

Khalsa College Amritsar

**-An Autonomous College
Affiliated to Guru Nanak Dev University, Amritsar.**

Session 2018-19

Syllabus: Biotechnology

Post-Graduate Department of Biotechnology

CONTENTS

| Class | Page No. |
|---|------------------|
| B. Sc. Biotechnology (Semester I-IV) | 3 - 134 |
| M. Sc. Biotechnology (Semester I-IV) | 135 - 187 |

B.Sc. Biotechnology

Syllabus SEM I to VI (2018-19)

**KHALSA COLLEGE
AMRITSAR**

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

SEMESTER-I

Scheme of Courses

| Sr.No. | Name of the Paper | Total Periods | Theory Marks | Total Periods | Practicals Marks |
|--------|---|---------------|--------------|---------------|------------------|
| | | Per week | (30+10*) | per week | (15+5*) |
| 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 & Bioinformatics | 3 | 40 | 4 | 20 |
| | Fundamentals | | | | |
| BT-6. | Punjabi (Compulsory) OR # ○◆✂✎●✎ □●✎er Π∂✎ OR **Punjab History & Culture | | 50 (37+13*) | | |
| BT-7. | Communication Skills in English-I | | 50 (37+13*) | | |
| BT-8. | General Microbiology-A | 3 | 40 | 4 | 20 |
| BT-9. | Biochemistry - A | 3 | 40 | 4 | 20 |
| | ***Drug Abuse: Problem, Management and Prevention (Compulsory) | | 50 (37+13*) | | |
| | | | ----- | | |
| | | | 380 | | 140 |

Total Marks = 520

Note:

1. *denotes Internal Assessment
2. #Special Paper in lieu of Punjabi Compulsory.
3. **For those students who are not domicile of Punjab
4. ***This paper marks will not be included in the total marks.

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

SEMESTER-II

Scheme of Courses

| Sr.No. | Name of the Paper | Total Periods per week | Theory Marks (30+10*) | Total Periods per week | Practicals Marks (15+5*) |
|--------|--|---------------------------|-----------------------------|---------------------------|--------------------------------|
| 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) #○◆✎✎●✎ □●* ੳIIੲ✎ | OR | 50 (37+13*) | | |
| | **Punjab History & Culture | | | | |
| BT-7. | Communication Skills in English-II | | 50 (37+13*) | | |
| BT-8. | General Microbiology-B | 3 | 40 | 4 | 20 |
| BT-9. | Biochemistry - B | 3 | 40 | 4 | 20 |
| | ***Drug Abuse: Problem, Management and Prevention (Compulsory) | | 50 (37+13*) | | |
| | | | ----- | | |
| | | | 380 | 120 | |
| | | | Total Marks = 500 | | |

Note:

1. *denotes Internal Assesment
2. #Special Paper in lieu of Punjabi Compulsory.
3. **For those students who are not domicile of Punjab
4. ***This paper marks will not be included in the total marks.

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

SEMESTER-III

Scheme of Courses

| Sr. No. | Name of the Paper | Total Periods per week | Theory Marks (32+8*) | Total Periods per week | Practicals Marks (16+4*) |
|--------------------------|---|-----------------------------------|-------------------------------------|-----------------------------------|---|
| 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 (40+10*) | | |
| | | | 280 | | 140 |
| Total Marks = 420 | | | | | |

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

***Denotes internal assesment**

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

SEMESTER-IV

Scheme of Courses

| Sr. No. Name of the Paper | Total Periods per week | Theory Marks (32+8*) | Total Periods per week | Practicals Marks (16+4*) |
|---|-----------------------------------|-------------------------------------|-----------------------------------|---|
| 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 (40+10*) | | |
| | | ----- | | |
| | | 320 | 160 | |

Total Marks = 480

*** denotes internal assesment**

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 | Total Periods per week | Practical Marks (16+4*) |
|--------|---|---------------------------|------------------|---------------------------|-------------------------------|
| | | | Marks (32+8*) | | |
| 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 | 6 | - | - | 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

* Denotes internal assessment (BT-1 to BT-7)

** Denotes no internal assessment in the subject (BT-8)

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

SEMESTER–VI

Scheme of Courses

| Sr. No. | Name of the Paper | Total Periods | Theory Marks | Total Periods | Practical Marks |
|---------|--|---------------|--------------|---------------|-----------------|
| | | per week | (32+8*) | per week | (16+4*) |
| 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

* Denotes internal assessment (BT-1 to BT-4, BT-6, BT-7)

** Denotes no internal assessment in the subject (BT-5 & BT-8)

B.Sc. Biotechnology (Semester-I)
BT - 1
Zoology–A

Theory: 30
Practical: 15
Internal Assessment: 15
Total Marks: 60

Theory

Time: 3 Hrs
Periods/week: 3

Maximum Marks: 30

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 marks.

Unit – I

Digestive System: The alimentary canal and associated glands of 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 Man, structure of human 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: Respiratory system of man. Transport of O₂ and CO₂, Oxygen dissociation of haemoglobin, Bohr effect, chloride shift, Haldane effect, control of breathing.

Unit – IV

Integumentary System: Integument and its derivatives in human.

**B.Sc. Biotechnology (Semester-I)
BT-1**

Zoology–A (Practical)

**Time: 3 Hrs.
Periods/week: 4**

Max. Marks: 15

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

1. Demonstration of osmosis and diffusion.
2. Analysis of food stuff for the presence of starch, protein and fats.
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 man (compound tissues).
7. Visit to clinical laboratory / hospital for demonstration of ECG, ECHO, X-ray, ultrasound, CT-scan and MRI.

Books:

1. Goyal, J.P. (2013). Life Sciences-1. Trueman Book Company, Jalandhar.
2. Kaur, T. et. al., (2007). A textbook of biotechnology, Life Sciences-1. Lakhanpal Publ., Asr.
3. Sobti, R.C. (2005). Introduction to Biotechnology, Part-2, Concepts Tools and Application, Vishal Publishers
4. Sobti, R.C. & Nigam, S.K. (2002). Structural & function biology of chordates, Vishal Publishers, Jalandhar.
5. Sobti, R.C. & Sharma, V.L. (2005). Basics of Biotechnology: Introduction of Life Sciences. Vishal Publishers, Jalandhar.

B.Sc (BIOTECHNOLOGY) SEMESTER-I

BT-2 (Botany – A)

Time: 3 Hours
Credit Hrs.: 3/Week

Max. Marks: 40
Theory: 30; Int. Ass.: 10

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: Very short answer type 8 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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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, self incompatibility.

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*

B.Sc (BIOTECHNOLOGY) SEMESTER-I

Botany– (Practical)

BT-2 (Botany – A)

Time: 3 Hours

Credit Hrs.: 4/Week

Max. Marks: 20

Practical : 15; Int. Ass.: 05

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.

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

Inorganic Chemistry–A

Time: 3 Hrs.

Max.Marks:30+10(Internal Assesment)

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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-Splitting 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, Hund's 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)**

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

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, 3rded.
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 In troduction, Wiley-VCH.

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

Inorganic Chemistry-A (Practical)

Time: 3 Hrs.

Max. Marks: 15+05(Internal Assesment)

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.

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

Organic Chemistry–A

Time: 3 Hrs.

Max.Marks:30+10(Internal Assesment)

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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 Bronsted 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 stereoisomeric 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 (E1 mechanism), stereoselective and antielimination in E2 reactions, the E1 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.

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

UNIT-III

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiral 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 enantiomers, chiral centres other than carbon, prochirality.

UNIT-IV

Functional group transformation by nucleophilic substitution, the bimolecular (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 nucleophilic substitution, carbocation stability and the rate of substitution, by the SN^1 mechanism stereochemistry of SN^1 reactions, carbocation rearrangements in SN^1 reactions, solvent effects, substitution and elimination as competing reactions. The SN^1 - SN^2 continuum.

Books Recommended:

1. R.T. Morrison 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. Roberts 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.

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

Organic Chemistry-A (Practical)

Time: 3 Hrs.

Max. Marks: 15+05(Internal Assesment)

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-I)
2018-19**

BT - 5 Computers & Bioinformatics Fundamentals

Time: 3 Hrs.

Periods: 3

Max. Marks: 40

Theory Marks: 30

Theory Internal Assessment Marks: 10

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section A: 05 very short answer type questions are to be set, minimum 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 05 marks.

Section B: This section will comprise of 8 questions, four from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, two from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

UNIT-I

Computers: General introduction to computers, organization of computers, Computer hardware and software. Data Storage Devices: Primary and secondary Storage devices.

Input/Output Devices: Key-tape/diskette devices, light pen mouse and joystick. Printed Output: Serial, line, page, printers; plotters, visual output; voice response units.

UNIT-II

Introduction to bioinformatics: History, Pairwise and Multiple Sequence Alignment, Gap Penalties, Significance of Sequence Alignment.

Primary and Secondary databases, Online resources of Bioinformatics: Introduction about: NCBI, EBI, DDBJ, ExPasy, PDB, NDB, Motif and domain databases i.e. Pfam, Prosite, SMART. BLAST(Basic Local Alignment Search Tool)

Books Recommended:

1. Norton's P. (2001). Introduction to Computing Fundamental. McGraw Hill Education, New Delhi.
2. Sinha P.K. (2001). Fundamental of Computers. BPB Publication, New Delhi.
3. Jin Xiong.(2006) Essential Bioinformatics. Cambridge University Press.
4. Baxevais B.F. and Quellette F. (2004). Bioinformatics a Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience.

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

Computers & Bioinformatics Fundamentals (Practical)

Time: 3 Hrs.

Total Marks: 20

Practical Marks: 15

Practical Internal Assessment: 05

Periods: 4

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

1. Ms-Office: word, Excel, Power-point
2. Introduction about Various Databases at NCBI, EMBL, DDBJ.
3. GenBank Format, FASTA format etc
4. Basic Local Alignment Search tools (BLAST)

**B.Sc. (BIO-TECHNOLOGY)
SEMESTER-I
pMjwbI (lwzmI)**

smW : 3 GMty
iQaUrI AMk : 37

ieMtrnl

AsY~smYnt : 13

kul AMk: 50

pwT-kRm Aqy pwT-pusqkW

1. **swihq dy rMg** (sMpw. fw. mihl isMG), Bwg pihlw (kivqw Aqy khwxI), rvI swihq pRkwSn, AMimRqsr[
2. **pYrHw rcnw**
3. **pYrHw pVH ky pRSnW dy auqr**[
4. (a) **pMjwbI DunI ivauq** : aucwrn AMg, aucwrn sQwn qy ivDIAW, svr, ivAMjn, sur[
(A) **BwSw vMngIAW** : BwSw dw tkswlI rUp, BwSw Aqy aup-BwSw dw AMqr, pMjwbI aupBwSwvW dy pCwx-icMnH[
5. **mwq BwSw dw AiDAwpn**
(a) pihlI BwSw dy qOr auqr
(A) dUjI BwSw dy qOr auqr

AMk-vMf Aqy prIiKak leI hdwieqW

1. iksy kivqw dw swr jW ausdw ivSw vsqU (do ivcoN ie`k)
7 AMk
2. iksy khwxI dw swr, ausdw ivSw vsqU, khwxI klw jW pwqr auswrI (do ivcoN ie`k) **7 AMk**
3. pYrHw rcnw : iqMn iviSAW ivcoN iksy ie`k au~qy pYrHw ilKx leI ikhw jwvy[**4 AMk**
4. pYrHw dy ky aus bwry cwr pRSnW dy auqr
4 AMk
5. nMbr 5 au~qy idqrI ivAwkrx dy AwDwr 'qy vrxnwqmk pRSn
7 AMk
6. nMbr 6 ivc mwq BwSw dy pihlI BwSw Aqy dUjI BwSw vjoN AiDAwpn, mh`qv Aqy sm`isAwvW bwry cwr pRSn puqCy jwxgy, ijnHW ivco ividAwrQI ny do dw auqr dyxw hovygw[

(4+2)=8

AMk

not: ieMtrnl AsY~smYnt 13 AMkW dI hY, jo kwlj vloN inrDwirq idSw inrdsW Anuswr ienHW AMkW qoN v`KrI hovyGI[ies pypr dy kul AMk 37+13 = 50 hn[

**B.Sc. (BIO-TECHNOLOGY)
SEMESTER-I
mu`FlI pMjwbI
(In Lieu of Compulsory Punjabi)**

smW : 3 GMty

iQaUrI

AMk : 37

ieMtrnl

AsY~smYnt : 13

kul AMk: 50

1. pMjwbI Bwsæw qy gurmuKI ilpI

a) nwmkrx qy sMKyp jwx pCwx : gurmuKI vrxmwlv, A`Kr kRm, svr vwhk (a A e), lgW mwqrW, pYr ivc ibMdI vwly vrx, pYr ivc pYx vwly vrx, ibMdI, it`pI, A`Dk[

A) isKlweI qy AiBAws

12 AMk

2. gurmuKI, AwrQogRwPI Aqy aucwrn : svr, ivAMjn : mu`FlI jwx-pCwx Aqy aucwrn, muhwrnI, lgW mwqrW dI pCwx [

10 AMk

3. pMjwbI sæbd joV : mukqw (do A`KrW vwly sæbd, iqMn A`KrW vwly sæbd), ishwrI vwly sæbd, ibhwrI vwly sæbd, AONkV vwly sæbd, dULYNkV vwly sæbd, lW vwly sæbd, dulwvW vwly sæbd, hoVy vwly sæbd, knOVy vwly sæbd, lgWkr (it`pI, ibMdI, A`Dk) vwly sæbd, Suæ`D-ASu`D[

15 AMk

AMk vMf Aqy prIiKak leI hdwieqW

1. pihly Bwg ivcoN vrxnwqmk pRsæn pu`Cy jwxgy[ijnHW ivcoN iqMn pRsænW dw au~qr dyxw lwjæmI hY[hr pRsæn dy cwr-cwr AMk hn[**(4+4+4) 12 AMk**

2. Bwg dUsw ivcoN do-do nMbr dy pMj pRsæn pu`Cy jwxgy[swry pRsæn lwjæmI hn[**10 AMk**

3. Bwg qIsrw ivcoN iqMn pRsæn pu`Cy jwxgy[ijnHW dy pMj-pMj AMk hn[**15 AMk**

BT-6 Punjab History & Culture (From Earliest Times to C 320)
(Special Paper in lieu of Punjabi compulsory)
(For those students who are not domicile of Punjab)

Time: 3 Hours

Max. Marks: 50

Theory Marks: 37

Theory Internal Assessment Marks: 13

Instructions for the Paper Setters:-

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

1. Physical features of the Punjab and impact on history.
2. Sources of the ancient history of Punjab

Section B

3. Harappan Civilization: Town planning; social, economic and religious life of the India Valley People.
4. The Indo-Aryans: Original home and settlement in Punjab.

Section C

- a) Social, Religious and Economic life during later *Rig* Vedic Age.
- b) Social, Religious and Economic life during later Vedic Age.

Section D

- c) Teaching and impact of Buddhism
- d) Jainism in the Punjab

Suggested Readings

1. L. Joshi (ed): *History and Culture of the Punjab*, Art-I, Patiala, 1989 (3rd edition)
2. L.M. Joshi and Fauja Singh (ed); *History of Punjab* , Vol.I, Patiala 1977.
3. Budha Parkash : *Glimpses of Ancient Punjab*, Patiala, 1983.
4. B.N. Sharma: *Life in Northern India*, Delhi. 1966.

SEMESTER-I
COMMUNICATION SKILLS IN ENGLISH-I

BT-7

Time: 3 Hours

Max. Marks: 50
Theory Marks: 37
Internal Assessment: 13

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) Reading newspaper, articles, editorials etc.
- c) Short questions based on content and development of ideas of a given paragraph.

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

Activities:

- a) Personal and business letters.
- b) Converting a biographical note into a sequenced resume.
- c) Writing notices for circulation/ boards.
- d) Making notes of given passage with headings and sub-headings
- e) Writing newspaper reports based on given heading.

Suggested Pattern of Question Paper:

The question paper will consist of Seven skill-oriented questions from Reading and Writing Skills. The first 6 Questions carry 5 marks each. The 7th Question carries 7 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.

- i) Comprehension questions of an unseen passage.
- ii) Personal letter Official/Business letters.
- iii) Writing notices/agenda/resolution/ minutes for public circulation on topics of professional interest
- iv) Writing resume or converting a biographical note into resume
- v) Writing news report based on a given heading
- vi) Do as directed Articles Units 69-81
Conjunctions Units 113-120 (6 x 5=30 Marks)
- vii) Translation from English to Vernacular (Punjabi/ Hindi) (Isolated Sentences)
(1 x 7=7 Marks)

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press
3. *Murphy's English Grammar* (by Raymond Murphy) CUP

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

BT - 8

General Microbiology–A

Time: 3 Hrs.

Periods: 3

Theory : 30

Int. assessment: 10

Total : 40

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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- Introduction, Nutritional forms of bacteria, Transport mechanisms, Microbial culture media, Sterilization- Basic concept, physical and chemical methods of sterilization.

Unit - II

General Features- Bacteria, fungi, Neurospora, yeast and viruses. Microbes in extreme environments- the thermophiles and alkalophiles, culture collection, Methods of 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.

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

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, London.
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 A (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 15

Int. assessment: 05

Total : 20

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

1. Aseptic techniques of sterilization.
2. Cleaning of glassware.
3. Preparation of media, cotton plugging and sterilization
4. Isolation of micro-organism from air, water and soil samples. Dilution and pour plating, Colony purification.
5. Identification of bacteria by simple staining, negative staining and Gram staining.
6. Detection of specific bacteria by Wet mount preparation method and Hanging drop mount method.

Books Recommended:

1. Cappuccino, J.G. and Sherman, N. (1999). Microbiology: A Laboratory Manual 4th Ed: Harlow, Addition-Wesley.
2. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd.New Delhi.

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

BT - 9

Biochemistry - A

Time: 3 Hrs.

Periods: 3

Theory : 30

Int. assessment: 10

Total : 40

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 marks.

Unit - I

Water and its Properties: Role of water in life, Structure of water molecules, Physico-chemical properties of water, Dissociation and association constants, pH and buffers. pI , pK_a , Hasselbach Hendersson equation and its implications.

Unit - II

Carbohydrates: Introduction, Monosaccharides: Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses, epimers, and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Mutarotation, Structure and functions of Sugar derivatives, Disaccharides; concept of reducing and non-reducing sugars, Haworth projections of maltose, lactose, and sucrose, Structural and functional properties of Polysaccharides: storage polysaccharides - starch and glycogen; Structural Polysaccharides - cellulose, peptidoglycan and chitin.

Unit - III

Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules.

Unit - IV

Structure of nucleosides and nucleotides. Nucleic acid structure –Watson-Crick model of DNA, Structural features of different types of DNA, Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of temperature, acid and alkali on DNA. Structure and functions of biologically important nucleotides as - source of energy, component of coenzymes, second messengers.

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

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.
Periods: 4**

**Practical : 15
Int. assessment: 05
Total : 20**

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.

SEMESTER-I
Drug Abuse: Problem, Management and Prevention
(Compulsory)
Problem Of Drug Abuse

Time: 3 Hours

Max. Marks: 50
Theory Marks: 37; Int ass.: 13

Instructions for the Paper Setters:

Section–A (9 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying three marks. Answer to any of the questions should not exceed two pages.

Section–B (16 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying eight marks. Answer to any of the questions should not exceed four pages.

Section–C: (12 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.

Section – A

Meaning of Drug Abuse:

Meaning, Nature and Extent of Drug Abuse in India and Punjab.

Section – B

Consequences of Drug Abuse for:

| | | |
|------------|---|--------------------------------|
| Individual | : | Education, Employment, Income. |
| Family | : | Violence. |
| Society | : | Crime. |
| Nation | : | Law and Order problem. |

Section – C

Management of Drug Abuse:

Medical Management: Medication for treatment and to reduce withdrawal effects.

Section – D

Psychiatric Management: Counselling, Behavioural and Cognitive therapy.

Social Management: Family, Group therapy and Environmental Intervention.

References:

- Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
- Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
- Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
- Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
- Kessel, Neil and Henry Walton. 1982, *Alcoholism*. Harmond Worth: Penguin Books.

- Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
- National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
- Ross Coomber and Others. 2013, *Key Concept in Drugs and Society*. New Delhi: Sage Publications.
- Sain, Bhim 1991, *Drug Addiction Alcoholism, Smoking obscenity* New Delhi: Mittal Publications.
- Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab: A Sociological Study*. Amritsar: Guru Nanak Dev University.
- Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
- Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation*, Cambridge University Press.
- Verma, P.S. 2017, “*Punjab’s Drug Problem: Contours and Characteristics*”, Economic and Political Weekly, Vol. LII, No. 3, P.P. 40-43.
- World Drug Report 2016, United Nations office of Drug and Crime.
- World Drug Report 2017, United Nations office of Drug and Crime.

B.Sc. Biotechnology (Semester-II)

BT – 1

Zoology–B

Theory: 30

Practical: 15

Internal Assessment: 15

Total Marks: 60

Theory

Time: 3 Hrs

Maximum Marks: 30

Periods/week: 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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 marks.

Unit – I

Urinogenital System: Structure of kidney and nephron, structure 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: Anatomy of brain and cranial nerves of man, Nature, origin and propagation of impulse along the axon, synapse and myoneural junctions. Sense Organs

Unit –IV

Skeletal System: Jaw suspension & visceral arches, (striped, unstriped and cardiac) in man. Ultrastructure, chemical and physiological basis of skeletal muscle contraction.

B.Sc. Biotechnology (Semester-II)
BT – 1
Zoology–B (Practical)

Time: 3 Hrs.
Periods/week: 4

Max. Marks: 15

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

1. Study the following system of white rat 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 human.
4. Analysis of urine for urea, chloride, glucose and uric acid
5. Estimation of urea, uric acid, creatinine and bilirubin from serum.
6. Estimation of protein and bile pigment in urine.

As per UGC guidelines and instructions, the use of live materials is to be avoided and be replaced with models, simulated dissections and slides.

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 (BIOTECHNOLOGY) SEMESTER-II
BT-2 (Botany – B)

Time: 3 Hours
Credit Hrs.: 3/Week

Max. Marks: 40
Theory: 30; Int. Ass.: 10

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: Very short answer type 8 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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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*

Brassicaceae: *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:

Fabaceae: *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 (BIOTECHNOLOGY) SEMESTER–II

Botany– (Practical)

BT-2 (Botany – B)

Time: 3 Hours

Credit Hrs.: 4/Week

Max. Marks: 20

Practical : 15; Int. Ass.: 05

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)

Inorganic Chemistry-B

Time: 3 Hrs.

Max.Marks:30+10 (Internal Assesment)

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 marks.

Unit – I

π-Acid ligands

Carbon monoxide complexes, Two methods of preparation, structural and bonding in (linear MCO groups, polynuclear metal carbonyls carbonyl hydrides and halides). Complexes of N₂, 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, coronands, 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 photosynthesis.

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: 15+05 (Internal Assessment)

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, $\text{Co}(\text{NO}_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis:

Dil H_2SO_4 gp: CO_3^{2-} , 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)

Organic Chemistry–B

Time: 3 Hrs.

Max.Marks:30+10 (Internal Assesment)

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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, nucleophilic ring opening reaction of epoxides, acid catalysed ring opening of epoxides.

Unit -III

Principles of nucleophilic addition to carbonyl groups: Hydration ,acetal formation , cyanohydrin formation ; reaction with primary and secondary amines, Wittig reaction, stereoselective addition to carbonyl groups mechanism of halogenation ,acid and base catalysed chlorination, haloform reaction ,aldolcondensation, conjugate nucleophilic addition to unsaturated carbonyl compounds.

Unit - IV

Mechanism of acid- catalysed esterification, intramolecular ester formation (lactone), Hell-Volhard-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 Dieckmann condensation, acetic ester synthesis, malonic ester synthesis, Michael reaction Reformatsky reaction.

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

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: 15+05 (Internal Assesment)

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-II)
BT-5 Biostatistics

Time: 3 Hrs.

Periods: 3 per week

Max. Marks: 30

Internal assessment: 10

Total: 40

Instructions 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. Five questions are to be attempted. Each question will carry one mark, total weightage being 5 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 3 marks, total weightage being 15 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 5 marks, total weightage being 10 marks.

UNIT-I

Elementary Statistics: The mean, median, mode, standard deviation, variance, covariance of data.

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

Hypothesis Testing: Concept of Null and Alternate Hypothesis, Chi-square test (Goodness of fit and association of attributes).

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

SEMESTER-II
pMjwbI (lwzmI)

smW : 3 GMty

iQaUrI

AMk : 37

ieMtrnl

AsY~smYNT : 13

kul AMk : 50

pwT-kRm Aqy pwT-pusqkW

1. **swihq dy rMg** (sMpw. fw. mihl isMG), Bwg dUjw (vwrqk Aqy ryKw-ic`qr), rvI swihq pRkwSn, AMimRqsr[
2. **Sbd-bxqr Aqy Sbd rcnw** : pirBwSw, muFly sMklp[
3. **Sbd SRyxIAW**
4. **pYrHw rcnw**
5. **pYrHw pVH ky pRSnW dy auqr**
6. **muhwvry Aqy AKwx**

AMk-vMf Aqy prIiKak leI hdwieqW

1. iksy lyK/inbMD dw swr jW ausdw ivSw vsqU (do ivcoN ie`k)
(7 AMk)
2. ryKw icqr : swr, ivSw-vsqU, S^sIAq dy gux
(7 AMk)
3. XUint 3-4 nMbr auqy idqI ivAwkrx dy AwDwr qy vrxnwqmk pRSn
(7 AMk)
5. pYrHw rcnw : iqMn iviSAW ivcoN iksy ie`k au~qy pYrHw ilKx leI ikhw jwvy [
(4 AMk)
6. pYrHw dy ky aus bwry cwr pRSnW dy auqr
(4 AMk)
7. nMbr 7 ivc AAT AKwx Aqy A`T muhwvry puCy jwxgy, ijnHW ivcoN ividAwrQI ny cwr-cwr f vwkW ivc vrq ky ArQ sp`St krny hoxgy[
(4+4 = 8 AMk)

not: ieMtrnl AsY~smYNT 13 AMkW dI hY, jo kwlj vloN inrDwirq idSw inrdySW Anuswr ienHW AMkW qoN v`KrI hovyGI[ies pypr dy kul AMk 37+13 = 50 hn[

SEMESTER-II

mu`FlI pMjwbI

(In Lieu of Compulsory Punjab)

smW : 3 GMty

iQaUrI

AMk : 37

ieMtrnl

AsY~smYnt : 13

kul AMk : 50

pwT-kRm Aqy pwT-pusqkW

1. **pMjwbI sæbd bxqr** : DwqU, vDYqr (Agyqr, mDYqr, ipCyqr),
pMjwbI kosægq sæbd Aqy ivAwkrixk sæbd

12 AMk

2. **pMjwbI sæbd pRkwr** :

a) sMXukq sæbd, smwsI sæbd, dojwqI sæbd, dohry/duhrukqI
sæbd Aqy imsærg sæbd

A) isKlweI qy AiBAws

10 AMk

3. **pMjwbI sæbd rcnw** :

a) ie`k-vcn bhu-vcn, ilMg-puilmG, bhu-ArQk sæbd, smwn-
ArQk sæbd, bhuqy sæbdW leI ie`k sæbd, sæbd joV,
ivroDAwrQk sæbd

A) in`q vrqoN dI pMjwbI sæbdwvli : Kwx-pIx, swkwdwrI,
ru`qW, mhIinAW, igxqI, mOsm, mwrkIt/bwjæwr, vpwr, DMidAW
nwl sMbMiDq[

10+5=15 AMk

AMk vMf Aqy prIiKak leI hdwieqW

1. Bwg pihlW ivcoN cwr pRsæn puCy jwxgy ijnHW ivcoN iqMn
pRsænW dw au~qr dyxw lwjæmI hn[

hr pRsæn dy cwr-cwr nMbr hn [

(4+4+4) 12 AMk

2. Bwg dUsw ivcoN do-do nMbr dy pMj pRsæn pu`Cy jwxgy[swry
pRsæn lwjæmI hn[

10 AMk

3. Bwg qIsrw dy (a) Bwg ivcoN do svwl Aqy (A) Bwg ivcoN ie`k
svwl puiCAw jwvygw[hr pRsæn dy pMj-pMj AMk hn[

10+5=15 AMk

not: ieMtrnl AsY~smYnt 13 AMkW dI hY, jo kwlj vloN inrDwirq
idSw inrdySW Anuswr ienHW AMkW qoN v`KrI hovygI[ies pypr
dy kul AMk 37+13 = 50 hn[

**Punjab History & Culture (C 321 to 1000 A.D.)
(Special Paper in lieu of Punjabi compulsory)
(For those students who are not domicile of Punjab)**

Time: 3 Hours

**Max. Marks: 50
Theory Marks: 37; Int ass.: 13**

Instructions for the Paper Setters:

Section–A (9 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying three marks. Answer to any of the questions should not exceed two pages.

Section–B (16 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying eight marks. Answer to any of the questions should not exceed four pages.

Section–C: (12 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.

Unit I

1. Punjab under Chandragupta Maurya and Ashoka.
2. The Kushans and their Contribution to the Punjab.

Unit II

3. The Panjab under the Gurpta Emperor.
4. The Punjab under the Vardhana Emperors

Unit III

5. Political Developments 17th Century to 1000 A.D. (Survey of Political)
6. Socio-cultural History of Punjab from 7th to 1000 A.D.

Unit IV

7. Development of languages and Literature.
8. Development of art & Architecture

Suggested Readings

1. L. Joshi (ed): *History and Culture of the Punjab*, Art-I, Patiala, 1989 (3rd edition)
2. L.M. Joshi and Fauja Singh (ed); *History of Punjab* , Vol.I, Patiala 1977.
3. Budha Parkash : *Glimpses of Ancient Punjab*, Patiala, 1983.
4. B.N. Sharma: *Life in Northern India*, Delhi. 1966.

**SEMESTER–II
COMMUNICATION SKILLS IN ENGLISH-II**

Time: 3 Hours

**Max. Marks: 50
Theory Marks: 37
Internal Assessment: 13**

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, speech/ lecture and taking notes.

- 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, situation based Conversation in English; essentials of Spoken English

Activities:

- a) Conversation; dialogue and speech
b) Oral description or explanation of a common object, situation or concept.
c) Interviews and group discussion

Suggested Pattern of Question Paper:

The question paper will consist of Seven skill-oriented questions from Reading and Writing Skills. The first 6 Questions carry 5 marks each. The 7th Question carries 7 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.

- i) Making summary/ précis or paraphrasing of an idea of a given passage.
ii) Writing a paragraph of expository or argumentative nature of a given topic.
iii) Interpretation of a given data, chart, diagram etc and making a brief report.
iv) Transcoding (given dialogue to a prose or given prose to dialogue).
v) Draft an Advertisement for a given Product.
vi) Do as directed change of voice Units 42-46 (6 x 5=30 Marks)
vii) Retranslation from Vernacular (Punjabi/ Hindi) to English(Isolated Sentences) (1 x 7 = 7 Marks)

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press
3. *Murphy's English Grammar* (by Raymond Murphy) CUP

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

BT - 8

General Microbiology–B

Time: 3 Hrs.

Periods: 3

Theory : 30

Int. assessment: 10

Total : 40

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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

Viruses-Introduction, Plant and animal viruses-structure and composition, Classification based on differences in their transcription process. Cultivation of plant and animal viruses, Life cycle- Tobacco Mosaic Virus, Herpes simplex and Bacteriophages (Lysogenic and Lytic cycle)

Unit - III

Pathogenic micro-organisms- Factors contributing microbial pathogenicity (Adhesion, Invasiveness and toxigenicity), Natural resistance and Non specific defense mechanism against microorganisms. Introduction, mechanism of action, diagnosis and treatment for viral diseases-Influenza, AIDS and Hepatitis.

Unit - IV

Introduction, mechanism of action, diagnosis and treatment for bacterial diseases-Diphtheria, Tuberculosis, Typhoid. Fungal diseases-Aspergillosis and Candidiasis.

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

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, London.
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.

Periods: 4

Practical : 15

Int. assessment: 05

Total : 20

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

1. Enumeration of microorganism. Total vs viable counts.
2. Personal hygiene-Microbes from hands, tooth-scum and other body parts.
3. Growth curve of micro-organisms.
4. Identification of fungus by and lactophenol staining.
5. Identification of formation of germ tube by *Candida albicans*.

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.
3. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd.New Delhi.

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

BT - 9

Biochemistry - B

Time: 3 Hrs.

Periods: 3

Theory :30

Int. assessment:10

Total :40

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. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 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 5 marks, total weightage being 10 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.

Unit - III

Vitamins: Occurrence, Biomedical importance, Deficiency, of Fat soluble vitamins (A,D,E,K) and water soluble vitamins (Vitamin B complex and Vitamin C), vitamins as cofactor.

Unit - IV

Hormones: Secretory glands, Biomedical importance and disorders related with Steroid hormones (Ovarian, Testicular, Adrenal Cortical and Corpus luteal) and peptide hormones (Hormones of pancreas, hypophysis, parathyroid, GIT), Amino acid Hormones (Thyroidal, Adrenal medullary).

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

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.

Periods: 4

Practical : 15

Int. assessment: 05

Total : 20

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 spectrophotometric 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.

SEMESTER-II

**Drug Abuse: Problem, Management and Prevention
(Compulsory Paper)**

Drug Abuse: Management and Prevention

Time: 3 Hours

**Max. Marks: 50
Theory Marks: 37; Int ass.: 13**

Instructions for the Paper Setters:

Section–A (9 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying three marks. Answer to any of the questions should not exceed two pages.

Section–B (16 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying eight marks. Answer to any of the questions should not exceed four pages.

Section–C: (12 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.

Unit -I

Prevention of Drug abuse:

Role of family: Parent child relationship, Family support, Supervision, Shaping values, Active Scrutiny.

Unit -II

School: Counselling, Teacher as role-model. Parent-teacher-Health Professional Coordination, Random testing on students.

Unit -III

Controlling Drug Abuse:

Media: Restraint on advertisements of drugs, advertisements on bad effects of drugs, Publicity and media, Campaigns against drug abuse, Educational and awareness program

Unit - IV

Legislation: NDPs act, Statutory warnings, Policing of Borders, Checking Supply/Smuggling of Drugs, Strict enforcement of laws, Time bound trials.

References:

1. Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
4. Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
5. Kessel, Neil and Henry Walton. 1982, *Alcoholism*. Harmond Worth: Penguin Books.
6. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.

7. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
8. Ross Coomber and Others. 2013, *Key Concept in Drugs and Society*. New Delhi: Sage Publications.
9. Sain, Bhim 1991, *Drug Addiction Alcoholism, Smoking obscenity* New Delhi: Mittal Publications.
10. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab: A Sociological Study*. Amritsar: Guru Nanak Dev University.
11. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
12. Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation*, Cambridge University Press.
13. Verma, P.S. 2017, “*Punjab’s Drug Problem: Contours and Characteristics*”, Economic and Political Weekly, Vol. LII, No. 3, P.P. 40-43.
14. World Drug Report 2016, United Nations office of Drug and Crime.
15. World Drug Report 2017, United Nations office of Drug and Crime.

B.Sc. BIOTECHNOLOGY (SEMESTER-III)

Physical Chemistry – A

Time: 3 Hrs.

Max.Marks:32+08 (Internal Assessment)

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 enthalpy, 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 C_p and C_v . Internal energy change and enthalpy change in a chemical process. Hess's law of heat summation. Enthalpy of formation, enthalpy of ionisation and calculation of bond dissociation energies from thermochemical data.

Unit-II

Second law of thermodynamics, entropy and Gibbs's free energy, Carnot's cycle, Calculation of entropy change for reversible and irreversible processes under isothermal and non-isothermal conditions. Gibbs-Helmholtz 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 K_p , K_c and K_f . Temperature and pressure dependence of equilibrium constant.

Unit-III

Solutions:

Definition, types of solutions, Molarity, molality, normality, mole fraction, mass fraction, 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)

Physical Chemistry – A Practical

Time: 3 Hrs.

Max. Marks: 16+04(Internal Assessment)

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 Stalgotometer. 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 $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ (in water) and $\text{K}_2\text{Cr}_2\text{O}_7$ (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 standard solution $\text{Na}_2\text{S}_2\text{O}_3$.
7. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

**B.Sc. Biotechnology (Semester–III)
BT - 2
Zoology–C**

**Theory: 32
Practical: 16
Internal Assessment: 12
Total Marks: 60**

Theory

**Time: 3 Hrs
Periods/week: 3**

Maximum Marks: 32

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 an, prophylaxis and treatment, Entamoeba, 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 haemorrhagic 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 occurrence and eradication programmes. General account of drug therapy and drug resistance.

Books:

1. Chatterjee, K.D Parasitology (Protozoology and Helminthology)
2. Harrison A. (2000). Principles of Medicine
3. Sobti, R.C. (1992) Medical Zoology, Shoban Lal Nagin Chand & Co

B.Sc. Biotechnology (Semester–III)

BT-2

Zoology – C Practical

Time: 3 Hrs.
Period/week: 4

Max. Marks: 16

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, Trichomonas, Anopheles, Culex (mouth parts), lice, rat flea, Aedes aegypti, Tapeworm, Ascaris, Wuchereria, Trichinella, Ancylostoma, Oxyuris.
3. Pathological examination of blood and urine.
4. Blood Tests:
 - (a) Erythrocyte sedimentation rate
 - (b) Bleeding time
 - (c) Clotting time
 - (d) Prothrombin time

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT – 3 Biochemistry – III

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 Carolina.
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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. The absorbance curve of two dyes.
2. Determination of reducing sugar using 3,5 dinitrosalicylic acid.
3. Determination of Vitamin C Concentration by Titration.
4. Quantitative estimation of tri glycerides and cholesterol.
5. CMC of detergent and phospholipids.

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. Biotechnology (Semester–III)
BT - 4
Cell Biology – A**

**Theory: 32
Practical: 16
Internal Assessment: 12
Total Marks: 60**

Theory

Time: 3 Hrs

Maximum Marks: 32

Periods/week: 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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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, hot spring, arid, brackish extremophytes and freshwater environments.

Unit – III

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, regulation of receptor expression and function. Signal transduction: General considerations of Cell-matrix and cell - cell interactions.

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

B.Sc. Biotechnology (Semester–III)

BT-4

Cell Biology – A Practical

Time: 3 Hrs.
Periods/week: 4

Max. Marks: 16

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

I. Microscopy:

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

II. Study of Cells:

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

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

B.Sc. BIOTECHNOLOGY (SEMESTER-III)
BT - 5

Basic concepts in Immunology

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 class I and class II molecules, structure and role of class I and class II MHC molecules, structure of T-cell antigen receptors.

Books Recommended:

1. Austyn, J.M. and Wood K.J. (1993), Principles 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. (1996), 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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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. Blood Group testing
5. Separation of serum & Plasma from blood
6. Isolation of mononuclear cells from peripheral blood viability test by dye exclusion method.
7. Collection of blood sample by different 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.
Periods: 3

Theory : 32
Int. assessment: 08
Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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, Monohybrid, dihybrid and trihybrid crosses, Back cross and test cross.

Interaction of Genes: Incomplete inheritance and co-dominance, pleiotropism, 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.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

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.
Periods: 4

Practical : 16
Int. assessment: 04
Total : 20

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. Dermatographics : Palm print taking and finger tip patterns.
7. Preparation and study of mitosis slides from onion root tips by squash method.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT - 7

Agro and Industrial Applications of Microbes – A

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 marks.

Unit-I

Introduction: Basic concept of agriculture and food processing as industry. Differences between microbial industrial processes and chemical industrial processes.

Unit-II

Industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures.

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

Microbial association their interaction with plants, Asymbiotic and symbiotic nitrogen fixation (*Rhizobium*, *Azospirillum*, *Azobacter*, *Anabena*), nitrogen cycle and role of agro bacteria in agriculture or plants.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BT-7

Agro and Industrial Applications of Microbes – A Practical

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. Isolation of microbial cells by serial dilution-spread plate method, pour plate.
2. Measurement of bacterial size.
3. Metabolic Characterization by IMVIC test
4. Alcoholic and Mixed–Acid Fermentation.
5. Starter culture preparation, evaluation and application.
6. Determination of nitrate reduction by bacteria.

SEMESTER–III

ESL–221: ENVIRONMENTAL STUDIES–I (COMPULSORY)

Time: 3 Hrs.

Max. Marks: 50

Theory Lectures: 1½ Hours/ Week

Theory Marks: 40; Int ass.: 10

Section–A: (12 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying four marks. Answer to any of the questions should not exceed two pages.

Section–B: (16 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying eight marks. Answer to any of the questions should not exceed four pages.

Section–C: (12 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 of 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 Resources: 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 warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. 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)

Physical Chemistry – B

Time: 3 Hrs.

Max.Marks:32+08 (Internal Assessment)

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 marks.

Unit-I

Electrochemical Cells:

Electrode potential, 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 junction potential, pH, glass electrode, quinonehydroquinone electrode, Potentiometric titrations.

Unit-II

Chemical Kinetics:

Rate of reaction, rate constant, factors influencing rate of reaction, order, molecularity. Rate equations for 1st order, 2nd order & 3rd 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.

Unit-III

Catalysis:

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.

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

Unit IV

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. Transport number, factors effecting transport number, Ionic velocity, 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. Salt hydrolysis, calculation of hydrolysis constant, Buffer solutions, Buffer index, Buffer capacity universal buffer preparation. Acid base indicators. Theory of acid base indicators. pH change and selection of indicators in different acid base titrations.

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

Physical Chemistry – B Practical

Time: 3 Hrs.

Max. Marks: 16+04(Internal Assesment)

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, NH₄Cl, KNO₃
4. Conductometry:
 - a) Determination of cell constant.
 - b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
 - c) Precipitation titration of Na₂SO₄ vs. BaCl₂.
 - d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH₃COOH.
5. Determination of adsorption isotherm of oxalic acid on charcoal.

B.Sc (BIOTECHNOLOGY) SEMESTER-IV

BT-2 (Botany – C)

Time: 3 Hours
Credit Hrs.: 3/Week

Max. Marks: 40
Theory: 32; Int. Ass.: 08

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: Very short answer type 8 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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 12 marks.

Unit-I

Water relations, osmosis, transpiration, water potential, 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 causal agents, symptoms, epidemiology, 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 (BIOTECHNOLOGY) SEMESTER-IV

Botany– (Practical)

BT-2 (Botany – C)

Time: 3 Hours

Credit Hrs.: 4/Week

Max. Marks: 20

Practical: 16; Int. Ass.: 04

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 Carolina.
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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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 and Isoelectric pH of casein..
4. Determination of fat content in milk.
5. Estimation of blood cholesterol.

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. Biotechnology (Semester–IV)
BT - 4
Cell Biology – B**

**Theory: 32
Practical: 16
Internal Assessment: 12
Total Marks: 60**

Theory

**Time: 3 Hrs
Periods/week: 3**

Maximum Marks: 32

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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, pluripotent 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. Geoffrey, M. (2000). The Cell: A molecular approach 2nd Edition, ASM Press.
3. Lodish, H. Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Darnell, J. (1995).
Molecular Cell Biology 3rd Edition, Scientific American Books Inc.

B.Sc. Biotechnology (Semester–IV)

BT-4

Cell Biology – B Practical

Time: 3 Hrs.
Periods/week: 4

Max. Marks: 16

1. Microtomy:

Introduction of the instrument- its use, care, section cutting and stretching.

2. Preparation of Permanent Slides:

Principles and procedures- Section cutting of tissues and staining of tissues with Haematoxylin/eosin method.

3. Study of permanent slides of various tissues:

Gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.

Books Recommended:

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

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

BT - 5

Immunotechnology

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 parasitic 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, recombinant antigen vaccine, recombinant vector vaccine, synthetic peptide vaccine, multivalent subunit vaccine, DNA Vaccine

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

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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. Preparation of vaccine chart of child, highlighting optional vaccines
2. Haemagglutination assay
3. Haemagglutination inhibition assay
4. Double immunodiffusion test using specific antibody and antigen
5. Line of identity, partial identity and non identity
6. Single 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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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., Chapman 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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 B₁₂, alcohols, wine, beer, cheese, bread, citric acid, penicillins, glutamic acid, cellulases, proteases in leather industries, Biochips.

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

BT-7

Agro and Industrial Applications of Microbes – B Pr actical

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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. Additive and Synergistic effect of two antibiotics on the above microorganism.
3. Minimum inhibitory concentration of a antibiotics for the above microorganism.
4. Plating the milk samples for microbial contamination.
5. MBRT Test for determination of milk quality.
6. Isolation and identification of microbes from spoiled food sample.
7. Determination of Antimicrobial activity of essential oils.

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

BT - 8
Enzymology

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 K_m and V_{max} 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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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 K_m 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.

SEMESTER-IV

ESL-222: ENVIRONMENTAL STUDIES-II (COMPULSORY)

Time: 3 Hrs.

Max. Marks: 50

Theory Lectures: 1½ Hours/ Week

Theory Marks: 40; Int ass.: 10

Section-A: (12 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying four marks. Answer to any of the questions should not exceed two pages.

Section-B: (16 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying eight marks. Answer to any of the questions should not exceed four pages.

Section-C: (12 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/village 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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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.

UNIT III

Southern & Northern blotting, Hybridization, Merits and demerits of nitrocellulose and nylon membranes (N & N+). Methods of Transformation: CaCl₂, 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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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. Restriction enzyme digestion of the isolated DNA with 6, 5 and 4 cutters.
4. Agarose Gel Electrophoresis of the digested fragments.
5. DNA elution from Agarose gel
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

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

BT-2 Concepts of Plant Tissue Culture

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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, gibberellins 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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. Laboratory design set up for a PTC Laboratory.
2. Preparation of stock solutions of Murashige & Skoog (1962) medium.
3. Preparation of Murashige & Skoog's medium from stock solutions.
4. Different sterilization process (Instruments, glassware and thermolabile and thermostable components)
5. Selection, preparation, sterilization and inoculation of explants.
6. Preparation of different enclosures for tissue culture vessels.

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

BT-3 Animal Tissue Culture

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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

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

Animal Tissue Culture (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. Sources of contamination and decontamination measures.
2. Preparation of Hanks Balanced salt solution
3. Preparation of Minimal Essential Growth medium.
4. Isolation of lymphocytes for culturing and perform cell viability test.
5. Isolation of macrophages from blood for culturing

Book Recommended :

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

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

BT-4 PATENT LAWS IN BIOTECHNOLOGY

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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.

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

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 marks.

Unit-1

Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. Types of microbial culture: Batch, Fed batch and continuous culture, Molecular diffusion, Diffusion theory, role of diffusion in bioprocessing, Oxygen transfer methodology in bioreactors and factors affecting oxygen transfer.

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.

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

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.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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

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

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: 16+04(Internal Assessment)

Periods: 4

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

1. To study sedimentation 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

Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs.

Max.Marks:32+08(Internal Assessment)

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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,β -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

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

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

Time: 3 Hrs.

Max. Marks: 16+04(Internal Assessment)

Periods: 4

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

1. Record of IR spectra of diethyl ether, ethyl acetate and butanone and make its comparisons.
2. Synthesis and electronic spectral studies of d-d bands of $[\text{Ni}(\text{NH}_3)_3]\text{Cl}_2$ and $[\text{Ni}(\text{en})_3]\text{Cl}_2$ complexes. A comparison of their electronic spectra with that of $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ for the calculation of $10Dq$ values.
3. Covert cyclohexanone to cyclohexanol and hydrazine of cyclohexanone. Compare the UV-Vis and IR spectra of te products with that of the starting material.
4. Preparation of $[\text{Fe}(\text{py})_4(\text{NCS})_2]$ and its IR characterization.
5. Take a commercial sample of methyl orange and record its UV-Vis and florescence spectra under neutral, acidic and basic medium and make comparisons.
6. To verify Beer-Lambert law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determine the concentration of given $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$

BSC. (BIO-TECHNOLOGY) SEMESTER-V

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 mutagenesis, single primer method, PCR methods of site directed mutagenesis, Phage & plasmid display: selection of mutant peptides.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

rDNA Technology-B (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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 CaCl₂ method.
5. Confirmation of the transformants for the presence of plasmid.
6. Setting up PCR reaction for the amplification of DNA

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–VI)

BT-2 Applications of Plant Tissue Culture

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Applications of Plant Tissue Culture (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-3 Animal Biotechnology

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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

Cell Senescence and Death: Apoptosis and necrosis

Cell Differentiation in Animals: Totipotent, multipotent, pluripotent cell.

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 applications.

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

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Books Recommended :

1. Butler, M. (1991), Mammalian Cell Biotechnology – A Practical Approach, 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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Animal Biotechnology (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

1. DNA isolation from blood by organic method
2. DNA isolation by inorganic method
3. Spectrophotometric quantification of isolated DNA and calculating the yield.
4. Elution of DNA from Agarose Gel electrophoresis.
5. Isolation of RNA from blood.
6. Separation and purification of IgG antibodies from Serum using protein A column.
7. Maintenance of a cell line and check doubling time.

Book Recommended :

1. Butler, M.C. (1991) Mammalian Cell Biotechnology. A practical approach. IRL, Oxford University Press.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-4 Intellectual Property Rights and Enterepreneurship

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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)

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

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.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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

Waste water treatment, aerobic and anaerobic slug treatment process, role of micro organisms in pollution, microbe of sewage and industrial effluent and their safe disposal.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

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.

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

BT-6 Biophysical and Biochemical Techniques- B

Time: 3 Hrs.

Periods: 3

Theory : 32

Int. assessment: 08

Total : 40

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Biophysical and Biochemical Techniques -B (Practical)

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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.

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

Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs.

Max.Marks:32+08(Internal Assessment)

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 3 marks, total weightage being 15 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 4.5 marks, total weightage being 9 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 Spectrometry

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.

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.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

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

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

Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical

Time: 3 Hrs.

Periods: 4

Practical : 16

Int. assessment: 04

Total : 20

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

Synthesis and electronic spectral studies of d-d bands of $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ and $[\text{Ni}(\text{en})_3]\text{Cl}_2$ complexes. A comparison of their electronics spectra with that of $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ 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.

To Verify Beer – Lambert Law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determine the concentration of given $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ solution.

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

Separation of components of spinach using column chromatography.

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

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-8

Max. Marks: 20

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

SYLLABUS FOR

MASTER OF

SCIENCE

IN

BIOTECHNOLOGY

(Two years/Four semesters)

2018-19

Eligibility for M.Sc. in Biotechnology:

Pass with 50% aggregate marks in Bachelor's degree (Medical and allied Medical Sciences / Bio Sciences) or equivalent or relevant higher qualification.

Semester-wise marks distribution/course hours:

| S.No. | Semester | Marks | Course Hours |
|--------------------|----------|-------------|--------------|
| 1. | I | 600 | 27 |
| 2. | II | 625 | 30 |
| 3. | III | 550 | 39 |
| 4. | IV | 425 | 27 |
| Grand Total | | 2200 | 123 |

M. Sc in Biotechnology – Semester-I

| S. No. | Code | Title of Course | Marks | | Total Marks | Periods/week | | Total Periods /week | Course Hours |
|-------------|--------|--|-------------------|-------------------|-------------|----------------------|-----------|---------------------|--------------|
| | | | Theory (75 + 25*) | Practical (19+6*) | | Theory | Practical | | |
| 1 | MBT101 | Introductory Biomathematics and Biostatistics | 100 | - | 100 | 4 | - | 4 | 3 |
| 2 | MBT102 | Cell Biology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 3 | MBT103 | Molecular Biology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 4 | MBT104 | Biochemistry | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 5 | MBT105 | General Microbiology, Microbial Physiology & Biotechnology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| Total Marks | | | | | 600 | Total Periods | | 36 | - |
| | | | | | | Course Hours | | - | 27 |

M. Sc in Biotechnology – Semester-II

| S. No. | Code | Title of Course | Marks | | Total Marks | Periods/week | | Total Periods /week | Course Hours |
|-------------|--------|--|-------------------|-------------------|-------------|----------------------|-----------|---------------------|--------------|
| | | | Theory (75 + 25*) | Practical (19+6*) | | Theory | Practical | | |
| 1 | MBT201 | Environmental Biotechnology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 2 | MBT202 | Immunology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 3 | MBT203 | Biophysical and Biochemical Techniques | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 4 | MBT204 | Genetic Engineering | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 5 | MBT205 | Computer Applications | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| Total Marks | | | | | 625 | Total Periods | | 40 | - |
| | | | | | | Course Hours | | - | 30 |

* denotes Internal Assessment

M. Sc in Biotechnology – Semester-III

| S. No. | Code | Title of Course | Marks | | Total Marks | Periods/week | | Total Periods /week | Course Hours |
|-------------|--------|--|-------------------|--------------------|-------------|----------------------|-----------|---------------------|--------------|
| | | | Theory (80 + 20*) | Practical (20 +5*) | | Theory | Practical | | |
| 1 | MBT301 | Animal Tissue Culture & Animal Biotechnology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 2 | MBT302 | Plant Tissue Culture & Plant Biotechnology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 3 | MBT303 | Enzymology and Enzyme Technology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 4 | MBT304 | Bioprocess Engineering and Technology | 100 | 25 | 125 | 4 | 4 | 8 | 6 |
| 5 | MBT305 | Research Project I | 50** | - | 50 | 20 | - | 20 | 15 |
| Total Marks | | | | | 550 | Total Periods | | 52 | - |
| | | | | | | Course Hours | | - | 39 |

* Denotes internal assessment (MBT-301 to MBT-304)

** Denotes no internal assessment in the subject (MBT-305)

M. Sc in Biotechnology – Semester-IV

| S. No. | Code | Title of Course | Marks | | Total Marks | Periods/week | | Total Periods /week | Course Hours |
|-------------|---|--|-------------------------------|--------------------|-------------|----------------------|-----------|---------------------|--------------|
| | | | Theory (80 + 20*) | Practical (20 +5*) | | Theory | Practical | | |
| 1 | MBT401A Or MBT401B | Genomics and Proteomics Or Introduction to Bioinformatics | 100 | - | 100 | 4 | - | 4 | 3 |
| 2 | MBT402A Or MBT402B Or MBT402C | Medical Biotechnology Or Intellectual property Rights Or Microbial Biotechnology | 100 | - | 100 | 4 | - | 4 | 3 |
| 3 | MBT403 | Educational Tour/Industrial Visit | 50 | - | 50** | - | - | - | - |
| 4 | MBT404 | Research Project II | Thesis: Presentation/Viva: | | 175** | - | 28 | 28 | 21 |
| Total Marks | | | | | 425 | Total Periods | | 36 | - |
| | | | | | | Course Hours | | - | 27 |

* Denotes internal assessment (MBT-401 to MBT-402)

** Denotes no internal assessment in the subject (MBT-403 to MBT-404)

M.Sc. Biotechnology (Semester – I)
Introductory Biomathematics and Biostatistics
Session-2018-19
MBT-101

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section-A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section-E will consist of 10 short answer type questions which cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Unit – A

Binomial Theorem, Pascal rule and Pascal triangle. Scientific notation, significant digits, rounding off. Scientific notation, Sampling, problem identification, designing of experiment, factorial designs: full factorial design, fractional factorial design, concept of population and sample, random sampling, Data collection.

Unit-B

Measures of central tendency, mean, arithmetic mean, geometric mean & harmonic mean, median, mode, quartile, deciles, percentile, dispersion, mean deviation, standard deviation, geometric standard deviation, standard error, coefficient of variation, variance, coefficient of determinant and coefficient of non-determinant, moments, distribution of data, skewness and kurtosis.

Unit-C

Pearson's correlation coefficient, linear correlation and regression, Effect of change of origin and scale on correlation -coefficient, Angle between regression lines, exponential curve. Power function, log-function, Partial correlation.

Unit-D

Probability, Addition and Multiplication law of Probability, Conditional Probability, Probability distribution function, Poisson distribution function, binomial distribution, , standard normal distribution, Testing of hypothesis, Null and alternative hypothesis, Type-I and Type-II errors, level of significance, two tailed and one tailed tests, Z-score, chi-square (χ^2) test, student 't' test, 'F' test, student 't' distribution, chi square (χ^2) distribution, Analysis of variance, ANOVA-one way ANOVA and two way ANOVA.

Books Recommended:

- 1) Kothari, C.R. (2004) Research Methodology Methods and Techniques, New Age International Publications, New Delhi
- 2) P.S.S. Sundar Rao, P.H. Richard, An Introduction to Biostatistics, Prentice Hall of India (P.) Ltd. New Delhi 2003.
- 3) Jerrold H. Zar, Biostatistical Analysis, Tan Prints (I) Pvt. Ltd., New Delhi, 2003.

**M. Sc. Biotechnology (Semester-I)
Cell Biology (Theory)
Session-2018-19
MBT 102**

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION -A

History of cell biology: Development of cell theory, First cell, evolution of metabolism, Present day Prokaryotes and Eukaryotic Cells
Diversity of cell size and shape: General organization of prokaryotic and eukaryotic cells, Development of multicellular organisms
Structural organization: Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems

SECTION -B

Cell biology techniques: Microscopy-light, phase-contrast, fluorescence, confocal, scanning electron microscopy. Use of radioisotopes, cell culture, fractionation of cells contents.
Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle, Growth and characteristics of cell division.
Regulators of cell cycle progression: MPF, families of cyclins and cyclin dependent kinases, Growth factors, cell cycle inhibitors.

SECTION -C

Cell motility: Cilia, flagella of eukaryotes and prokaryotes, their molecular mechanism.
Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

SECTION -D

Cell transport across membranes: Simple Diffusion, Facilitated diffusion, Active transport, Energetics of transport, Mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, neurotransmission and its regulation.

Books Recommended:

- 1) Smith, C.A. and Wood, E.J. (1993). Cell Biology: Molecular and Cell Biochemistry. Chapman & Hall, London.
- 2) Karp, G. (1999). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons Inc., New York.
- 3) Pollard, T.D. and Ernshaw, W.C. (2002). Cell Biology. Elsevier Science (USA)
- 4) Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000). The World of the Cell. The Benjamin/Cummings Publishing Company.
- 5) Cooper, G.M. (2000). The Cell – A Molecular Approach. ASM Press, Washington, D.C.
- 6) Rastogi, S.C. (2005) Cell Biology, New Age International, pp. 532
- 7) Alberts, B., Bray, D., Hopkin, K., Johnson, A.D., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P (2009) Essential Cell Biology, Garland Science, pp 860

M. Sc. Biotechnology (Semester-I)
Cell Biology (Practical)
Session-2018-19
MBT 102

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Microscopic examination of bacteria, yeast and plant cell
2. Preparation of permanent slides of eukaryotic and prokaryotic cell.
3. Study of different stages of mitosis and meiosis.
4. Staining and visualization of different cell organelles.
5. Instrumental methods for cell biology-centrifugation, chromatography.
6. Histochemical techniques.

**M. Sc. Biotechnology (Semester-I)
Molecular Biology (Theory)
Session-2018-19
MBT103**

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

DNA: the vehicle of inheritance, chemical structure & base composition of nucleic acids, A, B and Z- DNA, double helical structures, forces stabilizing nucleic acid structure, super coiled DNA, properties of DNA, nucleic acid hybridization – cot curves.

DNA replication, Repair and Recombination: Replication initiation, elongation and termination in prokaryotes & eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity; DNA repair- photoreactivation, nucleotide and base excision repair, mismatch repair, SOS response, gene amplification, mobile genetic elements.

SECTION –B

Prokaryotic transcription; transcription unit, promoters: constitutive and inducible, initiation, termination- rho dependent and independent. Eukaryotic transcription, promoters for RNA polymerase I, II and III, transcription factors, regulatory elements & mechanism of transcription regulation, post-transcriptional modifications: processing of hnRNA, rRNA & tRNA; 5' cap formation, 3'-end processing, polyadenylation and splicing.

SECTION –C

Genetic code, prokaryotic & eukaryotic translation, the translation machinery, isoaccepting tRNA, wobble hypothesis, mechanism of initiation, elongation & termination, ribosome recycling factor, tm RNA, regulation of translation, co & post translation modification of proteins and intracellular protein targeting import into nucleus, mitochondria and peroxisome, non-ribosomal polypeptide synthesis, prions.

SECTION –D

Regulation of gene expression in prokaryotes and eukaryotes; (operon concept; lac, trp and ara operons), RNA interference, Viral & cellular oncogenes, tumor suppressor genes from humans, structure, function & mechanism of action of p53 tumor suppressor proteins, Molecular mechanism of antisense molecules, ribozymes, applications of antisense & ribozyme technologies.

Books Recommended:

1. Rawn, J. D. (1989). Biochemistry, 2nd edition, Neil Patterson Publications, U. S. A. , North Carolina,
2. Damal, J., Lodish, H., and Baltimore, D. (1990). Molecular Cell Biology, 2nd ed., Scientific American Books, Distributed by W. H. Freeman and Co., New York.
3. 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.
4. Stryer, L. (1995). Biochemistry, 4th ed., W. H. Freeman and Co., New York.
 5. Nelson, D. L. & Cox, M. M. (2005). Lehninger Principles of Biochemistry, 4th ed., Worth Publishers, New York.
 6. Watson J., Baker T., Bell S., Gann A, Levine M and Loscik R. (2008). Molecular Biology of the Gene. 6th Ed. Pearson Education.
 7. Krebs J.E., Goldstein E.S. and Kilpatrick ST (2009), Lewin's Genes, Jones and Bartlett Publishers, U.K.
 8. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume set Cold Spring Harbor Laboratory Press
 9. [James D. Watson](#), [Tania A. Baker](#), [Stephen P. Bell](#), [Alexander Gann](#), [Michael Levine](#), [Richard Losick](#) (2013) Molecular Biology of the Gene (7th Edition) Benjamin Cummings, Publishers.

M. Sc. Biotechnology (Semester-I)
Molecular Biology (Practical)
Session-2018-19
MBT103

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Isolation of genomic DNA from plant tissues.
2. Isolation of genomic DNA from *E. coli* cells.
3. Spectrophotometric analysis of DNA.
4. Restriction digestion of DNA.
5. Separation of digested fragments by agarose gel electrophoresis.
6. Transfer of resolved DNA fragments from agarose gel to nylon/nitrocellulose membrane.
7. Hybridization of nylon/nitrocellulose blots.

Books Recommended:

1. Practical handbook of biochemistry and molecular biology (1989) by Gerald D. Fasman (CRC Press, Taylor and Francis Group).
2. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F. Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press, New York).
3. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume set Cold Spring Harbor Laboratory Press, New York.

M. Sc. Biotechnology (Semester-I)
Biochemistry (Theory)
Session-2018-19
MBT104

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Carbohydrates: Classification, characteristics and functions of monosaccharides, disaccharides- polysaccharides. Epimers, isomers, anomers, chiral carbon atom, chair and boat form, glucopyranose and fructopyranose.

SECTION –B

Amino acids & peptides: Classification, chemical reactions and physical properties
Proteins: Classification of proteins. Primary, Secondary (Alpha helix and beta pleated structure), Tertiary and Quaternary structures of proteins. Disulphide bridges, Ramachandran plot.

SECTION –C

Lipids: Definition and classification of lipids. Fatty acids- General formula, nomenclature and chemical properties structure, function and properties of simple, complex, acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins.
Beta oxidation - Pathway and regulation. Role of acyl carnitine in fatty acyl transport.
Synthesis of fatty acid - Structure and composition of fatty acid synthetase complex, pathway and regulation. synthesis of triacyl glycerides. Ketone bodies - Formation and utilization.

SECTION –D

Nucleic Acids: Structure of nucleoside, nucleotide. De novo and salvage pathways of nucleotide synthesis. Experimental evidence for nucleic acids as genetic material. Secondary structure of DNA, Watson and Crick model of DNA. A, B and Z forms of DNA, T_m and its relation to GC content.

Overview of metabolite pathways: Glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate pathway and gluconeogenesis and their regulation; photosynthesis.

Books Recommended:

1. Stryer, L. (2012). Biochemistry: 7th Edition, W.H. Freeman and Company, New York
2. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2012). Principles of Biochemistry 6th Ed., W.H. Freeman and Company, New York
3. Moran, Horton, Scrimgeour & Perry (2011) Principles of Biochemistry, Prentice Hall.
4. Zubay, G.L., Parson. W.W. and Vance, D.E. (1995). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.

5. Rawn, J.D. (1989). Biochemistry, Neil Patterson Publishers.
6. Bucke C., (1999)), Carbohydrate Biotechnology Protocols, Humara Press.

**M. Sc. Biotechnology (Semester-I)
Biochemistry (Practical)
Session-2018-19
MBT104**

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Theory & Application of Buffers & pH
2. Preparation of buffers: Phosphate buffer and Tris buffer
3. Quantitation of sugars: Anthrone method and Bradford method
4. Protein estimation: Lowry's method
5. Determination of saponification and acid value of fat.
6. Determination of Iodine number of fat.
7. Separation of amino acids by TLC.

Books Recommended:

1. Singh, S.P. (2006) Practical manual of Biochemistry. 6th Edition, CBS publication.
2. Sawhney, S.K. and Randhir Singh (2001). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
3. Plummer D.T. (1998). An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
4. Bansal, D.D., Khardori, R. & Gupta, M.M. (1985). Practical Biochemistry. Standard Publication, Chandigarh.

M. Sc. Biotechnology (Semester-I)
General Microbiology, Microbial Physiology & Biotechnology (Theory)
Session-2018-19
MBT 105

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

Section – A

Principles of Microbiology: Principles and applications of bright field, dark field, phase contrast, fluorescence and scanning tunnelling microscopy.

Methods in Microbiology; pure culture techniques, theory and practice of sterilization, principles of microbial nutrition, microbial culture media, enrichment culture techniques, culture collection, culture purification and preservation methods.

Section-B

Prokaryotic cells: Organelle of microbes and their structure and functions. Cell wall types of Gram-positive and Gram-negative bacteria, capsules, Pili, Fimbriae, flagella. Classification of microorganisms based on their nutritional requirements. Sporulation and regeneration in bacteria. Brief comparison of archaea and eubacteria.

Section – C

Microbial Growth: Definition of growth, mathematical expression of growth, growth curve, diauxic and synchronous growth, effect of temperature, pH (acidity, basicity), oxygen and water availability on growth.

Virology: General characteristics , classification, ultrastructure of virus, viroids. Methods of isolation and purification of virus (T4, Mu, X174, M13 only). Lytic and lysogenic life cycles of virus.

Section- D

Bacterial Genetics: Recombination in bacteria, transformation, transduction, conjugation, plasmids; drug resistance in bacteria, transposons.

Bacterial classification: Bacterial classification according to Bergey's manual, 16S rRNA, % GC ratio, DNA-DNA homology, fatty acid analysis methods of classification.

Books Recommended:

1. Damal, J, Lodish, H. and Baltimore, D. (2007). Molecular Cell Biology, 6th edition, Scientific American Books, Distributed by W.H. Freeman and Co., New York.
2. Lewin, B. (2007). Gene IX, 9th edition, Jones and Bartlett Publishers.
3. Lehninger, Nelson, D. L. & Cox, M. M. (2005). Lehninger Principles of Biochemistry, 4th ed., Worth Publishers, New York.
4. Freifelder, D. (2000). Microbial Genetics, Narosa Publishing House.

5. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2004). *Molecular biology of the gene* (5th Ed.). Pearson Education (Singapore) Pvt. Ltd.
6. Chander, M., Puri, P. (2008). *A Concise course in Microbiology*. Krishna Publishing House. Pvt. Ltd.
7. Prescott, L.M., Harley, J.P. and Klein, D.A. (2011). *Microbiology* (6th Edition). McGraw Hill Inc.
8. Ronald, A.M. (1995). *Principles of Microbiology*. Mosby Year Book Inc. Missouri.
9. Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (2010). *Microbiology: Concepts and Applications*. McGraw Hill, NY.
10. Tortora, G.J., Funke, B.R., Case, C.L. (2012). *Microbiology an Introduction* (11th edition), Benjamin Cummings.

M. Sc. Biotechnology (Semester-I)
General Microbiology, Microbial Physiology & Biotechnology (Practical)
Session-2018-19
MBT105

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. To study the morphology and structural characteristics of different bacteria and fungi using light microscope.
2. To perform serial dilution of the soil sample to isolate bacterial and fungal CFU.
3. To perform the Gram staining of given bacterial samples isolated in above experiment.
4. To evaluate the microbiological quality of potable water by MPN/MTFT method.
5. To isolate bacterial or fungal DNA and purify it by gel electrophoresis.
6. To test for the antibiotic sensitivity of the bacterial sample.
7. To perform the MIC test for antibiotic sensitivity of a bacterial strain against a specific antibiotic.
8. Preservation/cryopreservation of a microbial strain.

Books Recommended:

1. Claus, W.G. and Claus, G.W. (1991). Understanding microbes: Laboratory Text Book for Microbiology, W.H. Freeman Company.
2. Benson, H. J. (1994). Microbiological Applications, 6th ed., Win, C. Brown Publishers, England.
3. Cappucino, J.G. (1999). Microbiology-A laboratory manual, 4th ed., Harlow, Addition-Wesley.

M. Sc. Biotechnology (Semester-II)
Environmental Biotechnology
Session-2018-19
MBT201

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Environmental Pollution and management: Types of pollution including electronic pollution, methods for the measurement of pollution, Air pollution and its control through Biotechnology; sources of water pollution, waste water treatment: physical, chemical and biological treatment processes. Microbiology of waste water treatments, aerobic and anaerobic process. Thin film techniques for waste water treatment using aquatic plants. Role of nanotechnology in environmental pollution control.

SECTION –B

Solid waste management with vermicomposting: Organic waste processing, composting, anaerobic digestion, vermiculture and vermicomposting, essential precautionary steps in vermicomposting, vermiculturing, vermiwash, overall benefits, economics and marketing.

Biomass production and Biofuels: Introduction, plant biomass, sources of biomass, forest biomass, crop residues (cereals, leguminous crops, sugar cane etc.) aquatic biomass, wastes as a source of energy, composition of plant biomass (cellulose, hemicellulose and lignins), biomass conversion, biological and non- biological processes, useful products biomass (ethyl alcohol, methanol, methane), Application and future prospects, Recent trends in biofuel research.

SECTION –C

Biological nitrogen fixation and biofertilizer: The range of nitrogen fixing organisms, biochemistry of nitrogenase, genetics of nitrogen fixation, regulation of *nif* gene expression, symbiotic nitrogen fixation, genetic analysis of *Rhizobium* bacteria, regulation of nod gene expression, transfer of *nif* genes from *Klebsiella pneumoniae* to other organisms, application and future prospects. green manuring, the blue green algae, algalization, *Azolla*, present status and improvements.

SECTION –D

Bioremediation: Types of bioremediation, use of fungi, algae and bacteria in biosorption, ecological considerations, biodegradation of oil spills, surfactants, TNT wastes, dye stuff wastes, insecticides, herbicides, antibiotics. plastic menace, biodegradable plastics, volatile toxic gases and biofiltration.

Books Recommended:

1. Manahan, S. E. (2000), Environmental Science and Technology, Lewis Publishers, New York.

2. Anderson, D. & Conning, D.M. (1984). Experimental Toxicology, Royal Society of Chemistry.
3. Abbasi, S.A., and Ramasami, E. (1999). Biotechnological Methods of Pollution Control. Universities Press, Hyderabad.
4. Alexander, M.(1999). Biodegradation and Bioremediation. Academic Press, San Diego.
5. David, T.G. (1984). Microbial Degradation of Organic Compounds, Marcel Dekkar Inc., New York.
6. Omenn, G.E. (1987). Environmental Biotechnology, Plenum Press, New York.
7. Rittmann, D.E., McCarty, P.L. (2001). Environmental Biotechnology: Principles and Applications. McGraw Hill, New York.

M. Sc. Biotechnology (Semester-II)
Environmental Biotechnology (Practical)
Session-2018-19
MBT-201

| | |
|------------------------|-------------------|
| Practical | : 19 marks |
| Int. assessment | : 06 marks |
| Total | : 25 marks |
| Time | : 3 hours |

1. Determination of potable water quality in terms of coliforms, *Enterobacter*, *Shigella*, *Salmonella* qualitative assay.
2. Determination of BOD of given water/wastewater sample.
3. Determination of COD of given water/wastewater sample.
4. Isolation of *Rhizobium* from root nodule and mass cultivation.
5. Study the technique of vermicomposting.
6. Bioremediation of dyes using different fungi strains from soil.
7. Isolation of xenobiotic degrading microbes by enrichment culture technique.

M. Sc. Biotechnology (Semester-II)
Immunology (Theory)
Session-2018-19
MBT202

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Introduction: Phylogeny of immune System, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, Nature and biology of antigens and super antigens, Antibody structure and function, Antigen-Antibody interactions.

SECTION –B

Major histocompatibility complex, BCR & TCR, generation of diversity, Complement system. Cells of the Immune system: Hematopoiesis and differentiation, lymphocytes trafficking, B-lymphocytes, T- lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cell, eosinophils, neutrophils and mast Cells. Regulation of immune response: Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes, Cytokines and their role in immune regulation, T- cell regulation, MHC restriction, Immunological tolerance.

SECTION –C

Cell- mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. Hypersensitivity. Autoimmunity.

SECTION –D

Transplantation, Immunity to infectious agents (intercellular parasites, helminthes & viruses), Tumor immunology, AIDS and other immunodeficiencies, Hybridoma Technology and Monoclonal antibodies.

Books Recommended:

1. Kubly, J. (2004), Immunology, 5th Edition. W.H. Freeman and Company, New York
2. Roitt, I.M., Brostoff, J., Male, D.K., & Roth, D. (2006). Immunology (7th ed.). The C.V. Mosby Company. St. Louis
3. Murphy, K.M. (2011). Janeway's Immunobiology, 8th Edition (Immunobiology: The Immune System (Janeway)) Garland Science. Taylor and Francis Group.
4. Kanfmann, S.H.E., Sher A., Ahmed, R. (2002). Immunology of Infections Diseases, ASM Press, Washington

5. Strites D.P., Terr. A.I. & Parslow T.G. (1997), Medical Immunology, 9th Ed., PHI, Cambridge.
6. Paul, W./E. (1995), Fundamental Immunology, 3rd Ed., Raven Press, New York
7. Austyn, J.M. and Wood K.J. (1993), Principles of Cellular and molecular Immunology, Oxford University Press Inc. New York.
8. Britch, J.R. and Lennox, E.S. (1995), Monoclonal Antibodies Principles and Application, Wiley Liss.

M. Sc. Biotechnology (Semester-II)
Immunology (Practical)
Session-2018-19
MBT202

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Blood film preparation and identification of cells.
2. R.B.C. Counting.
3. Total leukocyte count & Differential leukocyte count
4. A,B,O Blood group testing
5. Direct and indirect haemagglutination assays.
6. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion method
7. Separation of serum / plasma from blood
8. Double immunodiffusion test
9. Dot Immuno blot assay (DIBA).

Books Recommended:

1. Stevans, C.D. (2009). Clinical Immunology and Serology : A Laboratory Perspective F.A. Davis Company, Philadelphia
2. . Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.
3. Celis, K.E. (1998). Cell Biology: A laboratory handbook. Vol-I Academic Press, U.K.

M. Sc. Biotechnology (Semester-II)
Biophysical and Biochemical Techniques (Theory)
Session-2018-19
MBT 203

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Principles and application of light, phase contrast, fluorescence scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.

Centrifugation: Types of centrifuges and centrifugation, rotors and applications, ultracentrifuge-Analytical and preparative.

SECTION –B

Principles and techniques of nucleic acid: hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and South Western blotting techniques; Polymerase chain reaction. Principles and applications of gel filtration, ion-exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid (HPLC) chromatography

SECTION –C

Principles of biophysical methods used for analysis of biopolymeric structure, X-ray diffraction fluorescence UV/CD, visible NMR and ESR spectroscopy, hydrodynamic methods, Atomic absorption and plasma emission spectroscopy. Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

SECTION –D

Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Brief idea of radiation dosimetry; Cerenkov radiation; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biochemistry; Radiotracer techniques

Books Recommended:

- 1) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
- 2) Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
- 3) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.

- 4) Cooper, T.G (1977). The Tools of Biochemistry, John Wiley & Sons, N.Y.
- 5) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.
- 6) Sadasivam, S. and Manickam, A. (1992). Biochemical Methods for Agricultural Sciences, Wiley Eastern Limited, New Delhi.
- 7) Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Pub.House, New Delhi.
- 8) Plummer, D.T. (1990). An Introduction to Practical Biochemistry 3rd ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- 9) Rana, S.V.S (2008) Bio-Techniques, Rastogi publications

M. Sc. Biotechnology (Semester-II)
Biophysical and Biochemical Techniques (Practical)
Session-2018-19
MBT 203

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Isolation of DNA and protein from biological samples.
2. Estimation of DNA and protein by Spectrophotometer
3. Preparation of standard curve of protein by Bradford method.
4. Electrophoresis of proteins-Native and denaturing PAGE.
5. Ion exchange chromatography of proteins.
6. Affinity chromatography of proteins
7. Thin layer chromatography of biomolecules.
8. Gel permeation chromatography

**M. Sc. Biotechnology (Semester-II)
Genetic Engineering (Theory)
Session-2018-19
MBT204**

Theory : 75 marks
Int. assessment: 25 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes,

SECTION –B

Plasmids; M13 mp vectors; pUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Yeast vectors, Shuttle vectors, siRNA technology.

SECTION –C

Expression strategies for heterologous genes: vector engineering, codon optimization, host engineering, *in vitro* transcription & *in vitro* translation, expression in bacteria, expression in yeast, Inclusion bodies; Methodologies to reduce formation of inclusion bodies.

Linkers; Adaptors; Homopolymeric tailing, strategies for cDNA libraries; Transformation; Northern, Southern and Colony hybridization, Southwestern and Far-western cloning; Phage display

SECTION –D

Cloning differentially expressed genes (mRNA differential display and subtractive cloning). DNA-Protein Interactions (Electromobility shift assay; DNaseI footprinting)

PCR and Its Applications

Primer design; Fidelity of thermostable enzymes (Taq & Pfu polymerases); DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; PCR in gene recombination; SOEing; Site specific mutagenesis; deletion; addition;

Books Recommended:

1. RW old and SB Primrose (2004). Principles of gene manipulation. Black Well Publication.
2. Molecular Cloning; a laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2001, 3rd Edition, reprint 2007.
3. DNA Cloning: A Practical Approach, D.M. Glover and B.D. Hames, IRL Press, Oxford, 1995.
4. Gene cloning and DNA analysis : An introduction by TA brown (5th ed.) 2006 Blackwell Sci. Ltd.

5. Principles of gene manipulations and genomics Primrose & Twyman 2006, Blackwell Sci. Ltd.
6. Molecular Biotechnology (2nd Edn.) S.B. Primrose, Blackwell, Scientific Publishers.Oxford.
7. Hugo A. Barrera-Saldaña (2012) Genetic Engineering - Basics, New Applications and Responsibilities, Publisher: InTech
8. Gene Cloning and DNA Analysis: An Introduction by [T. A. Brown](#) (April, 2013) John Wiley & Sons

M. Sc. Biotechnology (Semester-II)
Genetic Engineering (Practical)
Session-2018-19
MBT204

Practical : 19 marks
Int. assessment: 06 marks
Total : 25 marks
Time : 3 hours

1. Isolation of plasmid.
2. Making competent cells of *E.coli*.
3. Transformation of competent *E.coli* cells.
4. Cloning of foreign DNA insert in plasmid (PET Vector).
5. Isolation of total RNA.
6. Expression of fusion protein (His-tagged/MBD-tagged)
7. PCR.

Books Recommended:

1. Practical handbook of biochemistry and molecular biology (1989) by Gerald D. Fasman (CRC Press, Taylor and Francis Group).
2. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F. Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press, New York).
3. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A Laboratory Manual (Fourth Edition): Three-volume set Cold Spring Harbor Laboratory Press, New York.

M. Sc. Biotechnology (Semester- II)
Computer Applications (Theory)
MBT205

Time: 3 Hours

Total Marks: 100
Theory Marks: 75
Internal Assessment: 25

Instruction for paper setters and candidates

The Question paper will consist of five sections A, B, C and D. Section – A, B, and C will have two questions from the respective section of the syllabus and carry 20 marks each. Section D will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 15 marks in all. Candidate are required to attempt one question each from section A, B and C of the Question Paper and the entire section D.

Section – A

Introduction to digital computer organization, low level and high level languages, the binary number system. Programming techniques. Introduction to internet and its applications.

Introduction to MS-Excel , use of worksheet to enter data , edit data , move data , Use of inbuilt statistical functions for computations of mean, S.D. , Correlation, regression coefficient etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presenting of data. Introduction to various statistical software packages.

Section – B

Introduction to programming in C, Overview , Character set, C Tokens, Keywords, Identifiers, Variables, Constant , Data Types, Comments, Structure of a C. Program Operators & Expression, Types of Operators , Precedence and Associativity, Expression , Statement and Types of statements Built-in functions: printf(), scanf(), getch(), getchar(), putchar(), header files, Pre-processor directives : #include, #define , Control Statements : If, If- else ,Nested If-else, switch ,while, do-while ,for ,Nested for loop ,break ,continue etc.

Section C

Arrays, One Dimensional arrays, Two Dimensional Arrays, storing data into arrays, searching and sorting,function, calling a function, passingarguments, call by reference, call by value, storing and displaying strings, structure & union.

Section –D

Introduction ,characteristics of Database approaches ,Database users, Schemas and Instances, DBMS Architecture and data independence Database language , Introduction to SQL, History , Basic Structure , DDL Commands(CREATE , ALTER ,DROP) , DML Commands (SELECT , INSERT, UPDATE , DELETE), Simple Queries , Aggregate Functions, clauses (WHERE ,JOIN , DISTICT , ORDER BY , GROUP BY, HAVING and UNION).

Books Recommended:

1. Sinha, P.K. (1992), Computer Fundamentals.
2. Norton, P. (2000). Introduction to Computers. Mc Millan, New York.
3. Taxali , R.K. (2002). PC software made simple, TMH.
4. Kanetkar , Y.P. (2004), Let us C ,BPB Publications .
5. SOOD S. , Kumar S. and Maalti (2010) . Programming using C ,Jyoti Book Depot Pvt. Ltd.
6. Gupta , S.C. (2004). Fundamentals of Statistics , Himalaya Publishing House .

M. Sc. Biotechnology (Semester- II)
Computer Applications (Practical)
MBT205

Time: 3 Hours

Total Marks: 25
Practical Marks: 19
Internal Assessment: 06

1. Write programmes to demonstrate conditional statements using c language.
2. Write programme to manipulate matrices.
3. To demonstrate array function.
4. To perform mail merge.
5. Use of Excel and Power Point.

M. Sc. Biotechnology (Semester-III)
Animal Tissue Culture & Animal Biotechnology (Theory)
Session-2018-19
MBT301

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION -A

Concept of aseptic techniques in ATC; design and layout of ATC lab, Equipment for ATC lab. Laboratory safety and Biohazards, balanced salt solution and tissue culture media. Detection of contamination, preservation, storage and shipment of cells. Growth of cells in the serum free hormone(s) supplemented medium, Role of CO₂ in culture medium.

SECTION -B

Dispersion and disruption of tissue, monolayer and suspension culture techniques, measurement of growth and viability of cells in culture, maintenance of cultured cell line, primary and established cell line cultures, cell separation.

SECTION -C

Cell culture characteristics, scale up methods for propagation of anchorage dependent and suspension cell culture, concept of Bioreactors for mass culture of mammalian cells, microcarrier culture. Three dimensional culture system and tissue engineering.

SECTION -D

Cell synchronization, cell transformation, cell immobilization techniques, Cell cloning and micromanipulation, animal cloning.

Books Recommended:

1. Spier, R. R. and Griffiths, J. B. (1990). Animal Cell Biotechnology, Academic Press, London.
2. Gareth, E. J. (1996). Human Cell Culture Protocols, Humana Press.
3. Julio, E., Celis (1998). Cell Biology-A Laboratory Hand Book, Vol. I-IV, 2nd Ed., Academic Press, New York.
4. Butler, M. (2004). Animal Cell Technology, 2nd Ed., BIOS Scientific Publishers, U.K.
5. John M. Davis (2011) Animal Cell Culture: Essential Methods: Publishers Wiley
6. R. Ian Freshney (2012) : A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley and Sons, New York.

**M. Sc. Biotechnology (Semester-III)
Animal Biotechnology (Practical)
Session-2018-19
MBT301**

Practical : 20 marks
Int. assessment: 05 marks
Total : 25 marks
Time : 3 hours

1. Preparation of tissue culture medium
2. Sterilization of medium by membrane filtration technique
3. Preparation of single cell suspension from spleen.
4. Cell counting and cell viability.
5. To obtain monolayers of peritoneal macrophages
6. Trypsinization of monolayer and subculturing.
7. Cryopreservation and thawing.
8. Determination of cell doubling time of a given cell line.

Books Recommended:

1. Culture of Animal Cells, (3rd Edition), R. Ian Freshney. Wiley-Liss.
2. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, OXFORD.
3. Cell Growth and division: A practical Approach. Ed. R. Basega, IRL Press.
4. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd. Oxford.
5. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P Mather and David Barnes. Academic Press.
7. R. Ian Freshney (2012) : A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley and Sons, New York.

M. Sc. Biotechnology (Semester-III)
Plant Tissue Culture & Plant Biotechnology (Theory)
Session-2018-19
MBT 302

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION -A

Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids, History of plant cell culture, Culture media types, Media composition, Plant growth regulators, Gelling agents, Cellular totipotency, Dedifferentiation and Redifferentiation, Callus and cell culture, Organogenesis and embryogenesis.

SECTION -B

Micropropagation methods, stages of micropropagation, types, applications and limitations. Somatic embryogenesis types, protocol, media requirements, embryogenic callus, Embryogenic determined cells (EDCs), advantages and disadvantages of somatic embryogenesis. Applications of propagation techniques in crop improvement. Acclimatization of micropropagated plantlets, Technical problems in PTC. Axillary bud, shoot tip and meristem culture. Embryo culture technique and rescuing hybrid embryos.

SECTION -C

Production of synthetic seed and their applications. Virus free plant production by PTC. Anther and microspore culture, Development of haploid plants, diploidization, applications. Protoplast isolation, culture and fusion, Somatic hybridization, Methods of somatic cell fusion, selection of somatic hybrids, cybrids and their applications. Somaclonal variations, isolation of useful variants at cellular level, Production of disease resistance, herbicide resistance and salt tolerance plants.

SECTION -D

Secondary metabolites production: Methods: Hairy Root Culture, Biotransformation, Plant Cell Immobilization and free cell suspension culture, Applications and Limitations. Production of transgenic plants, Ti plasmids, *Agrobacterium* infection and tumour growth, *Agrobacterium* mediated genetic transformation of plants, Direct DNA transfer methods for genetic transformation, Crop improvement through transgenics and applications of transgenic plant production.

Books Recommended:

- 1) Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlag, Berlin.
- 2) Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1 – 5. McGraw Hill Publishing Company, New York.
- 3) Shaw C.H. (1988), Plant Molecular Biology – A Practical Approach IRL Press Oxford.

- 4) Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
- 5) Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.
- 6) Bhojwani, S.S. and M.K. Razdan (1983), Plant Tissue Culture. Theory and Practice Elsevier science publications Amsterdam.
- 7) Draper J.R. Scott, P. Armitage, R. Walden, (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
- 8) Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
- 9) Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
- 10) Hopkins W.G. (2006) Plant Biotechnology, Infobase Publishing, pp 153

M. Sc. Biotechnology (Semester-III)
Plant Tissue Culture & Plant Biotechnology (Practical)
Session-2018-19
MBT 302

Practical : 20 marks
Int. assessment: 05 marks
Total : 25 marks
Time : 3 hours

- 1) Methods of sterilization.
- 2) Preparation of media-MS (full strength, half strength).
- 3) Filter sterilization of thermo labile components
- 4) Micropropagation.
- 5) Effect of various growth hormones on cell division and cell proliferation
- 6) Callus induction & sub culturing, organogenesis.
- 7) Anther culture technique.
- 8) Acclimatization of tissue culture raised plantlets.

M. Sc. Biotechnology (Semester-III)
Enzymology and Enzyme Technology (Theory)
Session-2018-19
MBT 303

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION -A

Classification and nomenclature of enzymes, enzyme properties and denaturation; Energetics of enzyme catalyzed reactions, transition state; Mechanism of enzyme action; Regulation of enzyme activity; Isoenzymes, co-factors and co-enzyme, Concept of active centre, binding sites, stereospecificity and ES complex formation, activation energy and transition state theory. Effect of temperature, pH and substrate concentration on reaction rate. Extraction, and purification of enzymes.

SECTION -B

Basic aspects of Enzyme Kinetics: Pre-steady state kinetics. Michaelis-Menten, Line Weaver-Burke, Eadie-Hofstee and Hanes-Woolf equations and Km value. Enzyme inhibitors: Types of inhibitors–Reversible and irreversible, their mode of action. Enzyme activity, international units, specific activity, turnover number.

SECTION -C

Regulation of enzyme activity and concentration: Brief account of enzyme induction and repression, covalent modification, isoenzymes and allostery, ribozymes and abzyme. Enzyme specificity, Enzyme substrate complex. Nucleophilic and electrophilic attack. Role of metal ions in enzyme catalysis. Mechanism of enzyme action : Lysozyme, Chymotrypsin, zymogens and enzyme activation.

SECTION -D

Allosteric interactions and product inhibition: Complex kinetics and analysis. Membrane bound Enzymes- Lipid-protein interaction and Effect of fluidity on enzyme activity. Enzymic bioconversions: Starch and sugar conversion processes, Immobilization of Enzymes and their industrial applications.

Books Recommended:

- 1) Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox. 1993. Worth Publishers, New York.
- 2) Palmer, T. (2001). Enzymes. Horwood Publishing, Chichester
- 3) Methods in enzymology Vol.185 (1990) Gene Expression technology edited by D.V. Goeddel (Academic Press Inc. San Diego).

- 4) Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).
- 5) Fundamentals of enzymology: The cell and molecular biology of catalytic proteins (2003) by Nicholas C. Price, Lewis Stevens, Lewis Stevens published (Oxford University Press, USA).
- 6) Principles and reactions of protein extraction, purification, and characterization (2004) edited by Hafiz Ahmed PhD (CRC, Taylor Francis Group).
- 7) Shultz, A.R. (1994). Enzyme Kinetics, Cambridge Press.
- 8) Trevor, P. (1995). Understanding Enzymes, 4th ed. Prentice Hall/Ellis Horwood, England.
- 9) Engel, P.C. (1996). Enzymology Labfax, Bios Scientific Publisher, Academic Press, U.K.
- 10) Price, N.C. and Stevens, L. (1999). Fundamentals of Enzymology, 3rd ed., Oxford University Press.
- 11) Bisswanger, H. (2013) Practical Enzymology, Willey BlackWell

M. Sc. Biotechnology (Semester-III)
Enzymology and Enzyme Technology (Practical)
Session-2018-19
MBT 303

Practical : 20 marks
Int. assessment: 05 marks
Total : 25 marks
Time : 3 hours

1. Extraction and purification of enzymes.
2. Effect of pH on enzyme activity.
3. Effect of temperature on enzyme activity.
4. The effect of enzyme concentration on the rate of enzyme catalyzed reaction.
5. Effect of substrate concentration on enzyme activity and demonstration of the K_m and V_{max} of the reaction.
6. Immobilization of enzymes.

M. Sc. Biotechnology (Semester-III)
Bioprocess Engineering & Technology (Theory)
Session-2018-19
MBT304

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Introduction: Historical development from Petri-plate, shake flask, Lab level bioprocess, pilot level to industrial level bioprocess engineering. Scale up of bioprocesses parameters. Growth parameters, growth rate, specific growth rate and biomass doubling, degree of multiplication, growth yield, $Y_{dx/ds}$, Y_{dx/do_2} , metabolic quotient, effect of substrate concentration on growth rate, Monod growth relation, saturation constants and its importance, biomass estimation.

SECTION –B

Bioreactors type: Introduction, Basic function of a bioreactor, microbial, animal and plant bioreactors. Aseptic operation and contamination. Sterilization of bioreactors, Body construction, Temperature control and measurement. Aeration and agitation, impellers, Stirrer, glands and bearings, packed gland seal, mechanical seal, magnetic drives, Baffles, different types of spargers, different ports, temperature probes. Dissolve oxygen probe. Valves and stream traps : Gate valves, globe valves. Piston valves, needle valves, plug valves, ball valves, butterfly valves, pinch valve, Diaphragm valves, check valves, pressure control valves, pressure reduction and retaining valves, safety valves, steam traps. Bioreactor vessels, Wald hof-type acetators and cavitators, tower bioreactor, cylindroconical vessels, air lift bioreactors, deep jet bioreactor, cyclone column, packed tower, rotating disc bioreactor.

SECTION –C

Mass and Gas transfer in Microbial systems: Introduction, The oxygen requirement for industrial bioreactors, oxygen demand and supply and balance between them, volumetric oxygen transfer, determination of K_La values, sulphite oxidation techniques, gassing out techniques: static method and dynamic method, oxygen balance method. Fluid rheology: Bingham plastic, pseudo plastic, Dilatants, Casson body. Factors affecting K_La values in bioreactors, the effect of medium rheology on K_La values, scale up and scale down of aeration and agitation

SECTION –D

Sterilization

Introduction, medium sterilization, design of batch sterilization process, del factor, sterilization cycle, Richards rapid method for design of sterilization cycles, batch sterilization, scale up of batch sterilization, continuous sterilization, sterilization of feed, sterilization of wastes. Filter sterilization, filter sterilization of media and air, Depth filters design and theory.

Books Recommended:

1. Stansbury, P.F., Whittaker, A. Hall, S.J. Principles of Fermentation Technology 3 Edition. Pergamon Press. 2008.
2. Bailey, J.E., and Olis, D.R. Biochemical Engineering Fundamentals. McGraw Hill.
3. Moo-Young, M. Comprehensive Biotechnology. Vol 1-4.
4. Doran, P.M. Bioprocess Engineering Principles. Academic Press 2011.
5. Michael, L. Shuler and Kargi, F. Bioprocess Engineering: Basic Concepts. Pearson-Prentice Hall. 2009.
6. Crueger, W. and Crueger, A. Biotechnology: a Textbook of Industrial Microbiology. Panima Publishing Corporation.
7. McNeil, B and Harvey, L.M. Fermentation a practical approach. IRL Press (Oxford University Press). 2007.
8. Shijie Liu. Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Reactor Design. Elsevier Sci. Publishers. 2012.
9. Kim Gail Clarke. Bioprocess Engineering: An Introductory Engineering and Life Science Approach. Woodhead Publishing Ltd. 2013.
10. B. Atkinson Biochemical Engineering and Biotechnology Hand Book. MacMillan Press 2009.
11. J.M. Lee. Biochemical Engineering Prentice Hall 2008.

M. Sc. Biotechnology (Semester-III)
Bioprocess Engineering & Technology (Practical)
Session-2018-19
MBT304

Practical : 20 marks
Int. assessment: 05 marks
Total : 25 marks
Time : 3 hours

1. Determination of TDS, pH and conductivity of given wastewater sample after standardization of given probes/instruments.
2. Screening and Isolation of cellulose degrading microbes.
3. Bioremediation of dyes using different fungal/bacterial strain isolated from soil at shake flask level.
4. To study the parts of a bioreactor working and functioning of any bioreactor studied in theory paper by bioreactors assembling and dismantling.
5. Sterilization of fermenter and fermentation media.
6. To characterize and isolate the effluent decolourisation product by TLC/GLC.
7. Determinations of thermal death point (TDP) and thermal death time (TDT) of microbes for designing of sterilization.
8. Study the effect agitation on aeration and determination of KLa volumetric oxygen transfer rate in the bioreactor by dynamic gassing out technique.

M. Sc. Biotechnology (Semester-III)
Research Project I
MBT305

To make the students conversant with latest happening in the field of Biotechnology and to improve their communicational skill, research project with seminars covering latest topics in Biotechnology have been included in the curriculum. Each candidate will select topic for research project and deliver seminar on important recent scientific discovery published in prestigious scientific journals. Presentation of Seminars will carry 25 marks. An objective type common paper of 25 marks on all the seminars will be taken at the end of the session. The question paper will be set and evaluated by a board of three internal examiners.

**M. Sc. Biotechnology (Semester-IV)
Genomics and Proteomics
Session-2018-19
MBT401A**

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Whole genome analysis: Preparation of genomic library in vectors, ordered cosmid libraries, BAC libraries, shotgun libraries, comparative genomes (Arabidopsis, rice and panda)
DNA sequencing: conventional sequencing (Sanger, Maxam and Gilbert), pyrosequencing, next generation sequencing, automated sequencing, translation to large scale projects, epigenomics, cancer genomes.

SECTION –B

FISH, Comparative Genomic Hybridization (CGH), SKY (Spectral Karyotyping).
DNA Microarrays: Chemical DNA synthesis, Printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Fluorescence based assay formats and signal amplification strategies, Analysis of single nucleotide polymorphism using DNA chips.
Gene Identification and Expression Analysis: DNA microarrays, ESTs, SAGE, MPSS.

SECTION –C

Proteome analysis: Two dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Protein microarrays, differential display proteomics, yeast 2-hybrid system, FRET, bimolecular fluorescence complementation assay.

SECTION –D

Advantages and disadvantages of DNA and protein microarrays. Total expression vs functional proteomics, oligosaccharide microarrays for glycomics, pharmacogenomics, introduction to metabolomics.

Books Recommended:

1. Peruski, L.F. Jr. and Peruski, A.H. (1997). *The Internet and New Biology: Tools for Genomic and Molecular Research* ASM.
2. Schena, M.ed. (1999). *DNA Microarrays: A practical approach*. Oxford University Press.
3. Hunt, S. and Livesey, F. ed. (2000). *Functional Genomics: A practical approach*. Oxford University Press.
4. Josip Lovric. (2011). *Introducing Proteomics: From concepts to sample separation, mass spectrometry and data analysis*. Wiley
5. R. Varshney. (2013). *Translational Genomics for Crop Breeding*. Wiley-Blackwell Ltd.

6. Sandy B. Primrose, Richard Twyman (2009). Principles of Gene Manipulation and Genomics, 7th Edition. Wiley.
7. Genomics: Essential Methods (2010). by Mike Starkey (Editor), Ramnath Elaswarapu (Editor). Wiley.
8. Nawin C. Mishra, Günter Blobel (2010). Introduction to Proteomics: Principles and Applications. Wiley
9. Jonathan Pevsner. (2009). Bioinformatics and Functional Genomics, 2nd Edition. Wiley Blackwell.
10. Molecular Analysis and Genome Discovery, 2nd Edition (2011). Ralph Rapley (Editor), Stuart Harbron (Editor). Wiley Sci Publishers.
11. Introduction to Proteomics. (2008). Agnieszka Kraj (Editor), Jerzy Silberring (Editor). Wiley Publishers.

**M. Sc. Biotechnology (Semester-IV)
Introduction to Bioinformatics
Session-2018-19
MBT401B**

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Introduction to Bioinformatics: History of Bioinformatics, milestones, Genome sequencing Projects, Human Genome Project, objectives and applications of Bioinformatics.
Introduction to databases: Type and kind of databases, e.g. PUBMED, MEDLINE
Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISS PROT, INTERPRO, UNIPROT. Genome project TIGR database, SGD, PLASMODB Data format

SECTION –B

Sequence alignment: Scoring matrices, PAM, BLOSUM, Local and global alignment concepts; Dot matrix sequence comparison; Dynamic programming; Needleman-Wunch algorithm, SmithWaterman algorithm;

SECTION –C

Database searches for homologous sequences, FASTA and BLAST, PSSM searching, PSIBLAST and PHI-BLAST, Multiple sequence alignment; Phyllogenetic analysis Motifs and Pattern Databases: PROSITE, Pfam, BLOCKS, PRINTS

SECTION –D

Protein sequence analysis tools, secondary structure prediction, tertiary structure prediction homology modelling, fold recognition, ab initio methods structure visualization and analysis tools, rasmol chimera spdviwer, Structure analysis Structural databases: PDB, PDBsum, NDB etc. SCOP, CATH

Books:

- Cynthia Gibas & Per Jamesbeck, (2000). “ Developing Bioinformatics Computer Skills,” O’ Riley & Associates.
- Campbell and Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
- Bourhe P. E. and Weissig H. (2003). Structural Bioinformatics (Methods of structural Analysis). Wiley-Liss.
- Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
- Wayne W. Danile(2004), Biostatistics: A foundation for Analysis in the Health Sciences, 8th Edition Wiley.

**M. Sc. Biotechnology (Semester-IV)
Medical Biotechnology
Session-2018-19
MBT402A**

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Genetically engineered stem cells in cancer treatment, Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications; Ethical issues

SECTION –B

Immunotherapy: Cancer immunotherapy; Role of cytokine therapy in cancers; Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Clinical transplantation and immunosuppressive therapy; Vaccine development; recombinant vaccines and clinical applications.

SECTION –C

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors

SECTION –D

Genetic markers-Biomarkers in early drug development; Biomarkers in Clinical development; Biomarkers for molecular Diagnostics- example of cancer biomarkers; IVET
Drugs; Types of Drugs - examples of latest drugs; steps in drug designing, HTS, In silico drug designing, structure based drug designing, methods of docking concept of ADME metabolism & Drug Excretion; QSAR; Drug Legislation & safety.

Books Recommended:

- 1) Spier, R.R. and Griffiths, J.B. (1994). Animal Cell biotechnology, 6th Ed., Academic Press, London.
- 2) Krogsgaard-larsen P. , Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U. (2002).

- 3) Text Book of Drug Design and Discovery, Taylor and Francis Publications, Washington D.C. Palson, O.B. and Bhatia, N.S. (2009). Tissue Engineering. Dorling Kindersley (India) Pvt.Ltd.
- 4) Robert L. and other (2009) .Essentials of Stem Cell Biology. 2nd Ed. Academic Press, London.
- 5) Khan, F.A. (2013) Medical Biotechnology, Academic Press, pp 368

**M. Sc. Biotechnology (Semester-IV)
Intellectual Property Rights
Session-2018-19
MBT402B**

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Introduction to intellectual property rights and its different forms.
Ownership of Tangible and Intellectual Property, Farmers Rights, Animal and Plant breeders rights, Brief history of IPR system in India.

SECTION –B

Development of patent system in India. Introduction to Indian Patent law, Basic requirements of patentability, patentable subject matter, Non obviousness, Compulsory licensing, Patent infringements and revocation,

SECTION –C

World Trade Organisation and its related intellectual property provisions, TRIPS agreement, Patent Cooperation treaty, Budapest treaty.
Patent Litigation: Substantive Aspects of Patent Litigation, Procedural Aspects of Patent Litigation

SECTION –D

Recent Development in Patent System and Patentability of Biotechnology invention Special issues in Biotechnology Patents: Disclosure Requirements, Collaborative and competitive research, Challenges for the Indian Biotechnological research and industries.

Reference Books:

Intellectual Property rights in the WTO and Developing countries (2001) by Watal, J. Oxford University Press, New Delhi.

Law Relating to Intellectual Property Rights, 1st Edition(2007) by Ahuja, V.K

Patent law and Entrepreneurship, 3rd Edition, Kalyani publishers (2010) by Singh, I. and Kaur, B

New developments in biotechnology: Patenting life-special report (1990) Office of Technology Assessment (OTA), US Congress (Washington D.C. Dekker).

Draft manual of patent practice and procedure (2008) Patent Office, India.

Intellectual Property Bulletin.

M. Sc. Biotechnology (Semester-IV)
Microbial Biotechnology
Session-2018-19
MBT402C

Theory : 80 marks
Int. assessment: 20 marks
Total : 100 marks
Time : 3 hours

Instructions for paper setters and candidates

The question paper will consist of five sections A, B, C, D and E. Section - A, B, C and D will have two questions from the respective sections of the syllabus and carry 15 marks each. Section - E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt one question each from sections A, B, C and D of the question paper and the entire section E.

SECTION –A

Introduction to microbial technology, Microbial metabolites : Primary & Secondary, microbial applications in food and health care industries. Introduction to microbial genomes, phylogenetic relationships between various genera of microbes- 16SrRNA sequencing and Ribosomal Database project.

SECTION –B

Prokaryotic genome organization, chromids, Bacterial and viral metagenomics, synthetic genomics, microbial sequencing projects, comparative genomics of relevant organisms such as pathogens and non-pathogens, human microbiome project.

SECTION–C

Microbial biofilms, polyketide synthase, antibiotic resistance, extremophiles and extremophilic biocatalysts, lantibiotics, biosynthesis of nanomaterials, probiotics, microbial degradation of xenobiotics, viral enzymes in modern biotechnology and clinical applications.

SECTION –D

Microbial bio-products : penicillin G, Microbial Enzymes : amylases, cellulases, cellobiohydrolase, endoglucanase, cellobiase, β -glucosidase, proteases. Microbial cultures, microbial product recovery. Alcohol biotechnology : Beer, Whisky, and Wine. Microbial culture, fermentation media, microbial bio-processes and product recovery for beer, whisky and wine.

M. Sc. Biotechnology (Semester-IV)

Educational Tour/Industrial Visit

Session-2018-19

MBT403

To enrich students' learning experiences and to help them to acquire practical knowledge about the subject, industrial visits will be arranged by the Department. The students are required to submit written report about the visit at the end of semester. Viva voce will be conducted.

M. Sc. Biotechnology (Semester-IV)
Research Project-II
MBT404

To give the students sufficient experience and proficiency in the research methodology and to enable them to carry out independent research, projects will be assigned to the students as per individual interest and availability of specialized faculty. The project report will be submitted in the form of dissertation. The project will be presented for evaluation at the end of semester and viva voce examination will be conducted.