) Peptone water. ii) Nutrient broth. iii) Nutrient agar. iv) Mac Conkey's agar.	2
4)	Preparation of Fungal culture media i) Sabouraud's agar ii) PDA	2
5)	Enumeration of bacteria by total viable count from soil by spread plate technique and pour plate technique	2
6)	Observation of motility by hanging drop technique.	1
7)	Study of growth curve of bacteria	1
8)	Isolation, colony characters, Gram staining & motility of <i>E.coli</i> , <i>Bacillus sp.</i>	2
9)	Differentiation of fecal & non-fecal coliforms by IMViC Test	1
10)	Isolation, colony characters, Gram's staining and motility of Bacteria isolated from- Air (solid impaction technique)	1
11)	Study of Sugar (Glucose/Lactose) Fermentation ability of Microorganisms	1

References:

1. *Experimental Microbiology - Patel*

2. *Media Preparation - Dr. A.M. Deshmukh*

3. *Bacteriological Techniques - F. J. Baker*

Practicals in Instrumentation :-

Sr. No.	Name of the Practical	Practicals
1)	Use, care and study of Compound Microscope	1
2)	Demonstration (Principle, working, construction) of Colorimeter	1
3)	Determination of λ - max of a dye solution (Any dye)	1
4)	Demonstration (Principle, working, construction) of PH meter	1
5)	Demonstration (Principle, working, construction) of Autoclave	1
6)	Demonstration (Principle, working, construction) of Centrifuge	1
7)	Demonstration (Principle, working, construction) of Hot air oven & Incubator	1
8)	Demonstration (Principle, working, construction) of Laminar Air Flow	1
9)	Study of UV absorption spectra of macromolecules (protein and nucleic acid) & determination of Purity	1
10)	Separation of Amino Acids by Paper Electrophoresis	1
11)	Separation of Small & Large Biomolecules by Dialysis technique	1

References:

- 1. Practical Biochemistry - J. Jayaraman*
- 2. Practical Biochemistry - David Plummer*

Practical-III

Laboratory Exercises in Plant Science & Animal Science

Practicals in Plant Science :-

Sr. No.	Name of the Practical	Practicals
1)	Study of algae (Nostoc, Sargassum)	1
2)	Study of bryophyte (Riccia / Anthoceros)	1
3)	Study of Pteridophyte (Selaginella)	1
4)	Study of gymnosperms (Pinus)	1
5)	Study of Angiosperms (Sunflower, Maize)	1
6)	Plant anatomy – Dicot and monocot root, stem, leaf	2
7)	Study of apical meristem (Stem and root)	1
8)	Study of typical flower	1
9)	Study of types of inflorescence	1
10)	Study of fruit types as per theory	1
11)	Study of morphology of seed (Monocot & dicot)	1
12)	Breaking of seed dormancy	1

References:

1. Vikas Handbook of Botany - Shrivastava K. C., B.S. Dattatray, A. B. Raizada (1977)

Practicals in Animal Science :-

Sr. No.	Name of the Practical	Practicals
1)	Classification and Identification of Non-chordates & Chordates. (One animal each). Non- chordates- Sycon, Hydra, Liver fluke/ Earthworm / Nereis, Cockroach, Pearl oyster/Pila, Starfish. Chordates- Lebeo, Frog, Cobra, Alligator, Fowl and Rat.	2
2)	Earthworm Dissection (Digestive system, Nervous system)	2
3)	Study of Plasmodium, Ascaris, Liver Fluke, Taenia- Salium	2
4)	Blood slide Preparation and Identification of Blood cells.	2
5)	Blood cell count i) Differential count of W. B. Cs. ii) Total count of W. B. Cs and R. B. Cs.	2
6)	Preparation of Haemin Crystals	1
7)	Study of Bone Marrow cells	1
8)	Histology of Skin, Tooth, Liver, Kidney, Uterus.	2
9)	Demonstration of – ii) Bee Keeping- Study of Instruments iii) Sericulture - Study of different Stages.	2
10)	Study Tour-Visit to Sericulture/Apiculture/Vermicomposting unit)	2

References:

1. Practical Zoology by Lal.

Practical-IV Methods in Mathematics, Statistics & Computer Applications in Biotechnology

Practicals in Mathematics, Statistics & Computer Applications:-

Sr. No.	Name of the Practical	Practicals
<i>Practicals in Mathematics</i>		
1)	1. Applications of differential equation i) Growth & decay, ii) Newton's law of cooling	2
2)	Eigen values & Eigen vectors	2
3)	Complex numbers: Geometrical representation of complex numbers (Argand's diagram) Graphical representation of Z , Z_1+Z_2 , $Z_1 - Z_2$, $Z_1 \cdot Z_2$, Z_1/ Z_2 $[Z-a] = b$	2
<i>Practicals in Statistics</i>		
1)	Frequency distribution – Graphical, Histogram, ogive curve [less & greater than].	2
2)	Measures of central tendency (Grouped and ungrouped) A. M., Median, Mode.	2
3)	Measures of Dispersion – Range, s. d., C. V. combined s. d.	2
4)	Correlation, Regression. Scattered diagram, Karl Pearson's correlation coefficient, eqn of Regression line.	2
5)	Testing of Hypothesis: Large sample test: Normal, proportion. Small sample test.: χ^2 , t, f.	2
<i>Practicals in Computer Applications</i>		
1)	Study of commands of word.	1
2)	Creation of worksheet with graphs	1
3)	Power Point presentation.	2

4)	Write program to convert temperature in Celsius into Fahrenheit.	2
5)	Write program to find area of circle	1
6)	Write program to find given number is even or odd.	1
7)	Write program to display Fibonacci series	1
8)	Write program to find class from given marks of subject.	1
9)	Write program to print sum of 1 to n numbers	1
10)	Write program to display number, square & cube upto given number.	1
11)	Write program to sort elements of array	1
12)	Write program for addition of two matrix	1
13)	Introduction to biological database	1

List of minimum equipment's-for Biotechnology

- 1) *Hot air oven - 1*
- 2) *Incubator - 1*
- 3) *Autoclave - 1*
- 4) *Refrigerator - 1*
- 5) *Students microscopes(oil immersion) - 10 nos. for one batch*
- 6) *Digital balance - 2*
- 7) *pH meter - 1*
- 8) *Centrifuge - 1*
- 9) *Colorimeter - 1*
- 10) *Distilled Water Plant - 1*
- 11) *Laminar air flow cabinet - 1*
- 12) *Colony counter - 1*
- 13) *Water bath - 1*
- 14) *Arrangements for gas supply and fitting of two burners per table.*
- 15) *One working table of 6' x 2½' for two students.*
- 16) *One separate sterilization room attach to the laboratory (10' x 15')*
- 17) *At least one wash basin for a group of five students*
- 18) *One separate instrument room attached to lab (10' x 15')*
- 19) *One laboratory for one batch including working tables (6' x 2½') per two students for one batch*
- 20) *Store room (10' x 15')*

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

Semester	Core Course	Marks	Evaluation	Standard of passing
I.	DSC - A	10	semester wise	35% (4 M)
II	DSC - B	10	semester wise	35% (4 M)

Scheme of marking (practical)

Semester	Marks	Evaluation	Standard of passing
I & II	50	Annual	35% (18 M)

Note: For Semester I & II for both DSC-A & B, 9 subject theory papers of 30 Hrs. (36.5 Lectures)
Credit - 2

Practical Examination Annual having 4 Practical I to IV (each having 50 Marks)

For Continuous Internal Evaluation/Examination - 10 Marks

Mandatory : 1. Presenty - 3 Marks
2. Any one of the following - 7 Marks
Unit Test / Home Assignment/ Seminar