

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



NAAC Accredited-2015  
'B' Grade (CGPA 2.62)

**Name of the Faculty: Science & Technology**

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: Biotechnology**

**Name of the Course: B.Sc. I ( Sem-I & II )**

**(To be effective from the academic year 2019-2020 (June-2019)).**

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur,**  
**Faculty of Science**  
**Choice Based Credit System (CBCS)**  
**(2019-2020: W. e. f. June 2019)**

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**Choice Based Credit System:** With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate degree, Solapur University has implemented Choice Based Credit System (CBCS) at Undergraduate level.

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

· **Outline of Choice Based Credit System:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

**Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: **Ability Enhancement Compulsory Courses (AECC)** and **Skill Enhancement Courses (SEC)**. "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; (i) Environmental Science and (ii) English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

· **Credit:** Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. The contact hours are transformed into credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 20 marks and University Evaluation for 80 marks.

# Punyashlok Ahilyadevi Holkar Solapur University, Solapur

## Faculty of Science

### Choice Based Credit System (CBCS),(w.e.f.2019-20) Structure for B. Sc-I Biotechnology

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits	
	Type	Name		L	T	P					
<b>Class :</b>	<b>B.Sc.- I Semester – I</b>										
<b>Ability Enhancement Course(AECC)</b>		English (communication skill)	Paper- I	4.0			100	80	20	4.0	
<b>Core</b>	DSC 1A		PAPER I: Biochemistry-I	2.5	--	--	50	40	10	4.0	
			PAPER II: Metabolism-II	2.5	--	--	50	40	10		
	DSC 2A		Paper-I: Cell Biology-I	2.5	--	--	50	40	10	4.0	
			Paper-II: Cell Biology-II	2.5	--	--	50	40	10		
	DSC 3A		Paper-I: Developmental Biology-I	2.5	--	--	50	40	10	4.0	
			Paper-II: Developmental Biology-II	2.5	--	--	50	40	10		
	DSC 4A		Paper-I Chemical Science	2.5	--	--	50	40	10	4.0	
			Paper-II Biophysics	2.5	--	--	50	40	10		
	<b>Total</b>				<b>24</b>	--	--	<b>500</b>	<b>400</b>	<b>100</b>	<b>20</b>
	<b>Class :</b>	<b>B.Sc.- I Semester – II</b>									
<b>Ability Enhancement Course(AECC)</b>		English (communication skill)	Paper- II	4.0			100	80	20	4.0	
<b>Core</b>	DSC 1B		Paper-I: Mammalian Physiology-I	2.5	--	--	50	40	10	4.0	
			Paper-II: Mammalian Physiology-II	2.5	--	--	50	40	10		
	DSC 2B		Paper-I: Plant physiology-I	2.5	--	--	50	40	10	4.0	
			Paper-II: Plant physiology-II	2.5	--	--	50	40	10		
	DSC 3B		Paper-I: Computer	2.5	--	--	50	40	10	4.0	
			Paper-II: Biostatistics	2.5	--	--	50	40	10		
	DSC 4B		Paper-I: Animal	2.5	--	--	50	40	10	4.0	

		Tissue Culture								
		Paper-II: Plant Tissue Culture	2.5	--	--	50	40	10		
	Democracy, Elections and Good Governance		3.0			50	40	10	NC	
<b>Total (Theory)</b>			<b>27</b>	--	--	<b>550</b>	<b>440</b>	<b>110</b>	<b>20</b>	
<b>Core</b>	DSC 1 A & 1B	Practical I and II	--	--	4	100	80	20	4.0	
	DSC 2 A & 2B	Practical I and II	--	--	4	100	80	20	4.0	
	DSC 3A & 3B	Practical I and II	--	--	4	100	80	20	4.0	
	DSC 4A & 4B	Practical I and II	--	--	4	100	80	20	4.0	
<b>Total (Practical)</b>					<b>16</b>	<b>400</b>	<b>320</b>	<b>80</b>	<b>16</b>	
<b>Grand Total</b>			<b>51</b>		<b>16</b>	<b>1450</b>	<b>1160</b>	<b>290</b>	<b>56</b>	

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur,**

**Faculty of Science**

**Choice Based Credit System (CBCS)**

**(W.e.f. June 2019)**

**Title of the Course: B.Sc. Part-I**

· **Subject:** Biotechnology

· **Introduction:** This course provides a broad overview of Biotechnology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using Biotechnology. The course structure is basic science centric where students learn core science and are taught necessary fundamental subject for that purpose.

· **Objectives of the course:** The objectives of B. Sc. Biotechnology course are:

- a. To provide an intensive and in depth learning to the students in field of Biotechnology.
- b. Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing world.
- c. To develop awareness & knowledge of different organization requirement and subject knowledge through varied branches and research methodology in students.
- d. To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

**Course outcome and Advantages:** Biotechnology has tremendous job potential.

- a) The successful students will be able to establish research organizations with the help of Agriculture, environment protection and also their own industry for Biofertilizer, microbial byproducts.  
Clinical pathology, transgenic plant and animals, vaccines, antibiotics etc.
- b) Scientific Research Organizations.
- c) Universities in India & abroad.

· **Eligibility and Admission:** A Candidate passing 10+2 with biology MLT, dairy science, Fisheries, Agricultural science as one of the subject and passed from state syllabus / CBSE /equivalent with minimum passing percentage of as per the directives of the higher education and Solapur university, Solapur.

· **Duration:** The duration for this program is of 3 years with semester pattern (06 Semesters)

· **Medium of Instruction:** English

· **Syllabus Structure:**

· The University follows semester system.

· An academic year shall consist of two semesters.

· Each B.Sc. course shall consist of three years i.e. six semesters.

· B.Sc. Part-I Biotechnology shall consist of two semesters: Semester I and Semester II.

In semester I, there will be two core papers is having paper I and paper II of 100 marks.

Similarly in Semester II there will be two core papers is having paper I and paper II of 100 marks. English will be as Ability Enhancement Course (AECC) in both Semester-I and II. English paper carries 100 marks in each semester.

The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B.Sc. Part-I Biotechnology sem I & II the internal assessment will be based on Internal tests, Home assignment, Tutorials, Seminars, Group discussion, Brain storming sessions etc. as given below. Practical course examination is of 100 marks shall be conducted at the end of semester II. The practical examination of 100 marks shall also consist of 80 marks for University practical assessment and 20 marks for college internal assessment.

· **Scheme of Evaluation**

As per the norms of the grading system of evaluation, out of 100 marks, the candidate has to appear for college internal assessment of 20 marks and external evaluation (University assessment) of 20 marks.

**Semester – I:**

**Theory: (100 marks)**

University Examination (80 marks): No. of theory papers: 2 (paper I and paper II of 40 marks each )

**Internal Continuous Assessment: (20 marks and 10 marks each for two papers )**

(a) Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

**Semester – II**

**Theory: (100 marks)**

University Examination (80 marks): No. of theory papers: 2 (paper III and paper IV of 40 marks each)

**Internal Continuous Assessment: (20 marks and 10 marks each for two papers)**

(a) Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

**Practical Examination: (100 marks)**

University Examination (80 marks): No. of practical course: 1

**Internal Continuous Assessment: (20 marks)**

(a) Internal practical test - Scheme of marking: **10 marks**

(b) Viva/group discussion/model or chart/attitude/attendance/overall behavior: **10 marks**

**Passing Standard**

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in internal assessment and passed in University examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same 70 marks of external examination and his performance shall be scaled to 100 marks.

· **ATKT**

Candidate passed in all papers, except **5 (five)** papers combined together of semester I and II of B.Sc. Part-I Biotechnology examination shall be permitted to enter upon the course of Semester III of B.Sc. Part-II Biotechnology.

# SEMESTER – I

Subject Code: DSC 1A (Total credits: 4)

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## PAPER I: BIOCHEMISTRY

Total credits: 2.0  
Contact Hrs: 30.0

### UNIT I

(5 Periods)

**Introduction to Biochemistry:** A historical prospective.

**Amino acids & Proteins:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different level of structural organization of proteins. Denaturation and renaturation of proteins. Fibrous and globular proteins.

### UNIT II

(5 Periods)

**Carbohydrates:** Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides., Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

### UNIT III

(5 Periods)

**Lipids:** Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, prostaglandins, cholesterol.

### UNIT IV

(5 Periods)

**Nucleic acids:**– Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z- DNA, denaturation and renaturation of DNA.

### UNIT V

(5 Periods)

**Enzymes:** Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites. enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria.

### UNIT VI

(5 Periods)

**Vitamins:** Definition, differences between fat soluble & water soluble vitamins. Source, requirement, Role of: NAD<sup>+</sup>, NADP<sup>+</sup>, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

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### SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004). Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008). Introduction to Plant Physiology. John Wiley and Sons.

5. Salisbury, F.B. and Ross, C.W. (1991). Plant Physiology, Wadsworth Publishing Co. Ltd.
6. Harper's Review of Biochemistry- H.A. Harper (Ed)
7. Principals of Biochemistry- Lehninger.
8. Biochemistry – U. Satyanarayan.
9. Elements of Biochemistry- P.K. Gupta.
10. Fundamental of Biochemistry- J.L. Jain.
11. Elementary Biochemistry- J.L. Jain.

## PAPER II: METABOLISM

**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I** **(5 Periods)**  
**Carbohydrates Metabolism:** Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle.

**UNIT II** **(5 Periods)**  
**Oxidative phosphorylation:** membrane arrangement of respiratory chain and electron transport mechanism of oxidative phosphorylation; ATP synthase complex and ATP generation; Inhibitors & Uncouplers of electron transport chain and ATP synthase complex.

**UNIT III** **(5 Periods)**  
**Amino acid metabolism:** General reactions of amino acid metabolism and urea cycle. glyconic and ketogenic amino acids.

**UNIT IV** **(5 Periods)**  
**Nucleotide metabolism:** Sources of the atoms in the purine and pyrimidine molecules Outline of biosynthesis and degradation of purine and pyrimidines,

**UNIT V** **(5 Periods)**  
**Lipid metabolism:** Biosynthesis of saturated and unsaturated fatty acids. Hydrolysis of triacylglycerols, Transport of fatty acid into mitochondria,  $\beta$  oxidation of saturated fatty acids.

**UNIT VI** **(5 Periods)**  
**Hormonal regulation of metabolism:** Hormones regulates metabolism of carbohydrates, proteins and fats. Biochemistry of starvation: Alternate methods of energy generation, organ interrelationships during starvation.

### SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W. H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004). Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008). Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991). Plant Physiology, Wadsworth Publishing Co. Ltd.
6. Harper's Review of Biochemistry- H.A. Harper (Ed)



7. Principals of Biochemistry- Lehninger.
8. Biochemistry – U. Satyanarayan.
9. Elements of Biochemistry- P.K. Gupta.
10. Fundamental of Biochemistry- J.L. Jain.
- 11.Elementary Biochemistry- J.L. Jain.

## **Subject Code: DSC 2A (Total credits: 4)**

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### **PAPER I: CELL BIOLOGY-I**

**Total credits: 2.0**  
**Contact Hrs: 30.0**

#### **UNIT I (05 Periods)**

**Cell:** Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.

#### **UNIT II (05 Periods)**

**Cell Membrane:** Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity

#### **UNIT III (05 Periods)**

**Membrane permeability:** Cell recognition and membrane transport-passive and active.

#### **UNIT IV (05 Periods)**

**Cytoskeleton and cell motility:** Structure and function of microtubules, Microfilaments, Intermediate filaments. Membrane vacuolar system.

#### **UNIT V (05 Periods)**

**Endoplasmic reticulum:** Rough & smooth ER, Structure, function including role in protein segregation.

#### **UNIT VI (05 Periods)**

**Golgi complex:** Structure, biogenesis and functions including role in protein secretion.

**Lysosomes:** Vacuoles and micro bodies: Structure and functions.

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#### **SUGGESTED READING**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

## PAPER I: CELL BIOLOGY-II

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I (05 Periods)**

**Ribosomes:** Structures and function including role in protein synthesis.

**UNIT II (05 Periods)**

**Mitochondria & Chloroplasts:** Structure and function, Genomes, biogenesis.

**UNIT III (05 Periods)**

**Nucleus:** Structure and function, types of chromosomes based on centromere & and their structure.

**UNIT IV (05 Periods)**

**Cell growth:** Concept of cell growth and differentiation, Cell cycle and division: Events of cell cycle, Mitosis, and Meiosis; Cell synchrony and its applications, Cell senescence, Apoptosis.

**UNIT V (05 Periods)**

**Extracellular Matrix:** Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction (GPCR, growth factor-IGF & hormone-epinephrine).

**UNIT VI (05 Periods)**

**Cancer:** Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

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### SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Subject Code: DSC 3A (Total credits: 4)**

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## PAPER I: DEVELOPMENTAL BIOLOGY-I

**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I (05 Periods)**

**Gametogenesis:** Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis.

**UNIT II (05 Periods)**

**Fertilization:** Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk. Cleavage: Definition, types, patterns & mechanism

**UNIT III** (05 Periods)  
**Early embryonic development:** Blastulation: Process, types & mechanism Gastrulation in frog & chick. Introduction to teratogenesis, aging, metamorphosis, asexual reproduction & parthenogenesis.

**UNIT IV** (05 Periods)  
**Morphogenetic movements-** Epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

**UNIT V** (05 Periods)  
**Plant patterning:** structural and functional organization of the plant body, Model of plant development – Arabidopsis thaliana life cycle. Root, shoot and floral patterning.

**UNIT VI** (05 Periods)  
**Plant developmental responses to climate change:** Effects of elevated CO<sub>2</sub>, temperature & drought stress on plant development and morphology (Leaf, root & reproductive development).

## PAPER II: DEVELOPMENTAL BIOLOGY-II

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I** (05 Periods)  
**Embryonic Differentiation:** Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level.

**UNIT II** (05 Periods)  
**Embryonic Induction:** Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

**UNIT III** (05 Periods)  
**Organogenesis:** Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

**UNIT IV** (05 Periods)  
**Seed development:** Endosperm development during early, maturation and desiccation stages, embryogenesis, cell lineage during late embryo development, storage proteins of endosperm and embryo.

**UNIT V** (05 Periods)  
**Fruit growth:** Dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

**UNIT VI** (05 Periods)  
**Hormones:** Effect of different hormones on leaf, root & fruit development.

### SUGGESTED READING

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc.,

- Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
  3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.
  4. Bhojwani and Bhatnagar, "Plant Embryology".

**Subject Code: DSC 4A (Total credits: 4)**

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**PAPER I: CHEMICAL SCIENCE**

**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I (05 Periods)**

**Introduction:** Definition and formation of ionic and covalent bond with examples, e.g. NaCl, KCl, HCl, CH<sub>4</sub>, Cl<sub>2</sub>, H<sub>2</sub>; VBT- Postulates.

**UNIT II (05 Periods)**

**Concept of Hybridization:** sp, sp<sup>2</sup>, sp<sup>3</sup> hybridization with respect to C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, CH<sub>4</sub> (with respect to bond length, bond angle, bond energy and shape of the molecule). Dipole moment: Definition and significance.

**UNIT III (05 Periods)**

**Types of bonds in biomolecules:** Covalent (glycoside, peptide, phosphodiester), ionic, hydrogen, Van der Waals, hydrophobic, co-ordinate their formation and interaction.

**UNIT IV (05 Periods)**

**Solutions:** Solutions, types of solutions, solubility & factors affecting solubility; Mole concept: Definition & introduction to molarity, normality, molality, percentage with examples of solution preparation. Classification of solvents, Dilution factor.

**UNIT V (05 Periods)**

**Chemical equilibrium:** Chemical Equilibrium, Colligative properties: Definition, osmosis, osmotic pressure and reverse osmosis. Integrated rate expressions for zero, 1<sup>st</sup> and 2<sup>nd</sup> order reactions.

**UNIT VI (05 Periods)**

**pH of buffers:** pH and pOH, buffer capacity. Henderson equation for acidic and basic buffers with derivation. Reaction Kinetics: Introduction-Meaning and definitions of-rate constant, order and molecularity of reaction, activation energy.

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**SUGGESTED READING**

1. University General Chemistry by C.N. R. Rao, Macmillan
2. Principles of Physical Chemistry, 4th edition by S.H. Marron and C.F. Prutton
3. Essentials of Physical Chemistry by B.S. Bahel and G.D. Tuli
4. College Chemistry by Linus Pauling
5. Concise Inorganic Chemistry by J. D. Lee 5th Edition
6. Basic Inorganic Chemistry by Cotton and Wilkinson
7. Organic Chemistry, 5th Edition by Marrison Prentice Hall of India Pvt. Ltd. Boyd, New Delhi

## PAPER II: BIOPHYSICS

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

### **UNIT I (05 Periods)**

**Biophysics of Water:** Molecular structure, Association of water through H-bonding, Nature of hydrophobic interactions, physicochemical properties of water.

### **UNIT II (05 Periods)**

**Solutes:** Hydrophiles and Hydrophobes, The Influence of Ions on water: Structure-Making and Structure-Breaking.

### **UNIT III (05 Periods)**

**Protein Hydration:** Specific Roles of Water in Structure and Function, Secondary Structure, Protein-Protein Interactions, Involvement of Bound Water in Catalytic Action, Water and Nucleic Acids.

### **UNIT IV (05 Periods)**

**Laws of thermodynamics:** concept of free energy, unavailable energy & Entropy, Negative entropy change in living system, heat content of food, Bomb calorimetry, Energy generation & energy transfer processes in biochemical reactions.

### **UNIT V (05 Periods)**

**Macromolecular Interactions:** binding of small molecules by polymer, identical and independent sites model, Scatchard plot, interaction between binding sites, MWC model, Sequential model.

### **UNIT VI (05 Periods)**

**Ligand-receptor interaction:** oxygen-hemoglobin binding, binding of two different ligands, cooperative binding, anti-cooperative binding, energetics & dynamics of binding, structures of protein ligand complexes.

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### **SUGGESTED READING**

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.
2. Barrow. C. (1974), Physical Chemistry For Life Sciences, McGraw-Hill.
3. Berns M.W. (1982), Cells, Holt Sounders International Editors.
4. Bloomfield V.A. and Harrington R.E. (1975), Biophysical chemistry, W.A.Freeman and CO.
5. Bulter I.A.V. And Noble D.Eds. (1976), Progress in Biophysics and Molecular Biology (all volumes) pergamon, Oxford.
6. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A.Fremman and Co.
7. Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west press.

**SEMESTER – II**  
**Subject Code: DSC 1B (Total credits: 4)**

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**PAPER I: MAMMALIAN PHYSIOLOGY-I**

**Total credits: 2.0**

**Contact Hrs: 30.0**

**(05 Periods)**

**UNIT I**

**Digestion:** digestive system, Mechanism of digestion & absorption and assimilation of carbohydrates, Proteins, Lipids and nucleic acids.

**UNIT II**

**(05 Periods)**

**Digestive fluids:** Composition of bile, Saliva, Pancreatic, gastric and intestinal juice.

**UNIT III**

**(05 Periods)**

**Respiration:** Respiratory system, mechanism, Exchange of gases, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Chloride shift.

**UNIT IV**

**(05 Periods)**

**Circulation:** Composition of blood, Plasma proteins & their role, blood cells, Haemtopoisis, Mechanism of coagulation of blood.

**UNIT V**

**(05 Periods)**

**Mechanism of working of heart:** Cardiac output, cardiac cycle, Origin & conduction of heart beat.

**UNIT VI**

**(05 Periods)**

**Skeletal system:** Axillary and peripheral Skeletal system, types of joints.

**SUGGESTED READING**

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.

**PAPER II: MAMMALIAN PHYSIOLOGY-II**

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**Total credits: 2.0**

**Contact Hrs: 30.0**

**UNIT I**

**(05 Periods)**

**Muscle physiology:** Structure of cardiac, smooth & skeletal muscle, threshold stimulus, Physical, chemical & electrical events of mechanism of muscle contraction.

**UNIT II**

**(05 Periods)**

**Osmoregulation:** Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

**UNIT III**

**(05 Periods)**

**Nervous coordination:** Structure and types of nerve, Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, Neurotransmitters.

**UNIT IV** (05 Periods)

**Endocrine coordination:** Mechanism of action of hormones (insulin and steroids).

**UNIT V** (05 Periods)

**Different endocrine glands**– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

**UNIT VI** (05 Periods)

**Sensory organs:** Structure and function of eye, ear, tongue, skin, nose

### SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Herculourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John Wiley & sons, Inc.
3. Human physiology by Chattergy

## Subject Code: DSC 2B (Total credits: 4)

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### PAPER I: PLANT PHYSIOLOGY-I

**Total credits: 2.0**  
**Contact Hrs: 30.0**

**UNIT I** (05 Periods)

**Anatomy:** The shoot and root apical meristem and its histological organization, simple & complex permanent tissues.

**UNIT II** (05 Periods)

primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf).

**UNIT III** (05 Periods)

**Plant water relations:** Plant water relations: Importance of water for plant life, mechanism of water absorption, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration,

**UNIT IV** (05 Periods)

**Transpiration:** Stomata & their mechanism of opening & closing.

**UNIT V** (05 Periods)

**Micro & macro nutrients:** Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients.

**UNIT VI** (05 Periods)

**Mechanism:** Mechanism of uptake of nutrients, mechanism of food transport, source to sink transport.

## PAPER I: PLANT PHYSIOLOGY-II

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

- UNIT I** (05 Periods)  
**Carbon metabolism:** Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation,
- UNIT II** (05 Periods)  
Calvin cycle, CAM **pathway**, photorespiration, compensation point.
- UNIT III** (05 Periods)  
**Nitrogen metabolism:** Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.
- UNIT IV** (05 Periods)  
**Growth and development:** Growth and development: Definitions, phases of growth, growth curve.
- UNIT V** (05 Periods)  
**Growth hormones:** Physiological role and mode of action-auxins, gibberlins, cytokinins, abscisic acid and ethylene.
- UNIT VI** (05 Periods)  
**Seed dormancy:** seed germination, causes of seed dormancy, concept of photo-periodism and vernalization.

### SUGGESTED READING

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4 edition, Sinauer Associates Inc.MA, USA



## Subject Code: DSC 3B (Total credits: 4)

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### PAPER I: COMPUTER

**Total credits: 2.0**  
**Contact Hrs: 30.0**

#### **UNIT I (03 Periods)**

**Introduction to Computers:** History of Computers, Data, Information and Program, Hardware and Software, Types of Computers,

#### **UNIT II (07 Periods)**

**Number Systems:** Introduction, Bits and Bytes, Decimal Number System, Binary Number System, Hexadecimal Number System, Decimal to Binary Conversion, Conversion of fractional decimal to binary, Conversion of Decimal to Hexadecimal, Octal Representation, Representation of signed numbers.

#### **UNIT III (05 Periods)**

**Computer Organization:** Basic Components of a Digital Computer, Central Processing Unit, Arithmetic and Logic Unit – ALU, Memory Unit, Input and Output Devices.

#### **UNIT IV (03 Periods)**

**Operating Systems:** Introduction to Operating System (OS).

#### **UNIT V (07 Periods)**

**MS-Office** (Word, Excel, PowerPoint)- Word Features, Font, Font Style, Formatting, Copying and Pasting, Format Painter, Columns, Page Formatting.

**Excel-** Cell, Cell Address, Formula, Working with Excel, Creating charts,

**PowerPoint-** Preparing presentations (using Clip arts, shapes, moves etc).

#### **UNIT VI (05 Periods)**

Internet, Communication Protocol, Future of Internet, Uses of Internet, Popular Uses of the Web. Different types of Search engines, Infflibnet.

#### **SUGGESTED READING**

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Today by SK Basandara, Galgotia publication Pvt ltd. Daryaganj, New Delhi
3. MS-Office 2000 for Everyone by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., New Delhi
4. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. A First Course in Computer 2003 Edition with CD by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
6. Mastering Windows 95, BPB Publication, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi

## PAPER II: BIOSTATISTICS

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

### UNIT I (05 Periods)

**Introduction:** Importance and application, Tabulation and classification of Data, Frequency distribution, Diagrammatic and Graphical representation of data (problems).

### UNIT II (05 Periods)

**Measures of central tendencies:** Measures of central tendencies (with problems): Mean median and mode, their properties (with problems).

### UNIT III (05 Periods)

**Measures of dispersion:** Measures of dispersion - Range, mean deviation, Variance, Standard deviation,

### UNIT IV (05 Periods)

Coefficient of variation, Correlation and linear regression (with problems).

### UNIT V (05 Periods)

**Probability:** Definition of probability and distributions, concept and problems on probability, binomial, Poisson and normal distribution and their applications.

### UNIT VI (05 Periods)

**Hypothesis testing:** parametric and non parametric tests, t and z tests, chi-square tests, Analysis of variance (ANOVA).

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### SUGGESTED READING

1. Fundamentals of Biostatistics: Khan and Khanum; Ukaaz Publication.
2. Statistical Methods in Biology: Baily, N.T.J; English University Press
3. Statistics in Biology: Bliss C. I; MacGraw Hill, New York
4. Statistic for Biologists: 2<sup>nd</sup> Edition; Campbell R.C.; University Press, Cambridge
5. Statistical Methods: Gupta S. P.; Sultan Chand and Sons, New Delhi
6. test book of biostatistics- khumbhojkar

**Subject Code: DSC 4B (Total credits: 4)**

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## PAPER I: Animal Tissue Culture

**Total credits: 2.0**  
**Contact Hrs: 30.0**

### UNIT I

**Introduction:** History, Laboratory Design, Characteristics of animal Cell in Culture, Substrate for cell growth. Equipment's required for animal cell culture- laminar air flow, CO<sub>2</sub> incubator, Sterilization of apparatus, flow cytometry.

### UNIT II

**Culture Media:** Natural media-Clots, Biological fluids, Serum, Tissue Extract, Synthetic media-Balanced salt Solution, Serum containing media, complete media. Physiochemical properties of media, sterilization of media.

### UNIT III

**Culture Techniques:** Primary cell Culture, Cell Separation: Mechanical-Sieve, chopping, pipetting etc.  
Enzymatic: Trypsinization (Warm & Cold), Collagenase. Criteria for subculture,

### UNIT IV

**Methods of organ culture:** Plasma clot technique, raft method, agar gel method, Cryopreservation, Cell Synchronization: By physical mean & chemical blockade.

### UNIT V

**Establishment of cell lines:** Cell line selection & routine maintenance of cell lines, cell counting and monitoring. Indirect method of cell determination: protein, DNA, LDH, Glucose determination.

### UNIT VI

**Cell line Identification:** Tests of identification- Karyotyping, Isozymes, Analysis of cell cycle: Tritiated thymidine pulse method, Applications of animal cell culture.

### SUGGESTED READING

1. Animal Tissue culture : J. Paul
2. Culture of animal cell 3rd edition-R Ian Freshney
3. Animal cell culture- R.W.Masters
4. Animal biotechnology-M.M.Ranga
5. Animal biotechnology-R.Sasidhara
6. Animal cell culture technique-Ed. Martin Clynes Springer
7. Cell growth & division a practical approach-Ed. R. B. Segal & R.L.Press
8. Animal cell culture and technology by Michael Butler.

## PAPER II: Plant Tissue Culture

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**Total credits: 2.0**  
**Contact Hrs: 30.0**

### UNIT I

**Introduction and Infrastructure:** History and scope of plant tissue culture. Aseptic techniques in preparation, sterilization of glassware, laboratory fumigation, surface disinfection.

### UNIT II

**General laboratory setup:** Significance and importance of laboratory equipments, instruments, glassware and other requirements in plant tissue culture laboratory.

### UNIT III

**Culture Techniques:** Concept of totipotency, Culture media composition with significance and preparation. Culture techniques – callus, suspension, organ culture, Endosperm culture, Protoplast culture: Protoplast isolation, gene transfer in protoplast, fusion, cell wall regeneration & culture.

### UNIT IV

**Somaclonal variation:** Introduction, terminology, origin and mechanism selection at plant level, selection at cellular level. Production of hybrids & cybrids.

## **UNIT V**

**Clonal Propagation:** Micropropagation: through callus and its Stages, auxiliary Branching, Adventitious buds, Factors affecting, limitations & applications of micropropagation.

## **UNIT VI**

**Organogenesis:** somatic embryogenesis, factors affecting somatic embryogenesis. Plant hardening, artificial seed production. Cryopreservation & its advantages.

### **SUGGESTED READING**

1. Introduction to plant tissue culture- M.K. Razdan
2. Plant tissue culture-Theory & practice-S. S. Bhojwani & M.K. Razdan
3. Plant tissue culture-Kalyankumar Dey
4. Biotechnology- B.D. Singh
5. A text book of Biotechnology- R.C. Dubey
6. Biotechnology- H.S. Chawla

## **Practical Course in Biotechnology for B. Sc-I For both Semester I and II**

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### **Practical Course I Based on DSC 1 A & 1B**

**(Credits 4)**

1. To study invertase activity.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Effect of inhibitor (Inorganic phosphate) on the amylase activity.
4. Estimation of blood glucose by folin-Wu method.
5. Principles of Colorimetry: **(i)** estimation of protein by Lowry's method. **(ii)** To study relation between absorbance and % transmission.
6. Separation of Amino acids by paper chromatography.
7. Qualitative analysis of uric acid.
8. Qualitative tests for Carbohydrates, lipids and proteins.
9. Qualitative analysis of Vitamin A & C.
10. Estimation of total Cholesterol in serum.
11. To isolate chloroplast from spinach leaves and assay of Hill's reaction by Spectrophotometer.
12. Finding the coagulation time of blood
13. Determination of blood groups
14. Counting of mammalian RBCs
15. Determination of Total Leukocyte Count.
16. Determination of Differential Leukocyte Count
17. Determination of Haemoglobin.
18. Estimation of creatine in urine
19. Estimation of transaminase activity.
20. Estimation of serum bilirubin.

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of Osmosis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Demonstration of Microtomy: Fixation, block making, section cutting, double staining of animal tissues.
7. Cell division in onion root tip/ insect gonads.
8. Meiosis in Flower Buds of *Allium cepa*-Acetocarmine Stain
9. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.
10. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
11. Demonstration of plasmolysis by *Tradescantia* leaf peel.
12. Demonstration of opening & closing of stomata
13. Demonstration of guttation on leaf tips of grass and garden nasturtium.
14. Separation of photosynthetic pigments by paper chromatography.
15. Demonstration of aerobic respiration.
16. Determination of microflora from root nodules of leguminous plant.
17. Determination of plant cell size by micrometry.
18. T.S. of stem/root/leaf of monocot & dicot.
19. Estimation of plant hormone IAA (Indole Acetic Acid).
20. To determine the seed germination time & percentage in monocot & Dicot.

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of Anopheles.
4. Study of the developmental stages of Drosophila from stock culture/ photographs.
5. Study of different types of placenta.
6. Study of different types of sperms by smear technique- Frog, Hen, Rat and Human
7. To perform Sperm motility test.
8. Study of different types of eggs - Insects, Amphioxus, Frog and Hens egg.
9. Study of style and stigma
10. Study of different type of embryos.
11. Pollen germination in *In-situ* condition
12. Study of pollen germination by T.T.C. or Acetocarmine test
13. Collection of seed and storage of seeds for seed bank
14. Study of floral patterning in any suitable flower.
15. Preparing letter, purchase order chart, designing registration form, bio-data using MS-Word.
16. Graphical representation of data (on MS-Excel):
  - a. Histogram
  - b. Ogive Curve
  - c. Pie chart
  - d. Simple line graph.
  - e. Simple and Multiple bar diagram.
  - f. Sub-divided and percentage bar diagram.
17. Creating email Id and sending email.
18. Preparing presentation with PowerPoint- on bio-technology subject.
19. Measures of central Tendency (on MS-Excel): To calculate mean, median and mode
20. Measures of dispersion (by calculation): To calculate mean deviation, standard deviation, and variance.
21. Carry out an ANOVA using biological problems.

1. Measurement of viscosity by Ostwald's viscometer.
2. Surface tension measurement by Jaegers method.
3. Temperature measurement by RTD.
4. Study of Lambert's & Beer's law.
5. Study of UV spectra of protein/DNA
6. Denaturation & Renaturation of DNA.
7. Study of interaction of acridine orange with DNA.
8. Preparation of Molarity, Normality & percentage solutions.
9. Determination of conductivity of solutions.
10. Preparation of buffers (Phosphate buffer, acetate buffer)
11. Washing of glassware & sterilization techniques.
12. Plant Tissue Culture Media Preparation.
13. Isolation of explant & establishment of callus.
14. Aseptic seed germination.
15. Establishment of ovule/ anther culture.
16. Protoplast isolation.
17. Animal Cell Culture Media Preparation.
18. Separation of serum & plasma from blood by centrifugation technique.
19. Cell Separation by Trypsinization.
20. Cell Counting.



## Scheme of Marking for University Practical Examination

**Total Marks: 80**

Q.1. Major Performance	15
Q.2. Minor Performance	10
Q.3. Major Performance	15
Q.4. Minor Performance	10
Q5. A ( <b>Five spots</b> )	10
(a) Identify & Comment	
(b) Identify & Comment	
(c) Identify & Comment	
(d) Identify & Comment	
(e) Identify & Comment	
Q.5. B) Principal writing	10
Q.6. A) Laboratory Record (Journal)	05
Q.6. B) Viva –Voce (General)	05

**B O S in Biotechnology**