FACULTY OF LIFE SCIENCES

SYLLABUS

FOR

B.Sc. (BIO-TECHNOLOGY)
(Semester: I - VI)

Examinations: 2016-17

GURU NANAK DEV UNIVERSITY
AMRITSAR

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-I

Scheme of Courses

Sr.No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1.	Zoology-A	3	40	4	20
BT-2.	Botany-A	3	40	4	20
BT-3.	Inorganic Chemistry-A	3	40	4	20
BT-4.	Organic Chemistry-A	3	40	4	20
BT-5.	Computer Fundamentals	3	40	4	20
BT-6.	Punjabi (Compulsory) **OR** mFl pj`bl		50		
BT-7.	Communication Skills in English		50		
BT-8.	General Microbiology-A	3	40	4	20
BT-9.	Biochemistry - I	3	40	4	20
			380		140

Total Marks = 520

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-II

Scheme of Courses

Sr.No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1.	Zoology-B	3	40	4	20
BT-2.	Botany-B	3	40	4	20
BT-3.	Inorganic Chemistry-B	3	40	4	20
BT-4.	Organic Chemistry-B	3	40	4	20
BT-5.	Biostatistics	3	40		
BT-6.	Punjabi (Compulsory) **OR** mFll pj`bl		50		
BT-7.	Communication Skills in English		35		15
BT-8.	General Microbiology-B	3	40	4	20
BT-9.	Biochemistry - II	3	40	4	20
			365		135

Total Marks = 500

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-III

Scheme of Courses

Sr. No. Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1 Physical Chemistry-A	3	40	4	20
BT-2 Zoology -C	3	40	4	20
BT-3 Biochemistry-III	3	40	4	20
BT-4 Cell Biology – A	3	40	4	20
BT-5 Basic concepts in Immunology	3	40	4	20
BT-6 Genetics	3	40	4	20
BT-7 Agro and Industrial Applications of Microbes-A	3	40	4	20
ESL-221 Environmental Studies (Compulsory Paper)		50		
			280	140

Total Marks = 420

***ESL-221 Environmental Studies (Compulsory Paper) Marks will not be included in the total marks.**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER-IV

Scheme of Courses

Sr. No. Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1 Physical Chemistry-B	3	40	4	20
BT-2 Botany -C	3	40	4	20
BT-3 Biochemistry-IV	3	40	4	20
BT-4 Cell Biology – B	3	40	4	20
BT-5 Immunotechnology	3	40	4	20
BT-6 Molecular Biology	3	40	4	20
BT-7 Agro and Industrial Applications of Microbes-B	3	40	4	20
BT-8 Enzymology	3	40	4	20
ESL-222 Environmental Studies (Compulsory Paper)		50		
		320		160

Total Marks = 480

***ESL-222 Environmental Studies (Compulsory Paper) Marks will not be included in the total marks.**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER V

Scheme of Courses

Sr.No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practical Marks
BT-1	rDNA Technology -A	3	40	4	20
BT-2	Concepts of Plant Tissue Culture	3	40	4	20
BT-3	Animal Tissue Culture	3	40	4	20
BT-4	Patent Laws in Biotechnology	3	40		
BT-5	Bioprocess Engineering - A	3	40	4	20
BT-6	Biophysical and Biochemical Techniques - A	3	40	4	20
BT-7	Physical, Organic & Inorganic Aspects of Spectroscopy- A	3	40	4	20
BT-8	Term Paper	3	-	-	20
	(i) On recent advances in Life Sciences using Internet and library based resources. To be presented as hard Copy/CD/Floppy. Viva/ seminar should be conducted		**280**		**140**

Total Marks = 420

B.Sc. (BIO-TECHNOLOGY) (SEMESTER SYSTEM)

SEMESTER–VI

Scheme of Courses

Sr. No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practical Marks
BT-1	rDNA Technology -B	3	40	4	20
BT-2	Applications of Plant Tissue Culture	3	40	4	20
BT-3	Animal Biotechnology	3	40	4	20
BT-4	Intellectual Property Rights And Enterepreneurship	3	40	-	-
BT-5	Bioprocess Engineering - B	3	40		20
BT-6	Biophysical and Biochemical Techniques – B	3	40	4	20
BT-7	Physical, Organic & Inorganic Aspects of Spectroscopy- B	3	40	4	20
BT-8	Educational Tour & Written illustrated Reports. Viva should be conducted				20
			280		**140**

Total Marks = 420

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT - 1 **Zoology–A**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit – I

Digestive System: Comparative account of the alimentary canal and associated glands of Rabit and Man. Teeth : types, dental formula and function. Glands: Pancreas, Liver, Gastric glands. Digestion of dietary constituents, regulation of digestive processes and absorption, Types of nutrition, feeding mechanisms, extra and intracellular digestion, enzymatic digestion, symbiotic digestion.

Unit – II

Circulatory System: General plan of circulation in various groups of Rabit and Man, evolution of heart. Origin and regulation of heart beat, cardiac cycle, electrocardiogram, Cardiac output and fluid pressure, Composition and functions of blood and lymph, Molecular structure and function of haemoglobin, Blood clotting, blood groups including Rh-factor, Homeostasis, Haemopoiesis.

Unit – III

Respiratory System: Comparative account of respiratory organs of mammals. Different kinds of respiratory mechanisms, Transport of O_2 and CO_2, Oxygen dissociation of haemoglobin, Bohr effect, chloride shift, control of breathing.

Unit – IV

Integumentary System: Comparative account of integument and its derivatives in mammals.

BT-1 **Zoology–A (Practical)**

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Demonstration of osmosis and diffusion.
2. Demonstrate the presence of amylase in saliva, effect of pH and temperature on denaturation.
3. Determination of blood groups of human blood samples.
4. Recording of blood pressure of man.
5. Estimation of hemoglobin content.
6. Study of the following prepared slides: histology of rat/rabbit (compound tissues).

Books:

1. Sobti, R.C. & Nigam, S.K. (2002). Structural & function biology of chordates, Vishal Publishers, Jalandhar.
2. Sobti, R.C. & Sharma, V.L. (2005). Basics of Biotechnology: Introduction of Life Sciences. Vishal Publishers, Jalandhar.
3. Sobti, R.C. (2005). Introduction to Biotechnology, Part-2, Concepts Tools and Application, Vishal Publishers.

BT – 2 **Botany–A**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit – I

Apical Meristem: Tunica corpus and Histogen theories, reproductive apex and development of flower.
Secondary growth in stem and root of *Helianthus*.
Study of anomalous structure in *Boerhavia, Nyctanthes, Mirabilis and Dracena.*

Unit – II

Structure and development of anther and male gametophyte
Structure and development of ovule and female gametophyte; different types of ovules and embryo sacs

Unit – III

Pollination and fertilization; structure, development and function of endosperm and embryo (dicot and monocot), polyembryony, Self-pollination, cross -pollination, male sterility, selfincompatibility.

Unit – IV

Terminology pertaining to floral description, taxonomic importance of floral parts of the following families: Solanaceae: Solanum, Petunia
Liliaceae: Asphodelus/Asparagus
Rutaceae: Citrus, Murraya

BT-2 **Botany–A (Practical)**

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note. The question paper will be set by the examiner based on the syllabus

Plant Anatomy:

Anatomical studies of normal and abnormal secondary growth in general as mentioned in syllabus.

Embryology:

Study of the permanent slides pertaining to micro and megasporogenesis and female gametophytes and endosperms.

Taxonomy:

a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
b) Identification and short morphological economic note on the specimens included in Units IV & V of the theory paper A.
c) Each student is required to submit a family wise herbarium consisting of atleast 20 properly pressed and mounted plants.

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BT - 3 **Inorganic Chemistry–A**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit – I

Introduction, Wemer's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12 and their stereo-chemistries. Co-ordination numbers and stereo chemistries of the common transition metal : Ti,V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, & W. Factors affecting co-ordination numbers and stereo-chemistry Isomerism in coordination compounds. **(Books Consulted-Number 1,3,8).**

Unit – II

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory. **(Books 5,9)**

Unit – III

Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculation of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value, structure effects of crystal field splitting (Jahn-Teller distortion). Paramagnetism, diamagnetism, ferro and anti ferromagnetism, Microstates and spectroscopic terms, a calculation of spectroscopic terms for d^1 –d^2 electronic configurations using LS coupling, Hunds rule for finding the ground state term, limitations of C.F.T.

Unit – IV

Molecular Orbital Theory- Evidence for covalent character in bonding, MOEL diagram for octahedral and tetrahedral complexes involving σ as well as π bonding, charge transfer transitions.**(Books consulted No. 3,4,5,6,7,8)**

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. R.Hilgenfeld & W.Saengar, Topics in Current Chemistry, Vol.101.page 38-65.
3. J.E. Huheey, Inorganic Chemistry, 3rd ed.
4. F.A. Cotton & G. Wilkinson, Advanced Inorganic Chemistry.
5. B.E. Douglas & D.H. McDaniel, Concepts & Models of Inorganic Chemistry,1970.
6. A. Earnshaw, Introduction of Magnetochemistry, Academic press,1968.
7. R.S.Drago, Physical Methods Inorganic Chemistry, 1971.
8. F. Basalo & R.C. Johson, Co-ordination, Chemistry, 1964.
9. Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley-VCH.

BT-3 **Inorganic Chemistry (Practical)**

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus.

- Volumetric Analysis:

Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and $KMnO_4$.

Complexometric titration using EDTA Ca^{++},Mg^{++}: in context with study of hardness of water.

BT - 4 **Organic Chemistry–A**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Conformations of alkanes and cycloalkanes; conformational analysis of ethane, Butane, cyclohexane, monosubstituted and disubstituted cyclohexane, conformation of small, medium and large ring cycloalkanes and of polycyclic ring systems. Factors that affect reaction rates of these reactions, structure and relative stabilities of free radicals, halogenation, mechanism of chlorination of methane, selectivity in chlorination and bromination of higher alkanes .

Alcohols as Bornsted bases and acids, reactions of alcohols with hydrogen halides with detailed mechanism structure and bonding in carbocations and their relative stabilities, potential energy diagrams for chemical reactions.

UNIT-II

Stereochemistry of alkenes, naming stero isomeric alkenes by E-Z system, mechanism of hydrogenation of alkenes, stereochemistry of hydrogenation of cycloalkenes, Dehydration of alcohols and regioselectivity of these reactions, Acid catalysed dehydrohalogenation of alcohols with complete mechanistic discussion, Mechanism of dehydrohalogenation of alkylhalides (E_1 mechanism), stereoselective and antielimination in E_2 reactions, the E_1 Mechanism, electrophilic addition of hydrogen halides to alkenes its regioselectivity explained on the basis of mechanism , free radical addition of hydrogen bromide to alkenes, acid catalysed hydration of alkene with mechanism stereochemistry of halogen addition to alkenes and its mechanistic explanation. Hypohalous acid addition to alkenes, epoxidation of alkenes.

UNIT-III

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Prelog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereoisomers, Resolution of enantionmers, chiral centres other than carbon, prochirality.

UNIT-IV

Functional group transformation by nucleophilic substitution, the biomolecular (SN^2), mechanism of nucleophilic substitution , stereochemistry of SN^2 reactions, how SN^2 reactions occur, steric effect in SN^2 reactions, nucleophiles and nucleophilicity,the unimolecular (SN^1) mechanism of nucleophilies substitution, carbocation stability and the rate of substitution, by the SN^1 mechanism sterochemistry of SN^1 reactions, carbocation real arrangements in SN^1 reactions, solvent effects, subtitution and elimination as competing reactions. The SN^1 -SN^2 continum.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV ed. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
3. Schaum's Outlines Series, Theory and Problems of Organic chemistry.
4. I.L. Finar, Problems and their solution in Organic chemistry.
5. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
6. D. J. Cram and G. S. Hammond, Organic chemistry.
7. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry.

Organic Chemistry (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT - 5 **Computer Fundamentals**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Computers: General introduction to computers, organization of computers, digital and analogue computers, computer algorithm.

Introduction to Computer and Its Uses: Milestones in hardware and software -batch oriented/Online/real time applications. Use of computers in biology.

UNIT-II

Computer as a System: Basic Concepts: Stored programs, functional units and their inter-relation: communication with computer.

UNIT-III

Data Storage Devices and Media: Primary Storage: Storage addressed, and capacity, type of memory: secondary storage; magnetic tape- data representation and R/W: magnetic disc, fixed & removable, data representation and R/W: floppy disc drives.

UNIT-IV

Input/Output Devices: Key-tape/diskette devices, light pen mouse and joystick, source data automation.

Printed Output: Serial, line, page, printers; plotters, visual output; voice response units.

Computer Fundamentals (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Practical related to theory shall be carried out for this course.

Introduction to DOS: DOS commands are copy con, edit, doskey, type, md, cd, ver, date, time, ren, del, copy, move, attrib

Introduction to Windows

Ms-Word, Powerpoint

BT-6 **Punjabi (Compulsory)** ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)

ਸਮਾਂ : 3 ਘੰਟੇ **ਕੁਲ ਅੰਕ : 50**

ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ

1. **ਗਿਆਨ ਮਾਲਾ** (ਵਿਗਿਆਨਕ ਤੇ ਸਮਾਜ-ਵਿਗਿਆਨਕ ਲੇਖਾਂ ਦਾ ਸੰਗ੍ਰਹਿ),
   (ਸੰਪਾ. ਡਾ. ਸਤਿੰਦਰ ਸਿੰਘ, ਪ੍ਰੋ. ਮਹਿੰਦਰ ਸਿੰਘ ਬਨਵੈਤ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
   ਲੇਖ : ਪਹੀਆ ਪ੍ਰਦੂਸ਼ਣ, ਭਰੂਣ ਹੱਤਿਆ ਦੇ ਦੇਸ਼ ਵਿਚ, ਨਾਰੀ ਸ਼ਕਤੀ, ਵਾਤਾਵਰਣੀ ਪ੍ਰਦੂਸ਼ਣ ਅਤੇ ਮਨੁੱਖ, ਏਡਜ਼ : ਇਕ ਗੰਭੀਰ ਸੰਕਟ।
2. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਸੁਹਿੰਦਰ ਬੀਰ ਅਤੇ ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ)
   (ਪ੍ਰੋ. ਮੋਹਨ ਸਿੰਘ, ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ, ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ, ਸੁਰਜੀਤ ਪਾਤਰ, ਪਾਸ਼)
   ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।

3. **ਪੈਰ੍ਹਾ ਰਚਨਾ**
4. **ਪੈਰ੍ਹਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ**।
5. (ੳ) **ਪੰਜਾਬੀ ਧੁਨੀ ਵਿਉਂਤ** : ਉਚਾਰਨ ਅੰਗ, ਉਚਾਰਨ ਸਥਾਨ ਤੇ ਵਿਧੀਆਂ, ਸਵਰ, ਵਿਅੰਜਨ, ਸੁਰ।
   (ਅ) **ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ** : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ-ਭਾਸ਼ਾ ਦਾ ਅੰਤਰ, ਪੰਜਾਬੀ ਉਪਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ-ਚਿੰਨ੍ਹ।
6. **ਮਾਤ ਭਾਸ਼ਾ ਦਾ ਅਧਿਆਪਨ**
   (ੳ) ਪਹਿਲੀ ਭਾਸ਼ਾ ਦੇ ਤੌਰ ਉੱਤੇ
   (ਅ) ਦੂਜੀ ਭਾਸ਼ਾ ਦੇ ਤੌਰ ਉੱਤੇ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ:

1. ਕਿਸੇ ਨਿਬੰਧ ਦਾ ਸਾਰ ਜਾਂ ਉਸਦਾ ਵਿਸ਼ਾ ਵਸਤੂ (ਦੋ ਵਿਚੋਂ ਇਕ) । 10 ਅੰਕ
2. **ਆਤਮ ਅਨਾਤਮ** : ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ, ਕਲਾ ਪੱਖ 10 ਅੰਕ
3. ਪੈਰ੍ਹਾ ਰਚਨਾ : ਤਿੰਨ ਵਿਸ਼ਿਆਂ ਵਿਚੋਂ ਕਿਸੇ ਇਕ ਉਤੇ ਪੈਰ੍ਹਾ ਲਿਖਣ ਲਈ ਕਿਹਾ ਜਾਵੇ । 05 ਅੰਕ

4.	ਪੈਰ੍ਹਾ ਦੇ ਕੇ ਉਸ ਬਾਰੇ ਪੰਜ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ।	05 ਅੰਕ
5.	ਨੰਬਰ 5 ਉਤੇ ਦਿੱਤੀ ਵਿਆਕਰਣ ਦੇ ਆਧਾਰ 'ਤੇ ਵਰਣਨਾਤਮਕ ਪ੍ਰਸ਼ਨ।	10 ਅੰਕ
6.	ਨੰਬਰ 6 ਵਿਚ ਮਾਤ ਭਾਸ਼ਾ ਦੇ ਪਹਿਲੀ ਭਾਸ਼ਾ ਅਤੇ ਦੂਜੀ ਭਾਸ਼ਾ ਵਜੋਂ ਅਧਿਆਪਨ, ਮਹੱਤਵ ਅਤੇ ਸਮੱਸਿਆਵਾਂ ਬਾਰੇ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਵਿਦਿਆਰਥੀ ਨੇ ਦੋ ਦਾ ਉੱਤਰ ਦੇਣਾ ਹੋਵੇਗਾ।	5×2=10 ਅੰਕ

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT-6

Mudhli Punjabi
ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Compulsory Punjabi)

ਪਾਠ–ਕ੍ਰਮ

ਸਮਾਂ : 3 ਘੰਟੇ **ਕੁਲ ਅੰਕ: 50**

ਪਾਠ–ਕ੍ਰਮ

1. ਪੈਂਤੀ ਅੱਖਰੀ; ਪੈਰ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ ਅਤੇ ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਲਗਾਂ ਮਾਤਰਾਂ
2. ਲਗਾਖਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ)
3. (ੳ) ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹਾਂ ਦੀ ਵਰਤੋਂ,
   (ਅ) ਨਾਂਵ, ਪੜਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸਣ, ਲਿੰਗ ਅਤੇ ਵਚਨ

ਅੰਕ ਵੰਡ ਤੇ ਪੇਪਰ ਸੈਟਰ ਲਈ ਹਦਾਇਤਾਂ

1. ਪੈਂਤੀ ਅੱਖਰੀ ਦੀ ਬਣਤਰ ਅਤੇ ਤਰਤੀਬ ਨਾਲ ਸੰਬੰਧਿਤ ਪ੍ਰਸ਼ਨ। **10 ਅੰਕ**
   (ਦੋ ਪ੍ਰਸ਼ਨਾਂ ਵਿਚੋਂ ਇੱਕ ਕਰਨਾ ਹੋਵੇਗਾ)
   ਕਵਰਗ, ਚਵਰਗ, ਤਵਰਗ, ਟਵਰਗ ਆਦਿ ਸੰਬੰਧੀ ਪ੍ਰਸ਼ਨ ਪੁੱਛਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ ਅਤੇ ਲਗਾਂ ਮਾਤਰਾਂ ਦੀ ਵਰਤੋਂ ਨਾਲ ਸੰਬੰਧਿਤ ਪ੍ਰਸ਼ਨ (ਦੋ ਵਿਚੋਂ ਇੱਕ ਕਰਨਾ ਹੋਵੇਗਾ) **10 ਅੰਕ**

2. ਬਿੰਦੀ, ਟਿੱਪੀ ਅਤੇ ਅੱਧਕ ਦੀ ਵਰਤੋਂ ਸੰਬੰਧੀ ਪ੍ਰਸ਼ਨ **10 ਅੰਕ**

3. (ੳ) ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹਾਂ ਦੀ ਵਰਤੋਂ ਸੰਬੰਧੀ ਪ੍ਰਸ਼ਨ **10 ਅੰਕ**
   (ਅ) ਨਾਂਵ ਪੜਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸ਼ਣ ਅਤੇ ਲਿੰਗ ਵਚਨ ਸੰਬੰਧੀ ਮੁੱਢਲੀ ਕਿਸਮ ਦੇ ਪ੍ਰਸ਼ਨ (ਦੋ ਵਿਚੋਂ ਇੱਕ ਕਰਨਾ ਹੋਵੇਗਾ) **10 ਅੰਕ**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT-7 COMMUNICATION SKILLS IN ENGLISH

Time: 3 Hours **Max. Marks: 50**

Course Contents:

1. Reading Skills: Reading Tactics and strategies; Reading purposes–kinds of purposes and associated comprehension; Reading for direct meanings; Reading for understanding concepts, details, coherence, logical progression and meanings of phrases/ expressions.

Activities:

a) Active reading of passages on general topics
b) Comprehension questions in multiple choice format
c) Short comprehension questions based on content and development of ideas

2. Writing Skills: Guidelines for effective writing; writing styles for application, resume, personal letter, official/ business letter, memo, notices etc.; outline and revision.

Activities:

a) Formatting personal and business letters.
b) Organising the details in a sequential order
c) Converting a biographical note into a sequenced resume or vice-versa
d) Ordering and sub-dividing the contents while making notes.
e) Writing notices for circulation/ boards

Suggested Pattern of Question Paper:

The question paper will consist of five skill–oriented questions from Reading and Writing Skills. Each question will carry 10 marks. The questions shall be phrased in a manner that students know clearly what is expected of them. There will be internal choice wherever possible.

10x5=50 Marks

i) Multiple choice questions on the language and meanings of an unseen passage.
ii) Comprehension questions with short answers on content, progression of ideas, purpose of writing etc. of an unseen passage.
iii) Personal letter and Official/Business correspondence
iv) Making point-wise notes on a given speech/ technical report OR
Writing notices for public circulation on topics of professional interest
v) Do as directed (10x1= 10 Marks) (change of voice, narration, combination of 2 simple sentences into one, subject-verb agreement, using appropriate tense, forms of verbs.

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *English Grammar in Use* (Fourth Edition) by Raymond Murphy, CUP

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT - 8 **General Microbiology–A**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Principles of Microbiology: Principles and application of bright field, dark field phase contrast, fluorescence & immunofluorescence, electron microscopy, modern concept of bacterial nutrition. Microbial culture media, sterilization.

Unit - II

General Features: Bacteria, fungi, Neurospora, yeast and viruses. Microbes in extreme environments – the thermophiles and alkalophiles. culture collection, purification and preservation.

UNIT-III

Nature of the Microbial Cell Surface. Gram positive and gram negative bacteria. Kinds of flagella. Serotypes. Structure and anatomy of bacterial cell walls. Different types of bacterial staining.

Unit - IV

Bacterial Classification: Bacterial classification and taxonomy based on Bergey's Manual of Determinative bacteriology.

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4th Edition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5th Edition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, Londan.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H. G., (1995). General Microbiology 7th Edition, Cambridge Univ. Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K. Jain for CBS Publishers & Distributors.
7. Purohit, S.S. (2000). Microbiology: Fundamentals and Applications (6th Edition), Agrobios (India).
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge Univ. Press.
9. Tortora. G.J., Funke. B.R., 2001. Microbiology: An Introduction, Benjamin Cummings.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT- 8 General Microbiology (Practical)

Time: 3 Hrs. Max. Marks: 20
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Aseptic techniques

Cleaning of glassware

Preparation of media, cotton plugging and sterilization

Personal hygiene-Microbes from hands, tooth-scum and other body parts

Isolation of micro-organism from air, water and soil samples. Dilution and pour plating, Colony purification

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

BT - 9 **Biochemistry - I**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section A : 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section B : This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C : This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Water and its Properties: Physico-chemical properties of water, Dissociation and association constants, pH and buffers. pI, pka, Hasselbach Hendersson equation and its implications.

Unit - II

Carbohydrates: Structure of important mono,di,oligo and polysaccharides,

Unit - III

Glycoproteins and Peptidoglycans, glycolipids and lipopolysaccharides.

Unit - IV

Nucleic Acids**:** Structure of nucleosides and nucleic acids, biologically important nucleotides and their functions. Different types of DNA & RNA

Books Recommended:

1. Rawn, J.D. (1989). Biochemistry, Neil Patterson Publishers
2. Stryer, L. (1995). Biochemistry: 4th Edition, W.H. Freeman and Company, New York
3. Zubay, G.L., Parson. W.W. and Vance, D.E. (1995). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.
4. Bucke C., (1999)), Carbohydrate Biotechnology Protocols, Humara Press.
5. Horton et. al., (2001), Principles of Biochemistry, Prentice Hall.
6. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2005). Principles of Biochemistry 4th Ed., CBS Publishers and Distributors, New Delhi.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

Bio-Chemistry-I
(Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. Preparation of physiological buffers.
2. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
3. Determination of pKa value of P-nitrophenol
4. Estimation of carbohydrate in given solution by anthrone method.
5. Estimation of sugar in biological samples by dubois method.
6. Estimation of DNA/RNA

Books Recommended:

1. Plummer D.T. (1990) An Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985) Practical Biochemistry. Standard Publication, Chandigarh.
3. Sawhney, S.K. and Randhir singh (2001). Introductory Practical Biochemistry. Narosa Publishing House.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 1 **Zoology–B**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit – I

Urinogenital System: Succession of kidney, evolution of gonads and urinogenital ducts, Urine formation, water balance in mammals.

Unit –II

Endocrine System: Structure and physiology of thyroid, parathyroid, adrenal, hypothalamus, pituitary, pancreas and gonads of mammals.

Unit –III

Nervous System: Comparative anatomy and evolution of brain and cranial nerves of mammals, Nature, origin and propagation of impulse along the axon, synapse and myoneural junctions. Sense Organs

Unit –IV

Skeletal System: Comparative account of jaw suspension & visceral arches, (striped, unstriped and cardiac). Ultrastructure, chemical and physiological basis of skeletal muscle contraction.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 1 **Zoology–B (Practical)**

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Study the following system of white rat/rabbit with the help of charts / models / videos :
   Digestive, arterial, venous and urinogenital systems.
2. Make a temporary preparation of the following:
   Blood smear of mammals.
3. Study of the skeleton of Oryctolagus (Rabbit).and human.
4. Analysis of urine for urea, chloride, glucose and uric acid

Books:

1. Sobti, R.C. & Nigam, S.K. (2002). Structural & function biology of chordates, Vishal Publishers, Jalandhar.
2. Sobti, R.C. & Sharma, V.L. (2005). Basics of Biotechnology: Introduction of Life Sciences. Vishal Publishers, Jalandhar.
3. Sobti, R.C. (2005). Introduction to Biotechnology, Part-2, Concepts Tools and Application, Vishal Publishers.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 2 **Botany–B**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Systems of classification: Artificial, Natural and Phylogenetic; Salient features of Bentham & Hooker's, Hutchinson and Engler & Prantl's system of classification, (Details of Bentham & Hooker's system only). Angiosperms, Gymnosperms, Bryophytes and Lichens- their general characteristics.

Unit – II

General characteristics (excluding economic importance) of following families of angiosperms; giving examples of few important genera:

Ranunculaceae Ranunculus, Delphinium
Cruciferae Brassica
Apiaceae (Umbelliferae) Coriander
Asteraceae (Compositae) Helianthus, Sonchus, Ageratum
Lamiaceae (Labiatae) Ocimum/Salvia

Unit – III

General characteristics (excluding economic importance) of following families of angiosperms; giving examples of few important genera:

Leguminosae Lathyrus, Cassia and Acacia
Orchidaceae Zeuxine
Poaceae (graminae) Triticum

Criteria for primitive and advanced nature of families and flower. Evolutionary status of Ranunculaceae, Compositae, Orchidaceae.

Unit – IV

Introduction to seed biology, differences between seed and grain. Classification of seed-breeder, foundation, certified and truthfully labeled seeds (TFLs). Brief introduction to methods of seed production, seed testing (seed germination and seed viability test) and seed certification.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 2 **Botany–B (Practical)**

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note. The question paper will be set by the examiner based on the syllabus

a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.

b) Identification and short morphological economic note on the specimens included in Units III, IV & V of the theory paper B.

c) Each student is required to submit a family wise herbarium consisting of at least 20 properly pressed and mounted plants.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 3 **Inorganic Chemistry-B**

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit – I

л- Acid ligands

Carbon monooxide complexes, Two methods of preparation, structural and bonding in (linear MCO groups, polynuclear metal carbonyls carbonyl hydrides and halides). Complexes of N_2, with Ru and No with Fe.**(Book consulted, No. 4 Chapter 2)**

Unit – II

Alkali metal and alkaline earth metal chelators

Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers & podands, coronauds, cryptands, structure of 18 crown -6 complex with KNCS, ion cavity complex, effect of anion on phase transfer catalysis, sandwich formation, cryptands and their cation complexes. **(Book No. 2 pages 38-65).**

Unit –III

Stability of co-ordination compounds

Introduction Factors affecting the stability of metal ion complexes with general ligands and some biochemical ligands like amino acids, peptides, nucleotides and Nucleic acids and porphyrin **(Book consulted No. 1 Chapter 2).**

Unit – IV

Metal ions in biological system

Fe: Haemoglobin, structure and functions, oxygen transport, Bohr effect.

Mg: Chlorophyll structure and function in photosysthesis.

Zn: Carboxypeptidase enzyme functions.

(Book consulted, No. 9 Page No. 37-76).

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Inorganic Chemistry (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

- Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dryheating test, charcoal cavity test, $Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis:
Dil H_2SO_4 gp: CO^{2-}_3, NO_2^-, S^{2-}, SO_3^{2-}
Conc, H_2SO_4 gp: Cl^-, Br^-, I^-, NO_3^-, CH_3Coo^-
Individual gp: SO_4^{2-}, PO_4^{3-}, BO_3^{3-}

C. Basic radical analysis:
NH_4^+ Pb^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+} or Fe^{3+}, Al^{3+} , Co^{2+} , Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+} Mg^{2+}, Na^+, K^+ and their confirmation.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 4 **Organic Chemistry–B**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

SectionB: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit -I

Acidity of acetylene and terminal alkenes, metal ammonia reduction of alkyne, addition of hydrogen halides and water to alkyne, with detailed discussion of mechanism of these reaction, the Diels Alder reaction, orbital symmetry and the Diels alder reaction.

Unit -II

Conversion of alcohol to ether and ester with full dicussion of the reaction, crown ethers, conversion of vicinal halohydrin to epoxides, nucleophillic ring opening reaction of epoxides, acid catalysed ring opening of epoxides.

Unit -III

Principles of nucleophillic additon to carbonyl groups: Hydration ,acetal formation , cyanohydrin formation ; reaction with primary and secondary amines, Wittig reaction, steroselective addition to carbonyl groups mechanism of halogenation ,acid and base catalysed cholization, haloform reaction ,aldol condensaton, conjugate nucleophillic additon to unsaturated carbonyl compounds.

Unit - IV

Mechanism of acid- catalysed esterification,intramolecular ester formation lactone), Hell-Volerid-Zelinsky reaction, decarboxylation of malonic acid and related compounds. Mechanism of hydrolysis of acid chlorides, acid anhydrides, acid and base catalysed hydrolysis of esters, acid assisted hydrolysis of amides. Hoffman rearrangement of N-bromoamides. Hydrolysis of nitriles, claisen condensation ,the Deckmann condensation, acetic ester synthesis, malonic ester synthesis, Michael reaction Reformatsky reaction.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic Chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV Ed.
3. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
4. Schaum's Outlines Series, Theory and Problems of Organic Chemistry.
5. I.L. Finar, Problems and their Solution in Organic Chemistry.
6. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
7. D. J. Cram and G. S. Hammond, Organic Chemistry.
8. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
9. E.L. Eliel, Stereochemistry of Carbon Compounds.
10. W. Camp, Organic Spectroscopy.
11. F. A. Carey, Organic Chemistry.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Organic Chemistry (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Amides
- Amines
- Carboxylic acids and phenols.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT-5 **Biostatistics**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Elementary Statistics: Representation of data: discrete data, continuous data, histogram, frequency curves. The mean, median, mode, standard deviation, variance, covariance of data. Introduction to statistical sampling from a population.

UNIT-II

Probability: Basic concepts, sample space and events, use of counting method in probability, addition law, sample problems involving the estimation of probabilities, Conditional Probability and Independent Events, Bayes theorem.

UNIT-III

Introduction to Correlation & Regression: Scatter diagram, Linear correlation, linear regression lines.

UNIT-IV

Probability Distributions: Bernoulli, Binomial, Poisson and Normal Distributions.
Hypothesis Testing: Concept of Null and Alternate Hypothesis, Chi-square test (Goodness of fit and association of attributes), T-test (Comparison of Sample mean with population mean, Difference of two means)

Recommended books:

1. Elhance D.N. (1984). Fundamentals of Statistics. *Kitab Mahal, Allahabad.*
2. Mendenhall W. and Sincich T. (1995). Statistics for engineering and sciences (IVth edition). *Prentice Hall.* And sciences (IVth edition). Prentice Hall.
3. B.A./B.Sc Part-I (12+3 System of Education) 225 Gupta S.P. (2000). Statistical methods. *Sultan Chand and Company, New Delhi.*
4. Kapoor V.K. and Gupta S.C. (2000) Fundamentals of Mathematical Statistics. *Sultan Chand and Company, New Delhi*
5. J. Crawshaw and J Chamber (2002) Advanced level Statistics, 4th Edition, *Melson Thornes.*

BT-6 **Punjabi (Compulsory) ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)**

ਸਮਾਂ : 3 ਘੰਟੇ **ਕੁਲ ਅੰਕ : 50**

ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ

1. **ਗਿਆਨ ਮਾਲਾ** (ਵਿਗਿਆਨਕ ਤੇ ਸਮਾਜ-ਵਿਗਿਆਨਕ ਲੇਖਾਂ ਦਾ ਸੰਗ੍ਰਹਿ)
(ਸੰਪ. ਡਾ. ਸਤਿੰਦਰ ਸਿੰਘ, ਪ੍ਰੋ. ਮਹਿੰਦਰ ਸਿੰਘ ਬਨਵੈਤ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ, 2007
ਲੇਖ : ਸਾਹਿਤ ਤੇ ਲੋਕ ਸਾਹਿਤ, ਅੱਖਾਂ, ਅਚੇਤਨ ਦਾ ਗੁਣ ਤੇ ਸੁਭਾਅ, ਕੰਪਿਊਟਰ ਅਤੇ ਇੰਟਰਨੈੱਟ, ਮਨੁੱਖੀ ਅਧਿਕਾਰ।
2. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਸੁਹਿੰਦਰ ਬੀਰ ਅਤੇ ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ) (ਕਹਾਣੀਆਂ)
ਪਠਾਣ ਦੀ ਧੀ (ਸੁਜਾਨ ਸਿੰਘ), **ਸਾਂਵੀ ਕੰਧ** (ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ), **ਉਜਾੜ** (ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ), **ਘੋਟਣਾ** (ਮੋਹਨ ਭੰਡਾਰੀ), **ਦਲਦਲ** (ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ)
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।

3. **ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ ਰਚਨਾ** : ਪਰਿਭਾਸ਼ਾ, ਮੁੱਢਲੇ ਸੰਕਲਪ
4. **ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ**
5. **ਪੈਰ੍ਹਾ ਰਚਨਾ**
6. **ਪੈਰ੍ਹਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ**
7. **ਮੁਹਾਵਰੇ ਅਤੇ ਅਖਾਣ**

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ:

1.	ਕਿਸੇ ਨਿਬੰਧ ਦਾ ਸਾਰ ਜਾਂ ਉਸਦਾ ਵਿਸ਼ਾ ਵਸਤੂ (ਦੋ ਵਿਚੋਂ ਇਕ) ।	10 ਅੰਕ
2.	**ਆਤਮ ਅਨਾਤਮ** : ਸਾਰ, ਵਿਸ਼ਾ ਵਸਤੂ, ਪਾਤਰ ਚਿਤਰਣ, ਸਾਹਿਤ ਨੂੰ ਦੇਣ	10 ਅੰਕ
3-4.	3-4 ਨੰਬਰ ਉੱਤੇ ਦਿੱਤੀ ਵਿਆਕਰਣ ਦੇ ਆਧਾਰ ਤੇ ਵਰਣਨਾਤਮਕ ਪ੍ਰਸ਼ਨ।	10 ਅੰਕ
5.	ਪੈਰ੍ਹਾ ਰਚਨਾ : ਤਿੰਨ ਵਿਸ਼ਿਆਂ ਵਿਚੋਂ ਕਿਸੇ ਇਕ ਉਤੇ ਪੈਰ੍ਹਾ ਲਿਖਣ ਲਈ ਕਿਹਾ ਜਾਵੇ ।	05 ਅੰਕ
6.	ਪੈਰ੍ਹਾ ਦੇ ਕੇ ਉਸ ਬਾਰੇ ਪੰਜ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ	05 ਅੰਕ
7.	ਨੰਬਰ 7 ਵਿਚ ਅੱਠ ਅਖਾਣ ਅਤੇ ਅੱਠ ਮੁਹਾਵਰੇ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਵਿਦਿਆਰਥੀ ਨੇ ਪੰਜ-ਪੰਜ ਨੂੰ ਵਾਕਾਂ ਵਿਚ ਵਰਤ ਕੇ ਅਰਥ ਸਪੱਸ਼ਟ ਕਰਨੇ ਹੋਣਗੇ।	5+ 5=10 ਅੰਕ

BT-6 **Mudhli Punjabi**

ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Compulsory Punjabi)

ਸਮਾਂ: 3 ਘੰਟੇ **ਕੁਲ ਅੰਕ: 50**

ਪਾਠ – ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ
   ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ
   ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ **20 ਅੰਕ**
2. ਭਾਸ਼ਾ ਅਤੇ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਮੁੱਢਲੀ ਜਾਣ ਪਛਾਣ
   ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ **15 ਅੰਕ**
3. ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ
   ਸਾਧਾਰਨ ਵਾਕ: ਕਿਸਮਾਂ
   ਸੰਯੁਕਤ ਵਾਕ: ਕਿਸਮਾਂ
   ਮਿਸ਼ਰਤ ਵਾਕ: ਕਿਸਮਾਂ
   ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ ਦੇ ਵਿਭਿੰਨ ਸਮਾਜਿਕ ਪ੍ਰਸੰਗ **15 ਅੰਕ**

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. **ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ:** ਸੰਯੁਕਤ ਸ਼ਬਦ; ਸਮਾਸੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਲੋਕ ਸਭਾ); ਦੋਹਰੇ ਸ਼ਬਦ / ਦੁਹਰਰੁਕਤੀ (ਜਿਵੇਂ ਧੂੜ ਧਾੜ / ਭਰ ਭਰ), ਮਿਸ਼ਰਤ ਸ਼ਬਦਾਂ ਦੀ ਬਣਤਰ/ਸਿਰਜਨਾ; ਅਗੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਉਪ ਭਾਸ਼ਾ), ਪਿਛੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਰੰਗਲਾ), ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ: ਪੜਨਾਵੀਂ ਰੂਪ, ਕਿਰਿਆ/ਸਹਾਇਕ ਕਿਰਿਆ ਦੇ ਰੂਪ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ: ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਮੌਸਮਾਂ, ਗਿਣਤੀ ਨਾਲ ਸੰਬੰਧਿਤ ।

2. I. ਭਾਸ਼ਾ ਅਤੇ ਮਾਤ ਭਾਸ਼ਾ ਦੇ ਮਹੱਤਵ ਸੰਬੰਧੀ ਪ੍ਰਸ਼ਨ
   II. ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਸੰਬੰਧੀ ਪ੍ਰਸ਼ਨ

3. **ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ:** ਕਰਤਾ ਕਰਮ ਕਿਰਿਆ; ਸਾਧਾਰਨ ਵਾਕ, ਬਿਆਨੀਆ, ਪ੍ਰਸ਼ਨਵਾਚਕ, ਆਗਿਆਵਾਚਕ, ਸੰਯੁਕਤ ਅਤੇ ਮਿਸਰਤ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ; ਸੁਤੰਤਰ ਅਤੇ ਅਧੀਨ ਉਪਵਾਕ; ਸਮਾਨ (ਤੇ/ਅਤੇ) ਅਤੇ ਅਧੀਨ (ਜੋ/ਕਿ) ਯੋਜਕਾਂ ਦੀ ਵਰਤੋਂ; ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ: ਵਿਭਿੰਨ ਸਮਾਜਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸੰਗ; ਘਰ ਵਿਚ, ਬਾਜ਼ਾਰ ਵਿਚ, ਮੇਲੇ ਵਿਚ, ਸ਼ੋਪਿੰਗ ਮਾਲ/ਸਿਨਮੇ ਵਿਚ, ਵਿਆਹ ਵਿਚ, ਧਾਰਮਿਕ ਸਥਾਨਾਂ ਵਿਚ, ਦੋਸਤਾਂ ਨਾਲ ਆਦਿ।

ਅੰਕ–ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪਹਿਲੇ ਯੂਨਿਟ ਵਿੱਚੋਂ ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ ਰਚਨਾ ਨਾਲ ਸਬੰਧਿਤ 5-5 ਅੰਕਾਂ ਦੇ ਤਿੰਨ ਵਿਹਾਰਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਅੰਕਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਇਕ-ਇਕ ਜਾਂ ਦੋ-ਦੋ ਅੰਕਾਂ ਦੇ ਛੋਟੇ ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕੀਤੀ ਜਾ ਸਕਦੀ ਹੈ। ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਸ਼ਬਦਾਵਲੀ ਨਾਲ ਸਬੰਧਿਤ ਇਕ-ਇਕ ਅੰਕ ਦੇ ਪੰਜ (ਆਬਜੈਕਟਿਵ) ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
   20 ਅੰਕ
2. ਦੂਸਰੇ ਯੂਨਿਟ ਵਿੱਚ ਭਾਸ਼ਾ ਅਤੇ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਮੁਢਲੀ ਜਾਣ ਪਛਾਣ ਨਾਲ ਸੰਬੰਧਿਤ 5-5 ਅੰਕਾਂ ਦੇ ਤਿੰਨ ਵਿਹਾਰਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਅੰਕਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਇੱਕ-ਇੱਕ ਜਾਂ ਦੋ-ਦੋ ਅੰਕਾਂ ਦੇ ਛੋਟੇ ਪ੍ਰਸ਼ਨਾਂ ਵਿੱਚ ਕੀਤੀ ਜਾ ਸਕਦੀ ਹੈ।
   15 ਅੰਕ
3. ਤੀਜੇ ਯੂਨਿਟ ਵਿੱਚ ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ ਨਾਲ ਸਬੰਧਿਤ 5-5 ਅੰਕਾਂ ਦੇ ਦੋ ਵਿਹਾਰਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਅੰਕਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਇਕ-ਇਕ ਜਾਂ ਦੋ-ਦੋ ਅੰਕਾਂ ਦੇ ਛੋਟੇ ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕੀਤੀ ਜਾ ਸਕਦੀ ਹੈ।
   ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਿਹਾਰਕ ਵਰਤੋਂ ਨਾਲ ਸਬੰਧਿਤ 5 ਅੰਕਾਂ ਦਾ ਇਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛਿਆ ਜਾਵੇਗਾ, ਜਿਸ ਵਿਚ ਵਿਦਿਆਰਥੀ ਨੂੰ ਕਿਸੇ ਸਮਾਜਿਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸੰਗ ਵਿਚ ਵਰਤੇ ਜਾਂਦੇ ਪੰਜ ਵਾਕ ਲਿਖਣ ਲਈ ਕਿਹਾ ਜਾਵੇਗਾ।
   ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਭਾਸ਼ਾ ਸਰਲ ਅਤੇ ਸਪਸ਼ਟ ਰੱਖੀ ਜਾਵੇ। **15 ਅੰਕ**

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT-7 COMMUNICATION SKILLS IN ENGLISH

Time: 3 Hours **Max. Marks: 50**
Theory Marks: 35
Practical Marks: 15

Course Contents:

1. **Listening Skills:** Barriers to listening; effective listening skills; feedback skills. Attending telephone calls; note taking.

   Activities:
   a) Listening exercises – Listening to conversation, News and TV reports
   b) Taking notes on a speech/lecture

2. **Speaking and Conversational Skills**: Components of a meaningful and easy conversation; understanding the cue and making appropriate responses; forms of polite speech; asking and providing information on general topics.
   The study of sounds of English, stress
   Situation based Conversation in English
   Essentials of Spoken English

   Activities:
   a) Making conversation and taking turns
   b) Oral description or explanation of a common object, situation or concept
   c) Giving interviews

Suggested Pattern of Question Paper:

The question paper will consist of seven questions related to speaking and listening Skills. Each question will carry 5 marks. The nature of the questions will be as given below:-

Two questions requiring students to give descriptive answers.

Three questions in the form of practical exercises requiring students to give an appropriate response to a question, a proposal, a proposition, an invitation etc. For example, the paper setter may give a proposition and ask the students to agree or disagree with it or introduce a character giving invitations and ask the students to accept or refuse it etc.

Two questions requiring students to transcribe simple words in IPA symbols, marking stress.

PRACTICAL / ORAL TESTING

Marks: 15

Course Contents:

1. Oral Presentation with/without audio visual aids.
2. Group Discussion.
3. Listening to any recorded or live material and asking oral questions for listening comprehension.

Questions:

1. Oral Presentation will be of 5 to 10 minutes duration. (Topic can be given in advance or it can be of student's own choice). Use of audio visual aids is desirable.

2. Group discussion comprising 8 to 10 students on a familiar topic. Time for each group will be 15 to 20 minutes.

Note: Oral test will be conducted by external examiner with the help of internal examiner.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 8 **General Microbiology–B**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Microbial Growth: Bacterial generation doubling time and specific growth rate. Monoauxic, diauxic and synchronised growth curve. Sporulation and regeneration of bacteria

Unit – II

Classification of viruses. Plant and animal viruses, Life cycle of bacteriophage.

Unit- III

Pathogenic micro-organisms. Defence mechanism against micro-organisms.

Symbiosis and antibiosis among microbial populations

N_2-fixing microbes in agriculture

Unit - IV

Microbial metabolism. Fermentation products. A survey of products from micro-organisms. Production of heterologous proteins of interest in micro-organisms.

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4th Edition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5th Edition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, Londan.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schlegel. H. G., (1995). General Microbiology 7th Edition, Cambridge Univ. Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K. Jain for CBS Publishers & Distributors.
7. Purohit, S.S.(2000). Microbiology: Fundamentals and Applications (6th Edition), Agrobios (India).
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge Univ. Press.
9. Tortora. G.J., Funke. B.R., 2001. Microbiology: An Introduction, Benjamin Cummings.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

General Microbiology–B (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Enumeration of microorganism. Total vs viable counts.

Identification of isolated bacteria. Gram staining, other staining methods.

Growth curve of micro-organisms

Testing of water quality

Books Recommended:

1. Cappuccino, J.G. and Sherman, N. (1999). Microbiology: A Laboratory Manual 4th Ed: Harlow, Addition-Wesley.
2. Sambrook, J., Russel, D.W. (2001). Molecular Cloning. A laboratory manual 3rd Ed., Cold Spring Harbor Laboratory Press, New York.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

BT - 9 **Biochemistry - II**

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Lipids: Classification of lipids and fatty acids. General structure and function of major lipid subclasses, acylglycerols, phosphoglycerides, Sphingolipids, glycosphingolipids and terpenes, sterols, steroids.

Unit -II

Proteins: Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organization of proteins (Primary, Secondary, Quaternary and domain structure, protein classification and function. Forces stabilizing Primary, Secondary and Tertiary structure.

Unit - III

Vitamins: Types of vitamins and their deficiency symptoms, vitamins as cofactors.

Unit - IV

Hormones: Steroid and peptide hormones.

Books Recommended:

1. Rawn, J.D. (1989). Biochemistry, Neil Patterson Publishers.

2. Stryer, L. (1995). Biochemistry: 4th Edition, W.H. Freeman and Company, New York

3. Zubay, G.L., Parson. W.W. and Vance, D.E. (1995). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.

4. Bucke C., (1999)), Carbohydrate Biotechnology Protocols, Humara Press.

5. Horton et. al., (2001), Principles of Biochemistry, Prentice Hall.

6. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2005). Principles of Biochemistry 4th Ed., CBS Publishers and Distributors, New Delhi.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Bio-Chemistry-II
(Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. Protein estimation by Lowry's method.
2. Protein estimation by Bradford method.
3. Protein estimation by UV spectrophotometeric method
4. The determination of acid value of a fat.
5. The saponification value of a fat.

Books Recommended:

1. Plummer D.T. (1990) An Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985) Practical Biochemistry. Standard Publication, Chandigarh.
3. Sawhney, S.K. and Randhir singh (2001). Introductory Practical Biochemistry. Narosa Publishing House.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 1
Physical Chemistry – A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the Paper Setters/Examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Chemical Thermodynamics:
State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, Intensive and Extensive properties, various types of processes. First Law of Thermodynamics, internal energy and enthaply, change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between Cp and Cv. Internal energy change and enthaply change in a chemical process. Hess's law of heat summation. Enthaply of formation, enthaply of ionisation and calculation of bond dissociation energies from thermochemical data.

Unit-II

Second law of thermodynamics, entropy and Gibb's free energy, Carnot's cycle, Calculation of entropy change for reversible and irreversible processes under isothermal and non-isothermal conditions. Gibbs Hemholtz equation. Third law of thermodynamics, Nernst heat theorem, calculation of absolute entropies of substances. Meaning of chemical equilibrium, homogeneous and heterogeneous equilibria. Thermodynamic derivation of law of chemical equilibrium, Van't Hoff relation, Relation between free energy change and equilibrium constants Kp Kc and Kf. Temperature and pressure dependence of equilibrium constant.

Unit-III

Solutions:
Definition, types of solutions, vapour pressure of solution and Raoult's law. Factors influencing the solubility of gas in liquids, Henry's law. Ideal solutions, Duhem Margules equation. Distillation of ideal solutions, Lever rule, vapour pressure of ideal solutions and non ideal solutions. Distillation of non ideal solutions. Azeotropes, colligative properties, lowering of vapour pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common features and applications. Thermodynamic derivation of elevation in boiling point, depression in freezing point and osmotic pressure. Van't Hoff factor and its application to calculate degree of association and degree of dissociation.

Unit-IV

Phase Equilibria:
Definition of phase, component and degree of freedom, Phase rule and its thermodynamic derivation. Derivation of Clausius-Clapeyron equation and its importance in phase equilibria, phase diagrams of water system, KI water system and lead-silver system.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-1

Physical Chemistry – A Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Surface tension: Determination of surface tension of a given liquid by Stalgometer. Using number of drops and weight of drops methods
2. Determination of coefficient of viscosity of a pure liquid (Acetone, Ethanol, Propanol, Butanol, Glycol) (Effect of hydrogen bonding on viscosity)
3. Photometry.

   Verification of Lambert beer's law for solution of $CoCl_2H_2o$ (in water) and $K_2Cr_2O_7$ (in water)
4. a) pH of buffer solution

   b) Acid base titration HCl vs. NaOH.

   c) Determination of ionization constant of a weak acid (CH_3COOH)
5. Study of distribution law of Benzoic acid between benzene and water.
6. Study of distribution law by iodine distribution between water and CCl_4. Given standar solution $Na_2S_2O_3$.
7. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 2

Zoology–C

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Introduction to parasitology (pertaining to various terminologies in use). Brief account of Life history, mode of infection and pathogenicity of the following pathogens with reference to man, prophylaxis and treatment, Entamaeba, Trypanosoma, Leishmania, Giardia, Trichomonas and Plasmodium.

Unit-II

Histopathological changes in organs in relation to diseases such as livers, cirrhosis, nephrosis, tumors, cancer, AIDS.

Unit-III

Arthropod vectors of human diseases : Malaria, Yellow fever, Dengue haemorragic fever, Filariasis, Plague and Epidemic typhus. Distribution and control of the above mentioned vectors.

Unit-IV

General account of diseases such as AIDS, Hepatitis, typhoid and cholera, their occurence and eradication programmes. General account of drug therapy and drug resistance.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-2
Zoology – C Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Preparation of blood smear showing different stages of plasmodium

2. Study of permanent slides and specimens of parasitic protozoans, helminth and arthropods: Entamoeba, Giardia, Plasmodium, Trypanosoma, Leishmania, Trichomonae,

3. Anopheles,culex (mouth parts), lice, rat flea, Aedes Agypti, Tapeworm, Ascaris, Wuchereria, Trichinella, Ancylostoma, Oxyuris.

4. Pathological examination of blood and urine.

5. Blood Tests:

   (a) Erythrocyte sedimentation rate
   (b) Bleeding time
   (c) Clotting time
   (d) Prothrombin time

Books:

1. Sobti, R.C. (1992) Medical Zoology, Shoban Lal Nagin Chand & Co.

2. Parasitology (Protozoology and Helminthology) by K.D Chatterjee

3. Harrison A. (2000). Principles of Medicine.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT – 3 Biochemistry – III

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the Paper Setters/Examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Metabolism: - Basic principles of metabolism, metabolic pathways, catabolism, anabolism, basic principles of bioenergetics, biological oxidation reduction reaction, energy rich metabolites.

UNIT-II

Carbohydrate metabolism: - Biosynthesis and degradation of carbohydrates, Glycolysis, gluconeogenesis, feeders pathways for glycolysis, regulation of carbohydrates metabolism.

UNIT-III

Kreb's cycle: - Amphibolic nature of kreb's cycle, regulation and enzymes of kreb's cycle, glyoxylate pathway.

UNIT-IV

Electron transport chain: - Mitochondrial electron chain, oxidative phosphorylation, chemiosmotic hypothesis, ATP synthase and regulation of ATP synthesis.

Books Recommended:

1. Jain, J. L., Jain, S. and Jain. N. (2005). Fundamentals of Biochemistry, S. Chand & Company Ltd., New Delhi.
2. Rawn, J.D. (1989), Biochemistry, Niel Patterson Publications, North Carolnia.
3. Stryer, L. (1995), Biochemistry, 4th Ed., W.H. Freeman & Co., San Francisco.
4. Voet, D., Voet, J.G. (1999). Fundamentals of Biochemistry, John Wiley and Sons, New York.
5. Lehninger, A.L. Ntison, D.L. and Cox, M.M. (2008), Principles of Biochemistry, 2nd Ed.,Worth Publishers, New York

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-3 Biochemistry – III Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. The absorbance curve of two dyes.
2. Demonstration of Beer's Law.
3. Determination of reducing sugar using 3,5 dinitrosalicylic acid.
4. Chromatographic methods for separation of macromolecules
   - Thin layer chromatography
   - Gel permeation chromatography.

1. Plummer D.T. (1998). An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985). Practical Biochemistry. Standard Publication, Chandigarh.
3. Sawhney, S.K. and Randhir Singh (2001). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 4
Cell Biology – A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the Paper Setters/Examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Cell as a basic unit of living systems. The cell theory Broad Classification of Cell Types: PPLO's, bacteria, eukaryotic microbes, plant and animal cells. A detailed classification of cell types within an organism. Cell, tissue, organ and organism as different levels of organizations of otherwise genetically similar cells.

Unit - II

Ecological amplitude of cells in high altitude, sediments, arctic, hotspring, arid, brackish extremophytes and freshwater environments.

Unit - III

Biochemical composition of cells (proteins, lipids, carbohydrates, nucleic acids and the metabolic pool).

Unit-IV

Biological Membranes: Supramolecular architecture of membranes; Solute transport across membranes; Model membranes and Liposomes.

Books Recommended:

1. De-Robertis, F.D.P. and De-Robertis Jr. E.M.F. (1991) Cell and Molecular Biology, Saunders, Philadelphia.
2. Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Darnell, J. (1995). Molecular Cell Biology 3rd Edition, Scientific American Books Inc.
3. Geoffrey, M. (2000). The Cell: A molecular approach 2nd Edition, ASM Press.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-4

Cell Biology – A Practical

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

-**Microscopy:** (a) Principles of compound, phase contrast, electron microscopy.
(b) Use and care of Light compound microscope.

-**Study of Cells:** (a) Prokaryotic cells: *Lactobacillus, E. coli*. Blue green algae.
(b) Eukaryotic cells: Testicular material (for studies of spermatogenesis)

- Study of electron micrographs of various cell organelles-plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic Reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen, lipids, etc.

Books Recommended:

1. Shah, V.C., Bhatavdekar, J., Chinoy, N.J. and Murthy, S.K. (1988). Essential techniques in Cell Biology. Anand Book Depot, Ahemadabad.
2. Celis, J.E. (1998) Cell Biology: A Laboratory handbook. Vol. 1-3. Academic Press, UK.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 5

Basic concepts in Immunology

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the Paper Setters/Examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Types of immunity-innate and adaptive; Features of immune response-memory; Specificity and recognition of self and non-self; Terminology and approaches to the study of immune system.

UNIT-II

Lymphoid cells, heterogeneity of lymphoid cells; T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic.

UNIT-III

Antigen-antibody interactions; affinity and avidity; high and low affinity antibodies; Immunoglobulins, classes and structure; Complement fixing antibodies and complement cascade.

UNIT-IV

MHC cless I and class II molecules, structure and role of cless I and class II MHC molecules, structure of T-cell antigen receptors.

Books Recommended:

1. Austyn, J.M. and Wood K.J. (1993), Princi[les of Cellular and molecular Immunology, Oxford University Press Inc. New York
2. Paul, W./E. (1995), Fundamental Immunology, 3rd Ed., Raven Press, New York
3. Britch, J.R. and Lennox, E.S. (1995), Monoclonal Antibodies Principles and Application, Wiley Liss.
4. Roitt, I.M. Brostoff, J. and Male, D.K. 91996), Immunology, 4th Edition, Grower Medical Publishing , New York
5. Strites D.P., Terr. A.I. & Parslow T.G. (1997), Medical Immunology, 9th Ed., PHI, Cambridge.
6. Kanfmann, S.H.E., Sher A., Ahmed, R. (2002). Immunology of Infections Diseases, ASM Press, Washington
7. Kuby, J. (2004), Immunology, 5th Edition. W.H. Freeman and Company, New York

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-5

Basic concepts in Immunology Practical

Time: 3 Hrs. Max. **Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Blood Group testing
2. Separation of serum from blood
3. Separation of plasma from blood
4. Enumeration of T-cells by E-rosetting method
5. Separation of peritoneal macrophages from rat
6. Isolation of mononuclear cells from peripheral blood viability test by dye exclusion method.

Books Recommended:

1. Stevans, C.D. (1996). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. Celis, K.E. (1998). Cell Biology: A laboratory handbook. Vol-I Academic Press, U.K.
3. Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 6

Genetics

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Organization of Chromosomes: The structure of prokaryotic and eukaryotic chromosome, centromere and telomere structure, euchromatin and heterochromatin, Special chromosomes: Polytene chromosomes and Lampbrush chromosomes, satellite DNA, the supercoiling of DNA.

Unit – II

Mendel's Laws of Inheritance: Principle of segregation and Independent assortment, Mnohybrid, dihybrid and trihybrid crosses, Back cross and test cross.

Interaction of Genes: Incomplete inheritance and co-dominance, pleotropism, modification of **F2** ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicate genes, lethality and collaborators genes. Multiple allelism.

Unit – III

Linkage: Coupling and repulsion hypothesis, chromosomal theory of linkage, complete and incomplete linkage, linkage groups and significance of linkage.

Crossing Over: Introduction, mechanism of meiotic crossing over, types of crossing over, factors affecting it and its significance.

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Unit – IV

Mutation: Spontaneous versus induced mutations, types of mutations, mutations rate and frequency, Mutagens: Physical and Chemical, the molecular basis of mutations. Significance & Practical applications of Mutation

Basic Microbial Genetics: Conjugation, transduction, transformation

Books Recommended:

1. Maloy, S.R., Crown, J.E. and Freifelder, D. (1994). Microbial Genetics: 2nd Edition, Jones & Bartlett Publishers.
2. Hartl, D.L. (1994). Genetics: 3rd Edition, Jones & Bartlett Publishers.
3. Brooker, R.J. (1999). Genetics: Analysis and Principles, Jim Green.
4. Antherly A.G., Girton. J.R. (1999), The Science of Genetics. Harcourt college Publishers
5. Freifelder, D. (2000). Microbial Genetics, Narosa Publishing House.
6. Hartl. D.L., Jones E.W., (2001). Genetics: Analysis of Genes & Genomes 5th Edition. Jones & Bartlett Publishers.
7. Gupta PK (2007) Genetics, Rastogi Publications
8. Snustad and Simmons (2010) Principles of Genetics: 5th Edition, John Wiley & sons

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-6

Genetics Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Demonstration of Law of segregation and Independent assortment (use of coloured beads, capsules etc.).
2. Numerical problems on Mendelism and on modified F2 ratios.
3. Numerical problems on Paternity disputes (Blood groups)
4. Segregation demonstration in preserved material
5. Study of polytene chromosomes from permanent slides.
6. Testing of blood groups and Rh factors in human beings.
7. Dermatographics : Palm print taking and finger tip patterns.
8. Preparation and study of mitosis slides from onion root tips by squash method.

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BT - 7

Agro and Industrial Applications of Microbes – A

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Intorduction:

Basic concept of agriculture as industry. Industrially important microbes, its screening, selection and identification.

Unit-II

Maintenance and preservation of industrially important microbial cultures. Differences between microbial industrial processes and chemical industrial processes.

Unit-III

Improvement of Industrial Microbes:

Improvement programme of industrial microbes, mutational programme of penicillin producing microorganisms, selection pressure in maintaining the hyper producing microbes, revertant back of higher yielding microbes into lower production, media formulation and process optimisation of industrial and agro industrial microbes.

Unit-IV

Nitrogen fixation, *Rhizobium*, *Azospirillum*, *Azobacter*, *Anabena* in nitrogen fixation, Agrobacterium,

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BT-7
Agro and Industrial Applications of Microbes – A Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Autoclaving.
2. Microbial cells counting by serial dilution techniques.
3. Microbial cell counting by pore plate techniques.
4. Measurement of bacterial size.
5. Metabolic Characterization (e.g. IMVIC test)
6. One Step Growth of Bacteriophage.
7. Alcoholic and Mixed–Acid Fermentation.

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ESL–221: ENVIRONMENTAL STUDIES–I (COMPULSORY)

Time: 3 Hrs. **Max. Marks: 50**
Theory Lectures: 1½ Hours/ Week

Section–A: (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying five marks. Answer to any of the questions should not exceed two pages.
Section–B: (20 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying ten marks. Answer to any of the questions should not exceed four pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

1. **The Multidisciplinary Nature of Environmental Studies:**
   - Definition, scope & its importance.
   - Need for public awareness.
2. **Natural Resources**:
   - Natural resources and associated problems:
     a) **Forest Resources**: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
     b) **Water Resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
     c) **Mineral Resources**: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
     d) **Food Resources**: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
     e) **Energy Resources**: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
     f) **Land Recourses**: Land as a resource, land degradation, soil erosion and desertification.
   - Role of an individual in conservation of natural resources.
   - Equitable use of resources for sustainable lifestyles.
3. **Ecosystem:**
   - Concept of an ecosystem.
   - Structure and function of an ecosystem.
   - Producers, consumers and decomposers.
   - Energy flow in the ecosystem.
   - Ecological succession.
   - Food chains, food webs and ecological pyramids.
   - Introduction, types, characteristic features, structure and function of the following ecosystems:
     a. Forest ecosystem
     b. Grassland ecosystem
     c. Desert ecosystem
     d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

4. Social Issues and Environment:

- From unsustainable to sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environmental Protection Act:
  - Air (prevention and Control of Pollution) Act.
  - Water (prevention and Control of Pollution) Act.
  - Wildlife Protection Act.
  - Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

5. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS; Emblem, flag, motto, song, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 1

Physical Chemistry – B

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Electrochemical Cells:

Electrode poential, Electromotive force (EMF). Reversible and irreversible cells, measurement of EMF of a cell. Nernst equation. Reference electrodes and other electrodes, standard electrode potential. Activity and activity coefficient determination from EMF results. Concentration cells with transference and without transference, liquid function potential, pH, glass electrode, quinone-hydroquinone electrode, Potentiometric titrations.

Unit-II

Chemical Kinetics:

Rate of reaction, rate constant, factors influencing rate of reaction, order, molecularity. Rate equations for Ist order, IInd order & IIIrd order reactions. Methods for determining order of reaction. Half Life, Complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions. Activation energy and calculation from Arrhenius equation. Theories of reaction rates collision theory and transition state theory of biomolecular processes. Catalysis, acid base catalysis, enzyme catalysis including their mechanisms, Michaelis Menten equation for enzyme catalysis. Heterogeneous catalysis and its mechanism. Surface reactions with special reference to Unimolecular surface reactions.

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Unit-III

Ionic Equilibria and Conductance: Conductivity, equivalent and molar conductance. Variation of equivalent conductance with dilution of weak and strong electrolytes. Arrhenius and Debye Huckel theory. Kohlraush law of independent migration of ions. Transference number and their experimental determination using Hittorf and moving boundary methods. Ionic elocity, ionic mobility. Applications of conductance measurements. Determination of degree of ionisation of weak electrolyte, solubility, solubility product of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt, conductometric titrations. Ionic strength. Debye Huckel theory of activity coefficients. Mathematical treatment of multistage equilibria of acids and bases. Salt hydrolysis, calculation of hydrolysis constant, Buffer solutions, Buffer index, Buffer capcity universal buffer preparation. Acid base indicators. Theory of acid base indicators. pH change and selection of indicators in different acid base titrations.

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BT-1
Physical Chemistry – B Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Refractometry: Determine refractive index of a given liquid as a criterion for its purity. (Benzene i.e. commercial) benzene + A.R. acetone).

2. Polarimetry: Determine the %age composition of an optically active solution.

3. Calorimetry:
   a) Determination of Heat of neutralization
      (i) Strong acid-strong base
      (ii) Weak acid-strong base.
   b) Determination of Heat of solution of KCl, NH_4Cl, KNO_3

4. Conductometry:
   a) Determination of cell constant.
   b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
   c) Precipitation titration of Na_2SO_4 vs. $BaCl_2$.
   d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.

5. Determination of adsorption isotherm of oxalic acid on charcoal.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 2
Botany – C

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Water relations, osmosis, transpiration, water potentials, its components, physiological & molecular adaptations in plants with respect to cold-heat-drought and salt stress.

Unit-II

Heat shock proteins, dehydrins, late embryogenesis abundant proteins, role of different osmolytes in stress tolerance.

Unit-III

Plant Pathology & epidemiology: Definition, classification, mode of transmission & control measures of plant diseases. Disease resistance host pathogen interaction. Phytoalexins, PR proteins.

Unit-IV

A detailed account of the following plant diseases with respect to casual agents, symptoms, epidemology, disease cycle & their control measures. Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, False smut of rice, Bacterial blight of rice, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi, Bunchy top of banana, Downy mildew of bajra.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-2
Botany – C Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Estimation of relative water content of leaf.

2. Measurement of osmotic potential of different tissues by Chardokov method.

3. Study of Plant pathogens

   (a) Symptoms of the diseases

   (b) Morbid anatomy of the plants infected with following diseases.

   Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, False smut of rice, Bacterial blight of rice, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi, Bunchy top of banana, Downy mildew of bajra.

Books:

1. Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company

2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates

3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications

4. Pandey, B.P. (2001) Plant Pathology, S Chand

5. M.J. Carlile, S.C. Watkinson & G.W. Gooday (2001), The Fungi 2nd Ed., Academic Press.

6. G.N. Agrios (1997), Plant Pathology 4th Ed., Academic Press.

7. R.S. Mehrotra (1980) Plant Pathology Tata McGraw Hill New Delhi.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT – 3 Biochemistry – IV

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:
Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT – I

Lipid Catabolism: Oxidation of fatty acids, degradation of triacylglycerol, phosphoglycerides, sphingolipids, regulation of lipid metabolism.

UNIT-II

Lipid Anabolism: Synthesis of fatty acids, triacylglycerol, phosphoglycerides , sphingolipids, cholesterol.

UNIT-III

Amino Acid Metabolism: Transamination reactions of amino acids, urea cycle, biosynthesis and degradation of essential amino acids, regulation of amino acid biosynthesis.

UNIT-IV

Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines nucleotides, regulation of nucleotide biosynthesis. Degradation of purines and pyrimidines , nucleotides, salvage pathway.

Books Recommended:

1. Jain, J. L., Jain, S. and Jain., N. (2005). Fundamentals of Biochemistry, S. Chand & Company Ltd., New Delhi.
2. Rawn, J.D. (1989), Biochemistry, Niel Patterson Publications, North Carolnia.
3. Stryer, L. (1995), Biochemistry, 4th Ed., W.H. Freeman & Co., San Francisco.
4. Voet, D., Voet, J.G. (1999). Fundamentals of Biochemistry, John Wiley and Sons, New York.
5. Lehninger, A.L. Ntison, D.L. and Cox, M.M. (2008), Principles of Biochemistry, 2nd Ed., Worth Publishers, New York

BT-3 Biochemistry – IV Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Quantitative estimation of amino acids using the ninhydrin reaction.
2. Purification of protein using salt precipitation.
3. Isolation of Casein from milk.
4. UV absorption of proteins and amino acids.
5. Chromatographic methods for separation of macromolecules
    - Paper chromatography

Books Recommended:

1. Plummer D.T. (1998). An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985). Practical Biochemistry. Standard Publication, Chandigarh.
3. Sawhney, S.K. and Randhir Singh (2001). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 4

Cell Biology – B

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Structure and function of cell organelles, ultrastructure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.),

Unit-II

Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Unit - III

Cell Division and Cell Cycle: mitosis, meiosis, stages of cell cycle, binary fission, amitosis and its regulation. Cell-cell interaction Cell locomotion (amoeboid, flagellar and ciliar).

Unit – IV

Cell Senescence and Death: Apoptosis and necrosis
Cell Differentiation in Plants and Animals: Totipotent, multipotent, pleuripotent cell.
Precellular Evolution: artificial creation of “cells”

Books Recommended:

1. De-Robertis, F.D.P. and De-Robertis Jr. E.M.F. (1991) Cell and Molecular Biology, Saunders, Philadelphia.
2. Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Darnell, J. (1995). Molecular Cell Biology 3rd Edition, Scientific American Books Inc.
3. Geoffrey, M. (2000). The Cell : A molecular approach 2nd Edition, ASM Press.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-4

Cell Biology – B Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

- **Microtomy:** Introduction of the instrument- its use, care, section cutting and stretching.
- **Preparation of Permanent Slides:** Principles and procedures- Section cutting of tissues and staining of tissues with Haematoxylin/eosin method.
- Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).

Books Recommended:

1. Shah, V.C., Bhatavdekar, J., Chinoy, N.J. and Murthy, S.K. (1988). Essential techniques in Cell Biology. Anand Book Depot, Ahemadabad.
2. Celis, J.E. (1998) Cell Biology: A Laboratory handbook. Vol. 1-3. Academic Press, UK.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 5

Immunotechnology

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:-

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Cell Mediated Immunity:

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells.

UNIT-II

Immunodiagnostic Procedures:

Various types of immunodiffusion and immunoelectrophoretic procedures. Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, Haemagglutination and haemagglutination inhibition.

Unit-III

Immunity to viruses, intracellular and extracellular bacteria, immunopathological consequences of parastitic infections, immune invasion, mechanism used by parasites, regulation of immune invasion, mechanism used by parasites.

Unit-IV

Active and passive immunization, Adjuvants, whole organism vaccine, purified macromolecules as vaccine.

Books Recommended:

1. Abbas, A.K. Litchman, A.H. and Pober, J.S. (200). Immunology, 4th ed., Philadelphia, Pennsylvania: W.B. Saunders Company Publishers.
2. Benjamni, E., Coico, R. and sunshine, G. (2000). Immunology: A short course, 4th ed., New York, Wiley-Liss.
3. Roit, I.M., Delves, P. (2000). Essential Immunology, 10th ed., Oxford: Blackwell Scientific Publications.
4. Roitt, I., Brostoff, J. and Male, D. (2001). Immunology, 6th ed., Mosby.
5. Kanfmann S.H.E., Sher, A., Ahmed, R. (2002). Immunology of infections Diseases, ASM Press, Washington.
6. Butler, M. (2004). Animal Cell Technology, 2nd ed., BIOS Scientific Publishers, U.K.
7. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2006). Kuby Immunology, 4th ed., W.H. Freeman and Company, New York

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-5

Immunotechnology Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Differential leucocytes count
2. Total Leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Double immunodiffusion test using specific antibody and antigen
7. Direct and indirect ELISA

Books Recommended:

1. Stevans, C.D. (1996). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. Celis, K.E. (1998). Cell Biology : A laboratory handbook. Vol-I Academic Press, U.K.
3. Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 6

Molecular Biology

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit - I

Molecular basis of life. Structure of DNA. DNA replication both prokaryotes and eukaryotes.

Unit - II

DNA recombination molecular mechanisms : prokaryotic and eukaryotic. Insertion elements and transposons.

Unit-III

Structure of prokaryotic genes. Prokaryotic transcription. Prokaryotic translation. Prokaryotic gene expression (lac, his, trp, catabolic repression).

Unit - IV

Structure of eukaryotic genes. Eukaryotic transcription. Eukaryotic translation. Eukaryotic gene expression, transcription factors etc. Post translational regulation of gene expression.

Books Recommended:

1. Adams, R. L. P., Knowler, J. T., and Leader, D. P. (1992). The Biochemistry of Nucleic acids, 11th ed., Champman and Hall, The New York/London/Tokyo/Melbourne/Madras.
2. Bolsover, S. R., Hyams, J. S., S. Shephard, E. A. and White H. A. (1997) from Genes to Cells., John Wiley and Sons.
3. Lewin, B (1997), Gene VI, Oxford University Press. 10. Maulik, S. and Patel, S. D. (1997). Molecular Biotechnology Therapeutic Application and Strategies, John Wiley & Sons.
4. R. W. Old and S. B. Primrose (1989): Principles of Gene Manipulation : An Introduction to Genetic Engineering. Black Well Scientific Publications.
5. Strachan, T. A. and Read, A. P. (1996). Human Molecular Genetics, John Willey and Sons.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-6

Molecular Biology Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Preparation of stock solutions.
2. Isolation of genomic DNA from plants.
3. Gel casting and Setting up of gel apparatus
4. Preparation of Agarose gel for agarose gel electrophoresis
5. Spectrophotometric determination of purity.
6. Quantification of DNA by spectrophotometric and fluorometric (Ethidium bormide) analysis.

Books Recommended:

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 7

Agro and Industrial Applications of Microbes – B

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Industrial and Agro-industrial Microbes:
Microbes involved in antibiotics, pharmaceutical drugs, enzymes production, solvent production, surfactants, aq. culture, vermiculture, composting, herbicides and biopesticides production,

Unit-II

Biotransformation, organic acids production, vitamins, aminoacids, single cell protein, biofertilizers, alcohols, wine, beers, mycotoxins.

Unit-III

Microbial Processes in Agrobiotechnology:
Introduction, plant microbe interactions, BT gene in BT cotton, Spirulina production, soil treatment with microbes, Mycorrhizal fungi, microbial pesticides, mycoherbicides.

Unit-IV

Microbial Process in Industrial Biotechnology:
Introduction, primary and secondary metabolites production, production of vitamins B_{12}, alcohols, wine, beer, cheese, bread, citric acid, penicillins, glutamic acid, cellulases, proteases in leather industries, Biochips.

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BT-7

Agro and Industrial Applications of Microbes – B Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Screening of cellulase producing microorganism from wood degrading soil.
2. Antibiotic sensitivity of the above microorganism.
3. Minimum inhibitory concentration of a antibiotics for the above microorganism.
4. Additive and synergistic effect of two drugs on the above microorganism.
5. Plating the milk samples for microbial contamination.
6. MBRT Test for determination of milk quality.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT - 8

Enzymology

Time: 3 Hrs. **Max. Marks: 40**

Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit I

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group

Unit II

Mechanism of Enzyme Action: Nature of active site, identification of functional groups at active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes. Covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis.

Unit-III

Enzyme Kinetics:
A brief concept of bioenergetics and kinetics, Kinetics of single and bi-substrate enzyme catalyzed reactions, Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of Km and Vmax values, Lineweaver-Burk plot, Hanes Plot and

Unit-IV

Enzyme inhibition: reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition. Effect of pH and temperature on rate of enzyme catalyzed reactions. Reversible covalent modification and zymogen activation, Isozymes and their importance

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

BT-8

Enzymology Practical

Time: 3 Hrs. **Max. Marks: 20**

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Estimation of α-amylase activity from saliva.

2. Assay of acid phosphatase activity.

3. Effect of temperature on enzyme activity.

4. Effect of pH on enzyme activity

5. Determination of Km for acid phosphatase.

Books Recommended:

1. Plummer D.T. (1998). An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.

2. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985). Practical Biochemistry. Standard Publication, Chandigarh.

3. Sawhney, S.K. and Randhir Singh (2001). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

ESL–222: ENVIRONMENTAL STUDIES–II (COMPULSORY)

Time: 3 Hrs. **Max. Marks: 50**
Theory Lectures: 1½ Hours/ Week

Section–A: (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying five marks. Answer to any of the questions should not exceed two pages.
Section–B: (20 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying ten marks. Answer to any of the questions should not exceed four pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

1. **Biodiversity and its Conservation:**
   - Definition: Genetic, species and ecosystem diversity.
   - Biogeographical classification of India.
   - Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
   - Biodiversity of global, National and local levels.
   - India as mega-diversity nation.
   - Hot-spots of biodiversity.
   - Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts.
   - Endangered and endemic species of India.
   - Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

2. **Environmental Pollution:**
   - Definition, causes, effects and control measures of:
     a) Air Pollution
     b) Water Pollution
     c) Soil Pollution
     d) Marine Pollution
     e) Noise Pollution
     f) Thermal Pollution
     g) Nuclear Hazards
     h) Electronic Waste
   - Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.
   - Role of an individual in prevention of pollution.
   - Pollution case studies.
   - Disaster Management: Floods, Earthquake, Cyclone and Landslides.

3. **Human Population and the Environment**
   - Population growth, variation among nations.
   - Population explosion-Family welfare programme.

- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS.
- Women and child welfare.
- Role of information technology in environment and human health.
- Case studies.
- Road Safety Rules & Regulations**:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs.
- Accident & First Aid**:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance.

4. National Service Scheme

- **Entrepreneurship Development:** Definition & Meaning; Qualities of good entrepreneur; Steps/ ways in opening an enterprise; Role of financial and support service Institutions.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self defense training.

5. Field Visits:

- Visit to a local area to document environmental assets–river/forest/grassland/hill/ mountain.
- Visit to a local polluted site–Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems–pond, river, hill slopes etc.
- Contribution of the student to NSS/any other social cause for service of society.

Note: In this section the students will be required to visit and write on the environment of an area/ ecosystem/vi1lage industry/disaster/mine/dam/agriculture field/waste management/ hospital etc. with its salient features, limitations, their implications and suggestion for improvement.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-1 rDNA Technology A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length
of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT I

DNA Modifying enzymes: Ligases for blunt & sticky end ligation, DNA Polymerases, Klenow fragment, Alkaline phosphatase, Antarctic phosphatase, Polynucleotide kinase, Terminal deoxynucleotidyl transferase, Restriction enzymes, reverse transcriptase. RNase-H, DNase-I, Nuclease S-I

UNIT II

Cloning Vectors for E.coli: features of plasmids and development of plasmids as vector (α-complementation), lytic & lysogenic cycle in Lambda: bacteriophages as vector, Genetic selection (Hfl, Spi) and histochemical selection, genome composition of M13, Cosmids, Phagemids, fosmids.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

UNIT III

Southern & Northern blotting, Hybridization, Merits and demerits of nitrocellulose and nylon membranes (N & N+). Methods of Transformation: $CaCl_2$, electroporation, transfection, micro projectile.

UNIT IV

Labelling of DNA and RNA- Radioactive labeling (Nick Translation, Random Priming, End Labelling), Non-Radioactive labelling (Direct & Indirect non isotopic labeling), Detection systems of labeled probes

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

rDNA Technology (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus

1. Growing of E.coli bacterial culture.
2. Isolation of genomic DNA from bacteria.
3. Spectrophotometric quantification of DNA and determination of purity.
4. Agarose Gel Electrophoresis.
5. Restriction enzyme digestion of the isolated DNA with 6, 5 and 4 cutters.
6. Agarose Gel Electrophoresis of the digested fragments.

Books Recommended:

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-2 Concepts of Plant Tissue Culture

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Plant nutrition, macronutrients and micronutrients and their deficiency symptoms; Plant tissue culture media: types, components and their role.

Unit-II

Physiological functions and biosynthesis of major plant growth regulators such as auxins, cytokinins, gibberllins and abscisic acid.

Unit-III

Totipotency, factors affecting cellular totipotency **,** Cell differentiation, Dedifferentiation and redifferentiation of cells; tissue competency, plant-explant-plant concept. Factors influencing plant tissue culture: Genotypic, physiological, biochemical and other extrinsic factors.

Unit IV

Introduction to Methods of gene transfer - Direct (Biolistics) and indirect (agrobacterium mediated gene transfer)

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Books:

1. Taiz, L. and Zeiger, E. (2002) Plant Physiology, 3rd Edition, Publisher: Sinauer Associates; 3rd edition (Aug. 30, 2002)

2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers

3. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.

4. Smith, R.H. (2000) Plant tissue culture: techniques and experiments, Gulf professional publishing

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Concepts of Plant Tissue Culture (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. To study functions and operations of various instruments required for plant tissue culture (pH meter, autoclave, laminar air-flow, incubators, oven, distillation unit etc).
2. Laboratory design set up for a PTC Laboratory.
3. Cleaning of glassware, plasticware and contaminated cultures.
4. Different types of enclosure used in plant tissue culture. Preparation of cotton plugs.
5. Preparation of stock solutions of Murashige & Skoog (1962) medium.
6. Preparation of Murashige & Skoog's medium from stock solutions.
7. Different sterilization process (Instruments, glassware and thermolabile and thermostable components)
8. Selection, preparation, sterilization and inoculation of explants.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-3 Animal Tissue Culture

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Historical background , Advantages & Disadvantages of animal tissue culture, Design and layout of ATC Lab, Equipments used in ATC Lab, Aseptic Techniques in ATC- Sterilization of culture media, glassware & tissue culture laboratory. Growth and viability of cells in culture, cryopreservation and retrieval of cells from frozen storage, transportation of cells. Characteristics of normal and transformed cells.

Unit- II

Contamination- sources, Types, monitoring and eradication of contamination, Cross Contamination. Safety considerations in ATC laboratory, Clean Environment – P1, P2, P3 facility and their applications.

Unit-III

Culture Media and Reagents-Types of cell culture media, physiochemical properties, balanced salt solution, constituents of serum, serum free media (SFM), design of SFM, Advantages and disadvantages of serum supplemented and serum free media, conditioned media

Unit-IV

Primary culture and Established cell line Culture (Finite & continuous cell lines), Isolation of cells-Enzyme digestion, perfusion and mechanical disaggregation. Culture of attached cells and cells in suspension, phases of cell growth and determination of cell growth data (calculation of *in vitro* age, multiplication rate, population doubling time, cell counting, phases of cell cycle)

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Books Recommended

1. Gareth, E.J. (1996), Human Cell Culture Protocols, Humara Press.
2. Butler, M. (1996), The Animal Cell Culture and Technology, IRL Oxford Univ. Press.
3. Julio, E., Celis (1998), Cell Biology-A laboratory hand book, Vol. I-IV, 2nd ed., Academic Press, New York.
4. Freshney, R, T. (2006), Culture of Animal Cells 5th ed., John Wiley and Sons, New York

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Animal Tissue Culture (Practical)

Time : 3 Hrs. **Max. Marks: 20**

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. Sterilization techniques: Theory and
   Practical -Glass ware sterilization
   -Media sterilization
   -Laboratory Sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium.
5. Isolation of lymphocytes for culturing and perform cell viability test.
6. Isolation of macrophages from blood for culturing

Book Recommended :

1. Freshney, R.T. (2006), Culture of Animal Cells. 5 th ed., John Wiley and Sons, New Delhi.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-4 PATENT LAWS IN BIOTECHNOLOGY

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length
of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Introduction to Patent law. First Indian Patent Law and Amendments, History of Indian Patent System, Patentable and Non Patentable Inventions in India, Requirements and objectives of Patent, Patentable subject matter. Procedure for obtaining patent and patenting agencies in India.

Unit-II

Writing a patent, Formats of application and background information, Provisional and Complete Specifications, Types of patent applications, Life of a Patent, Rights of Patentee, Post Grant Opposition, Infringement of Patent, Patent Cooperation Treaty, Patent Offices in India, Sources of Patent Information, Patent literature search.

Unit - III

Patenting in Biotechnology, economic and depository considerations, TRIPs articles relevant to Biotechnology Sector, Patenting Genes, Gene fragments, SNPs, Proteins and Stem cells, Patents related to Bacteria, Virus, Fungi and medicinal plants.

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Unit IV

Ethical issues in Biotechnology, Types of risk associated with release of genetically modified microorganisms, Ecological impact, Biosafety, environmental and agricultural concerns, Ethics of Human cloning, reproduction and stem cell research, Legal aspects of patenting

Books:

1. Singh, I. and Kaur, B (2010) Patent law and Entrepreneurship, 3rd Edition, Kalyani Publishers
2. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-5 BIOPROCESS ENGINEERING – A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length
of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-1

Introduction:
Fundamental principles of Chemical Engineering and biochemical engineering. Applications of physical and chemical laws on biological samples, enzymatic reaction and simple kinetics.

Unit-II

Microbial Growth Kinetics :
Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, metabolic and biomass productivities.

Unit-III

Internal & external feed back systems, effector molecules and its kinetics, Effect of temperature, pH and inducer on product synthesis.

Unit-IV

Sterilization:
Introduction, air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Books Recommended:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
2. Young, M.Y. (2000), Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
3. Young, M.Y. (1996), Environmental Biotechnology, Principles & Applications, Kluwer Academic Publications, New Delhi.
4. Bailary, J.E. and Ollis, D.F.,(1986), Biochemical Engineering Fundamentals, McGraw Hills, N.Y.
5. S.J. Pirt (1985), Principles of microbes and cell cultivations. Blackwell Scientific Publication, London.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BIOPROCESS ENGINEERING – A (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus

1. To study the growth curve of microorganism.
2. To determine the specific growth rate and generation time of a bacterium during submerged fermentation.
3. Demonstration of sterilization of fermenter and other accessories.
4. To study the effect of temperature, pH and aeration on growth of microbes.
5. Production of an enzyme in a Bioreactor/shaking flask.

Reference Books:

1. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory (Pearson Benjamin Cummings).
2. Plummer D.T. (2004). An introduction to practical biochemistry (Tata McGraw Hill Publishers Co. Ltd., New Delhi).
3. Bansal, D.D., K Hardori, R., Gupta, M.M. (1985). Practical biochemistry (Standard Publication Chandigarh).

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-6 Biophysical and Biochemical Techniques-A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length
of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-I

Centrifugation: Basic principles of sedimentation, theory and applications of preparative and analytical centrifugation, Differential and density gradient centrifugation, Types of centrifugation machines and rotors, Sedimentation co-efficient, Factors affecting sedimentation coefficient, care of rotors.

Unit - II

Chromatography: Partition Coefficient, Theory and Principle of Paper and column chromatography, Two dimensional chromatography, gel exclusion chromatography, Principle and applications of paper, thin layer, ion-exchange and affinity chromatography.

Unit III

Gas Liquid Chromatography, High Performance Liquid chromatography, Fast Protein Liquid chromatography.

Unit IV

Spectroscopy: Basic Principle, Lambert Beer's law, Absorption spectrum, theory & principles of single and double beam UV/Visible spectroscopy, Basic Principle and instrumentation of NMR and ESR

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Books:

1) Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry: Principles and Techniques, Cambridge University Press, U.K.
3) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
4) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Biophysical and Biochemical Techniques (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus.

1. To study **s**edimentation using Swing Out Rotor and Angle Rotor.
2. To study separation of bio-molecules by paper chromatography.
3. To study separation of bio-molecules by thin layer chromatography.
4. Separation of proteins by ion-exchange column chromatography
5. Separation of proteins by affinity column chromatography.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length
of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT – I

1. Energy and Electromagnetic Spectrum
Introduction, electromagnetic spectrum and Units, regions of the spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degree of freedom, Frank Condon Principle, Fluorescence and Phosphorescence.

UNIT – II

II. Ultraviolet and Visible Spectroscopy
The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, Absorption and intensity shifts, Transition probability. Factors affecting λ_{max} Effect of steric hindrance to coplanarity, Solvent Effects.

UNIT – III

III. Infrared Spectroscopy
Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect) of different functional groups. Sampling Techniques.

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

UNIT – IV

IV. Applications of UV and IR Spectroscopy

Applications of UV spectroscopy, Woodward Fieser rules for calculating λ_{max} of conjugated polyenes and α,ß -unsaturated carbonyl compounds. Applications of IR spectroscopy, Absorption of Common functional Groups, Interpretation of simple IR spectra, Finger print Regions. Simple numerical problems based on UV and IR spectroscopy.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M. Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

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BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-A (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Record of IR spectra of diethyl ether, ethyl acetate and butanone and make comparisons.

Synthesis and electronic spectral studies of d-d bands of $[Ni(NH_3)_6]Cl_2$ and $[Ni(en)_3]Cl_2$ complexes. A comparison of their electronics spectra with that of $[Ni(H_2O)_6]Cl_2$ for the calculation of 10 Dq values.

Convert cyclohexnone to cyclohexanol and hydrazine of cyclohexazone. Compare the UV-vis and IR spectra of the products with that of the starting material.

Preparation of $[Fe(py)_4(NCS)_2]$ and its IR characterization.

Take commercial sample of methyl orange and record its UV-vis and flourencence spectra under neutral, acidic and basic medium and make comparisons.

To Verify Beer – Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of given $KMnO_4/K_2Cr_2O_7$ solution.

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BT-8 Term Paper

Max. Marks: 20

(i) On recent advances in Life Sciences using Internet and library based resources. To be presented as hard Copy/CD/Floppy. Viva/ seminar should be conducted by a panel of three internal examiners.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-1 rDNA Technology-B

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT I

Cloning vectors for Eukaryotes (TAC, YAC, BAC, Ti & Ri plasmids), Expression Vectors pET280 , pGEX , role of promoter, cassettes and gene fusion, important components of shuttle vectors.

UNIT II

Overview of cloning, genomic cloning in (Lambda) vector, cDNA cloning: Linker, Adapters, Different strategies for cDNA cloning- self priming and adaptor linker methods.

UNIT III

Principles & applications of PCR, Fundamental concepts & applications of microarray.

UNIT IV

DNA Sequencing: Sanger-Coulson method (chain terminating nucleotides), Maxam-Gilbert method (chemical degradation of DNA), Changing genes: site directed mutagenesis, cassette mutagenes, single primer method, PCR methods of site directed mutagenesis, Phage & plasmid display: selection of mutant peptides.

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rDNA Technology-B (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus

1. Isolation of plasmid DNA
2. Digestion of plasmid with three different restriction enzymes.
3. Preparation of competent cells
4. Transformation of competent cells by $CaCl_2$ method.
5. Confirmation of the transformants for the presence of plasmid.
6. Southern Blotting.

Books Recommended:

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006

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BT-2 Applications of Plant Tissue Culture

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the paper setters/examiners:
Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit I

Micropropagation methods (axillary bud, shoot-tip and meristem culture), Stages of micropropagation, Factors affecting micropropagation and technical problems, Applications of micropropagation, Acclimatization of tissue culture raised plants. Modes of regeneration, Somatic embryogenesis and organogenesis, Types of somatic embryogenesis, Applications of somatic embryogenesis.

Unit II

Haploid and triploid plant production through tissue culture; ovary and ovule culture; embryo culture and rescuing hybrid embryos; somaclonal variations, selection of variant cell lines and its applications.

Unit-III

Protoplast isolation and culture, viability of protoplasts, protoplast fusion, selection of somatic hybrids and cybrids, applications of somatic cell hybridization.

Unit-IV

Cell suspension culture, production of secondary metabolites by plant tissue culture, immobilized plant cell culture, use of bioreactors in secondary metabolite production, transgenic approaches in secondary metabolite production.

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Books:

1. Bhajwani, S.S, & Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.

2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers

3. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

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Applications of Plant Tissue Culture (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

1. Micropropagation and its different steps.
2. Significance of growth hormones in culture medium.
3. Induction of callus from different explants.
4. To study regeneration of shoots/embryos.
5. Raising of cell suspension cultures.
6. Anther culture, ovary culture and embryo rescue.

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BT-3 Animal Biotechnology

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit- I

Commonly used animal cell line, their origin and characteristics (WI-38, MRC-5, IMR-90, TIG 1, HEK-293, 3T3, BHK21-C13, C7, CHO-K1, A-2790, A9, B16, HeLa, A 549), Differentiation of cells, Organ Culture

Unit- II

Transfection methods (calcium phosphate precipitation, DEAE-Dextran- mediated transfection, Lipofection, electroporation,Retroviral infection, Microinjection), Promoters, Expression vectors and detection of transgenics, need to express proteins in animal cells.

Unit- III

Applications: Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; Bioreactors for large scale culture of cells; micro carrier cultures; Stem cells-characterization of embryonic stem cells & their plications.

Unit-IV

Genetic Engineering in Animal Cells: Genetic engineering in production of regulatory proteins, blood products, vaccines and hormones; Transgenic animals (Mice, rabbit, Cattle, goat, sheep, pigs, Fish), Animal cloning- IVF & embryo transfer

Books Recommended :

1. Butler, M. (1991), Mammalian Cell Biotechnology – A Practical Appproach, IRL, Oxford University Press.
2. Wolff, J.E.D. (1993): Gene Therapeutics Birkhuser
3. Rasko, I., and Downes, C.S. (1995). Genes in Medicine, Champan & Hall
4. Maulik, S. and Patel, S.D. (1997). Molecular Biotechnology Therapeutic Application and Strategies, John Wiley & Sons.

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Animal Biotechnology (Practical)

Time : 3 Hrs **Max. Marks: 20**

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus

1. DNA isolation from blood

2. Spectrophotometric quantification of isolated DNA.

3. Resolving DNA on Agarose Gel.

4. Isolation of RNA from blood.

5. Separation and purification of IgG antibodies from Serum using protein A column.

6. Maintenance of a cell line and check doubling time.

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BT-4 Intellectual Property Rights and Enterepreneurship

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.
Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.
Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit I

Intellectual Property, Introduction to Intellectual Property Rights (IPR), History of IPR in India, Benefits, Problems and Management of IPR, Different forms of protection under IPR: Trade secret, Patents, Plant Breeder Rights and Copyright, Trademark and Geographical indications.

Unit II

Intellectual property and its legal protection in research, design and development, World Trade Organization and its related intellectual property provisions, General Agreement on Tariffs and Trade (GATT), Principles and objectives of GATT, Principles, objectives, structure and functions of WTO

Unit III

Trade related Investment Measures (TRIMs), Trade related aspects of IPR (TRIPS), TRIPS agreement, objectives and principles, Most Favored Nation (MFN) Principle, Berne convention, Budapest Treaty, International depository authorities, World Intellectual Property Organisation (WIPO)

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Unit IV

Entrepreneurship, Characteristics of entrepreneur, Selection of a product line, design and development processes, Plant layout and design, Demand for a given product, Financing of Enterprise, Capital structure, Project inspection

Books:

1. Singh, I. and Kaur, B (2010) Patent law and Entrepreneurship, 3rd Edition, Kalyani publishers
2. Ahuja, V.K (2007) Law Relating to Intellectual Property Rights, 1st Edition

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-5 BIOPROCESS ENGINEERING – B

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

Unit-1

Design of a Fermenter:
Introduction, fermenter for microbial, animal & plant cell culture, Aseptic operation of fermenter, impeller and spargers, batch, fed batch, C.S.T.B.R, plug flow and air loop bioreactors and its kinetics.

Unit-II

Control and measurement equipments of fermenter, pH & D.O. probes, Operation and agitation and its kinetics.

Unit-III

Down Stream Processing: Introduction, removal of microbial cells and other solid matters. Foam separation, filtration, industrial filters and its principles, centrifugation and industrial centrifuges, cell disruption, aqueous two phase extraction system, super critical fluid extraction, whole broth processing.

Unit-IV

Effluent treatment, aerobic and anaerobic slug treatment process, fermentation economics.

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BIOPROCESS ENGINEERING – B (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Students will go for two week training in fermentation technology in industry/institute and the students will be required to submit written report of their training which will be evaluated by the teacher who has taught theory course.

Books Recommended:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
2. Young, M.Y. (2000), Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
3. Young, M.Y. (1996), Environmental Biotechnology, Principles & Applications, Kluwer Academic Publications, New Delhi.
4. Bailary, J.E. and Ollis, D.F.,(1986), Biochemical Engineering Fundamentals, McGraw Hills, N.Y.
5. S.J. Pirt (1985), Principles of microbes and cell cultivations. Blackwell Scientific Publication, London.

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BT-6 Biophysical and Biochemical Techniques- B

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

Mass spectroscopy: Ionization methods and Analyzers, MALDI TOF and MALDI Q, Applications of mass spectroscopy in biology for qualitative and quantitative determination of bio-molecules, Introduction to fluorescence spectroscopy

UNIT-II

Electrophoresis: Factors affecting electrophoretic mobility, Types of electrophoresis, Basic principle, theory and application of native, SDS-PAGE and Agarose Gel electrophoresis, Use of solubilizers in electrophoresis.

UNIT III

Introduction to IEF (Iso-electric focusing), Two dimensional gel electrophoresis and capillary electrophoresis, Applications of electrophoresis in biology for isolation of biomolecules based on charge and molecular weight.

UNIT-IV

Radioisotopic Techniques: Basic concepts of radioisotopy, theory and applications of Geiger-Muller tube, solid and liquid scintillation counters, primary and secondary flours. Safety rules for radioisotopic studies.

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Biophysical and Biochemical Techniques -B (Practical)

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus.

1. Qualitative and quantitative analysis of DNA sample
2. Preparation of standard curve of protein
3. Preparation of standard curve of DNA.
4. Casting of vertical and horizontal gels for electrophoresis.
5. Separation of bio-molecules by vertical and horizontal gel electrophoresis

Books:

1) Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
3) Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
4) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
5) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.
6) Slater, R.J.(1990). Radioisotopes in Biology- A Practical Approach, Oxford University Press, NY.
7) Wilson, K and Goulding, K.H. (1991). Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd., Edward Arnold, London.
8) Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
9) Tinoco Kenneth Saur and J.C. Wang. Physical Chemistry: Principles and Applications in Biological Sciences, 3rd edition.

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BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs. **Max. Marks: 40**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

I. Proton Magnetic Resonance spectroscopy (1H NMR)

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.
Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, Anisotropic effect. Spin spin splitting, Coupling constant.

UNIT-II

II. Applications of NMR spectroscopy

NMR spectra with various examples such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene, o-, m-, p- anisidine, o-, m-, p- nitrophenols, acetophenone. Simple numerical of structure elucidation of NMR spectroscopic data.

UNIT- III

III. Mass Spectrometery

Basic Principles Elementary theory. Molecular ions, isotope ions, fragment ions of odd and even electron types, Nitrogen rule, Factors affecting cleavage patterns, simple cleavage, cleavages at a hetero atom, multicentre fragmentations, rearrangements, diels – alder fragmentation, Mc Lafferty rearrangement.

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UNIT- IV

IV. Applications of Mass Spectroscopy

Cleavage associated with common functional groups , Aldehydes, ketones cyclic and acyclic esters, alcohols, olefins, aromatic compounds amines, Interpretation of the spectrum of unknown simple molecules.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M. Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

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BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical

Time : 3 Hrs. **Max. Marks: 20**
Periods: 4
Note: The question paper will be set by the examiner based on the syllabus.

Record the ^{1}H NMR spectra of ethyl acetate and ethyl acetoacetate (in $CDCI_3$ or CCI_4) and show the presence of tautomeric structures.

Preparation of benzillic acid from benzaldehyde. (Green Chemistry Experiment)

Separation of components of spinach using column chromatography.

Prepare *p*-nitroacetanllide and make comparison of ^{1}H NMR spectral data of aniline, acetanilide (starting material) and *p*-nitroacetanillede (product).

Compare the IR and ^{1}H NMR spectra of aspirin and salicyclic acid.

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BT-8

Max. Marks: 20

Educational Tour & Written illustrated reports. Viva should be conducted by a panel of three internal examiners.