

Khalsa College Amritsar

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

Session 2021-22

Syllabus: Biotechnology

Post-Graduate Department of Biotechnology

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B.Sc. Biotechnology

Syllabus SEM I to VI (2021-22)

**KHALSA COLLEGE
AMRITSAR**

**B.Sc. BIOTECHNOLOGY (SEMESTER SYSTEM)
Semester- I
Scheme of Courses**

Course No.	Course Title	Total Periods per week	Total Periods per week	Total	Marks
BTL101	Cell Biology	4	0	4	40 (30+10*)
BTP121	Cell Biology Lab	0	4	4	20 (15+5*)
BTL102	Botany-I	4	0	4	40(30+10*)
BTP122	Botany-I Lab	0	4	4	20 (15+5*)
BTL103	Biochemistry-I (Biomolecules)	4	0	4	40(30+10*)
BTP123	Biochemistry-I (Biomolecules) Lab	0	4	4	20 (15+5*)
BTL104	General Microbiology-I	4	0	4	40(30+10*)
BTP124	General Microbiology-I Lab	0	4	4	20 (15+5*)
BTL105	Chemistry-I (Inorganic Chemistry)	4	0	4	40 (30+10*)
BTP125	Chemistry-I (Inorganic Chemistry) Lab	0	4	4	20 (15+5*)
BTL106	Communicative English-I	4	0	4	50 (37+13*)
BTL107	Punjabi Compulsory s OR # ਮੁੱਢਲੀ ਪੰਜਾਬੀ OR **Punjab History & Culture	4	0	4	50 (37+13*)
BTL108	***Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	0	4	50 (37+13*)
	Total Credits	32	20	52	

Total Marks = 400

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. BIOTECHNOLOGY (SEMESTER SYSTEM)
Semester- II
Scheme of Courses**

Course No.	Course Title	Total Periods per week	Total Periods per week	Total	Marks
BTL151	Zoology-I	4	0	4	40 (30+10*)
BTP171	Zoology-I Lab	0	4	4	20 (15+5*)
BTL152	Genetics	4	0	4	40 (30+10*)
BTP172	Genetics Lab	0	4	4	20 (15+5*)
BTL153	Biochemistry-II (Bioenergetics and Enzymology)	4	0	4	40 (30+10*)
BTP173	Biochemistry-II (Bioenergetics and Enzymology) Lab	0	4	4	20 (15+5*)
BTL154	General Microbiology-II	4	0	4	40 (30+10*)
BTP174	General Microbiology-II Lab	0	4	4	20 (15+5*)
BTL155	Biomathematics and Biostatistics	4	0	4	40 (30+10*)
BTL156	Communicative English-II	4	0	4	50 (37+13*)
BTL157	Punjabi Compulsory OR #ਮੁੱਢਲੀ ਪੰਜਾਬੀ OR **Punjab History & Culture	4	0	4	50 (37+13*)
BTL158	***Drug Abuse : Problem, Management and Prevention (Compulsory Course)	4	0	4	50 (37+13*)
	Total Credits	32	16	48	

Total Marks 380

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

Course No.	Course Title	Total Periods per week	Total Periods per week	Total	Marks
BTL201	Fundamentals of biotechnology	4	0	4	40 (30+10*)
BTP221	Fundamentals of biotechnology Lab	0	4	4	20 (15+5*)
BTL202	Immunology-I	4	0	4	40 (30+10*)
BTP222	Immunology-I Lab	0	4	4	20 (15+5*)
BTL203	Chemistry-II (Organic)	4	0	4	40 (30+10*)
BTP223	Chemistry-II (Organic) Lab	0	4	4	20 (15+5*)
BTL204	Botany-II	4	0	4	40 (30+10*)
BTP224	Botany-II Lab	0	4	4	20 (15+5*)
BTL205	Biochemistry-III (Metabolism of Carbohydrates and Lipids)	4	0	4	40 (30+10*)
BTP225	Biochemistry-III (Metabolism of Carbohydrates and lipids) Lab	0	4	4	20 (15+5*)
BTL206	Molecular Biology	4	0	4	40 (30+10*)
BTP226	Molecular Biology Lab	0	4	4	20 (15+5*)
ESL-221	Environmental Studies-I (Compulsory Paper)	4	0	4	50***
	Total Credits	28	24	52	

Total Marks= 360

***Denotes internal assesment**

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

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

SEMESTER-IV

Course No.	Course Title	Total Periods per week	Total Periods per week	Total	Marks
BTL251	Industrial Biotechnology-I	4	0	4	40 (30+10*)
BTP271	Industrial Biotechnology-I Lab	0	4	4	20 (15+5*)
BTL252	Immunology-II	4	0	4	40 (30+10*)
BTP272	Immunology-II Lab	0	4	4	20 (15+5*)
BTL253	Biochemistry-IV (Metabolism of Proteins and Nucleic acid)	4	0	4	40 (30+10*)
BTP273	Biochemistry-IV (Metabolism of Proteins and Nucleic Acid) Lab	0	4	4	20 (15+5*)
BTL254	Skill Development in Biotechnology	4	0	4	40 (30+10*)
BTP274	Skill Development in Biotechnology Lab	0	4	4	20 (15+5*)
BTL255	Fundamental of Bioinformatics	4	0	4	40 (30+10*)
BTP275	Fundamental of Bioinformatics Lab	0	4	4	20 (15+5*)
BTL256	Zoology-II	4	0	4	40 (30+10*)
BTP276	Zoology-II lab	0	4	4	20 (15+5*)
BTP277	Industrial/Institutional Visit	-	-	-	20**
ESL222	Environmental Studies-II (Compulsory Paper)	4	0	4	50***
	Total Credits	28	24	52	

Total Marks=380

*** Denotes internal assessment**

**** Denotes no internal assessment in the subject (BTP277)**

*****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	Theory	Total Periods	Practical
		per week	Marks (30+10*)	per week	Marks (15+5*)
BT-501.	rDNA Technology -A	3	40	4	20
BT-502.	Concepts of Plant Tissue Culture	3	40	4	20
BT-503.	Animal Tissue Culture	3	40	4	20
BT-504.	Patent Laws in Biotechnology	3	40		
BT-505.	Bioprocess Engineering - A	3	40	4	20
BT-506.	Biophysical and Biochemical Techniques – A	3	40	4	20
BT-507.	Physical, Organic & Inorganic aspects of Spectroscopy- A	3	40	4	20
BT-508.	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		<hr/> 280 <hr/>		<hr/> 140 <hr/>

Total Marks = 420

* denotes internal assessment (BT-501 to BT-507)

** Denotes no internal assessment in the subject (BT-508)

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	(30+10*)	per week	(15+5*)
BT-601. rDNA Technology –B	3	40	4	20
BT-602. Applications of Plant Tissue Culture	3	40	4	20
BT-603. Animal Biotechnology	3	40	4	20
BT-604. Intellectual Property Rights And Enterepreneurship	3	40	-	-
BT-605. Bioprocess Engineering – B	3	40		20**
BT-606. Biophysical and Biochemical Techniques – B	3	40	4	20
BT-607. Physical, Organic & Inorganic Aspects of Spectroscopy- B	3	40	4	20
BT-608. Educational Tour & Written illustrated Reports. Viva should be conducted				20**
		280		140

Total Marks = 420

* Denotes internal assessment (BT-601 to BT-604, BT-606, BT-607)

** Denotes no internal assessment in the subject (BT-605 & BT-608)

B.Sc. Biotechnology (Semester-I)
BTL101
Cell Biology

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

Theory

Time: 3 Hrs

Maximum Marks: 30

Periods/week: 4

Note for the paper setters/examiners:

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

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.

Section-B

Structure and function of cell organelles, ultrastructure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.), Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Section-C

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).

Section-D

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

Books Recommended:

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

B.Sc. Biotechnology (Semester-I)
BTP121
Cell Biology Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

1. Study of Cells:
 - (a) Prokaryotic cells: Lactobacillus, E. coli. Blue green algae.
 - (b) Eukaryotic cells: Testicular material (for studies of spermatogenesis)
2. 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.
3. Preparation of Permanent Slides: Principles and procedures- Section cutting of tissues and staining of tissues with Haematoxylin/eosin method.
4. Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).
5. Preparation of Buccal Smear for microscopic examination.
6. Barr body observation in human squamous epithelial cells.
7. Microtomy of Plant Tissue specimens (Stem & Root)

Books Recommended:

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

B.Sc (BIOTECHNOLOGY) SEMESTER-I

BTL102 Botany-I

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Diversity in plants: General characters of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Concepts of species and hierarchical taxa, biological nomenclature.

Section-B

Anatomy of flowering plants: Meristems, simple and complex permanent tissues, internal structure of stem, root and leaf, secondary growth in stem and root of *Helianthus*.

Section-C

Reproduction in flowering plants: Structure and development of anther and male gametophyte, Structure and development of ovule and female gametophyte; Pollination (self and cross) and fertilization; structure and function of endosperm and embryo (dicot and monocot), polyembryony, self-incompatibility.

Section-D

Taxonomy of flowering plants: Artificial (Linnaeus), natural (Bentham & Hooker) and phylogenetic (Engler and Prantl) systems of classification; Terminology pertaining to floral description, General characteristics (including economic importance) of following families of angiosperms; giving examples of few important genera: Solanaceae: *Solanum/Petunia*, Rutaceae: *Citrus, Murraya*, Cruciferae- *Brassica*, Apiaceae (Umbelliferae) – *Coriander*, Asteraceae - *Helianthus*, Leguminosae –*Cassia/Acacia/Sweet pea*, Poaceae (Graminae)- *Triticum*

B.Sc (BIOTECHNOLOGY) SEMESTER-I

Books Recommended:

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press, California, USA.
2. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H.Freeman and Co., Worth Publishers, New York.
3. Rudall, P. J. (2007). Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition). Cambridge University Press, UK.
4. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
5. Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Vashistha, P. C. (2016). Botany for degree students. S. Chand and Company, New Delhi

Botany– (Practical)
BTP-122 Botany – 1 Lab

Time: 3 Hours
Periods/week: 4

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 stem, root and leaf in *Helianthus* and maize plant.

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 Unit IV of the theory paper

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

BTL-103
Biochemistry-I (Biomolecules)

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

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, pKa, Hasselbach-Henderson equation and its implications.

Section-B

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 monosaccharide 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, and chitin; Heteropolysaccharides: Peptidoglycan, Proteoglycan, glycoproteins

Section-C

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

Section-D

Proteins: Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organization of proteins (Primary, Secondary, Tertiary, Quaternary, A310 and domain structure, protein classification and function. Forces stabilizing Primary, Secondary and Tertiary protein structures

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

**BTP123
Biochemistry-I (Biomolecules) Lab**

**Time: 3 Hours
Periods/week: 4**

**Max. Marks: 20
Practical : 15; Int. Ass.: 05**

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

1. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
2. Determination of pKa value of P-nitrophenol
3. Estimation of carbohydrate in given solution by anthrone method.
4. Study the presence of reducing/non-reducing sugar in biological samples.
5. Protein estimation by Lowry's method
6. Protein estimation by Bradford method.
7. Protein estimation by Biuret method.
8. The determination of acid value of a fat.
9. The determination of saponification value of a fat

Books Recommended:

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

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

**BTL104
General Microbiology-I**

**Time: 3 Hours
Periods/week: 4**

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

Note for the paper setters/examiners:

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

Introduction to Microbiology- Historical Perspective and Important discoveries related to Microbiology. Relationship between Microbiology and Biotechnology- The Microbial Biotechnology. General Features- Bacteria, Fungi, Neurospora, Yeast and Viruses. Microbes in extreme environments- the thermophiles, halophiles, acidophiles, psychrophiles and alkalophiles.

Section-B

Basic concept of Microbial growth & culture media and its components, Sterilization- Basic concept, physical and chemical methods of sterilization. Bacterial nutrition- Introduction, Nutritional forms of bacteria, Basic concept of Transport mechanisms of nutrients across microbial cell membranes.

Section-C

Principles and application of bright field, dark field phase contrast, fluorescence & immunofluorescence, electron microscopy. Gram positive and Gram negative bacteria. Nature of the Microbial Cell Surface and Structure and anatomy of bacterial cell walls, Types of bacterial flagella. Different types of bacterial staining.

Section-D

Bacterial Classification: Bacterial classification and taxonomy based on Bergey's Manual of Determinative bacteriology- General outline only. An introduction to Bacterial Serotypes. Microbial culture collection centres, Methods of Microbial preservation.

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. Chander, M. And Puri, P. (2008). A Concise Course in Microbiology. Krishna Brothers Publishers, Old Railway Road, Jalandhar.
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)

**BTP124
General Microbiology-I Lab**

**Time: 3 Hours
Periods/week: 4**

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

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)

BTL105
Chemistry-I (Inorganic Chemistry)

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Introduction, Werner's coordination theory, naming of co-ordinate complexes. Co-ordination numbers 1-12. Factors affecting co-ordination numbers and stereo-chemistry, Isomerism in coordination compounds.

Section-B

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory.

Section-C

Stability of co-ordination compounds
Introduction Factors affecting the stability of metal ion complexes with general ligands
Alkali metal and alkaline earth metal chelators : Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers & cryptands.

Section-D

Crystal field theory-Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculations of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the $10 Dq$ value.
Spectroscopic terms for d^1 - d^2 electronic configurations.

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4. Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH

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

BTP125

Chemistry-I (Inorganic Chemistry) Lab

Time: 3 Hours

Max. Marks: 20

Periods/week: 4

Practical : 15; Int. Ass.: 05

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^{2+} , Mg^{2+} : in context with study of hardness of water.

Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dry heating test, charcoal cavity test,

$Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis: metal ions

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

**BTL-106
COMMUNICATION SKILLS IN ENGLISH-I**

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)

Prescribed Book:

Murphy's English Grammar (by Raymond Murphy) CUP

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press

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

BTL-107
ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

ਸਮਾਂ : 3 ਘੰਟੇ

ਥਿਊਰੀ ਅੰਕ : 37
ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ : 13
ਕੁੱਲ ਅੰਕ: 50

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਭਾਗ ਪਹਿਲਾ -ਕਵਿਤਾ ਅਤੇ ਕਹਾਣੀ)
ਡਾ. ਮਹਿਲ ਸਿੰਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਲੇਖਕ ਦਾ ਜੀਵਨ ਅਤੇ ਰਚਨਾ/ਸਾਰ/ਵਿਸ਼ਾ-ਵਸਤੂ)

ਭਾਗ-ਦੂਜਾ

ਇਤਿਹਾਸਿਕ ਯਾਦਾਂ

ਸ. ਸ. ਅਮੋਲ (ਸੰਪਾ.), ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਨਿਬੰਧ 1 ਤੋਂ 6 ਤਕ ਸਾਰ/ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸ਼ੈਲੀ)

ਭਾਗ-ਤੀਜਾ

(ੳ) ਪੈਰਾ ਰਚਨਾ (ਤਿੰਨਾਂ ਵਿਚੋਂ ਇੱਕ)
(ਅ) ਪੈਰਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ

ਭਾਗ-ਚੌਥਾ

(ੳ) ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ-ਭਾਸ਼ਾ ਵਿਚਲਾ ਅੰਤਰ, ਪੰਜਾਬੀ ਉਪ-ਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ-ਚਿੰਨ੍ਹ
(ਅ) ਪੰਜਾਬੀ ਭਾਸ਼ਾ - ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਸਿਲੇਬਸ ਦੇ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦੇ ਪੰਜ ਭਾਗ ਹੋਣਗੇ।
2. ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ।
3. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰੇ ਸਿਲੇਬਸ ਵਿਚੋਂ 01-01 ਅੰਕ ਦੇ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਨੋਟ : ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਇਨ੍ਹਾਂ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁੱਲ ਅੰਕ $37+13 = 50$ ਹਨ।

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

BTL-107

ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In Lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟੇ

ਥਿਊਰੀ ਅੰਕ : 37

ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ : 13

ਕੁਲ ਅੰਕ: 50

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ :

(ੳ) ਨਾਮਕਰਣ ਤੇ ਸੰਖੇਪ ਜਾਣ-ਪਛਾਣ : ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ, ਅੱਖਰ ਕ੍ਰਮ, ਸਵਰ ਵਾਹਕ (ੳ, ਅ, ਏ),

ਲਗਾਂ-ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ

(ਅ) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ-ਦੂਜਾ

ਗੁਰਮੁਖੀ ਆਰਥੋਗਰਾਫੀ ਅਤੇ ਉਚਾਰਨ :

ਸਵਰ, ਵਿਅੰਜਨ : ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ ਅਤੇ ਉਚਾਰਣ, ਮੁਹਾਰਨੀ, ਲਗ- ਮਾਤਰਾਂ ਦੀ ਪਛਾਣ

ਭਾਗ-ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਜੋੜ :

ਮੁਕਤਾ (ਦੋ ਅੱਖਰਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਤਿੰਨ ਅੱਖਰਾਂ ਵਾਲੇ ਸ਼ਬਦ), ਸਿਹਾਰੀ ਵਾਲੇ ਸ਼ਬਦ, ਬਿਹਾਰੀ ਵਾਲੇ ਸ਼ਬਦ, ਔਂਕੜ ਵਾਲੇ

ਸ਼ਬਦ, ਦੁਲੈਂਕੜ ਵਾਲੇ ਸ਼ਬਦ, ਲਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਦੁਲਾਵਾਂ ਵਾਲੇ ਸ਼ਬਦ, ਹੋੜੇ ਵਾਲੇ ਸ਼ਬਦ, ਕਨੌੜੇ ਵਾਲੇ ਸ਼ਬਦ, ਲਗਾਖਰ

(ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) ਵਾਲੇ ਸ਼ਬਦ

ਭਾਗ-ਚੌਥਾ

ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ ਸ਼ਬਦ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪਹਿਲੇ ਭਾਗ ਵਿਚੋਂ ਚਾਰ ਵਰਣਨਾਤਮਕ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੈ।
ਹਰ

ਪ੍ਰਸ਼ਨ ਦੇ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ।

(3×4)=12 ਅੰਕ

2. ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦੋ-ਦੋ ਅੰਕ ਦੇ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ। ਸਾਰੇ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ।

(5×2)=10 ਅੰਕ

3. ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨੇ ਲਾਜ਼ਮੀ ਹਨ। ਇਨ੍ਹਾਂ ਦੇ ਪੰਜ-ਪੰਜ ਅੰਕ ਹਨ।

(2×5)=10 ਅੰਕ

4. ਭਾਗ ਚੌਥਾ ਵਿਚ ਪੰਜ ਅਸ਼ੁੱਧ ਸ਼ਬਦਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਕੇ ਲਿਖਣਾ ਹੋਵੇਗਾ।

(5×1)=05 ਅੰਕ

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਇਨ੍ਹਾਂ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

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

BT-107

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 Setter:

The question paper consists of five units: I, II, III, IV and V. Units I, II, III and IV will have two questions each. Each question carries 8 marks. The students are to attempt one question from each unit approximately in 800 words. Unit-V consists of 7 short answer type questions to be set from the entire syllabus. Students are to attempt any 5 questions in about 20 words each. Each question carries 1 mark.

Note: The examiner is to set the question paper in two languages: English & Hindi.

Unit-I

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

Unit-II

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

Unit-III

5. Social, Religious and Economic life during Rig Vedic Age.
6. Social, Religious and Economic life during later Vedic Age.

Unit-IV

7. Teachings and impact of Buddhism.
8. 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.

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

BTL108

**DA1-Drug Abuse: Problem, Management and Prevention
(Compulsory)**

Problem Of Drug Abuse

Time: 3 Hours

Max. Marks: 50

Instructions for the Paper Setters:

Section–A (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying 05 marks. Answer to any of the questions should not exceed two pages.

Section–B (20 Marks): It will consist of four essay type questions. Candidates will be required to attempt two questions, each question carrying 10 marks. Answer to any of the questions should not exceed four pages.

Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

Unit-I

Meaning of Drug Abuse:

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

Unit-II

Consequences of Drug Abuse for:

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

Unit-III

Management of Drug Abuse:

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

Unit-IV

Psychiatric Management: Counselling, Behavioural and Cognitive therapy.

Social Management: Family, Group therapy and Environmental Intervention.

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. 23
4. Jasjit Kaur Randhawa & Samreet Randhawa, "Drug Abuse-Problem, Management & Prevention", KLS, ISBN No. 978-81-936570-6-5, (2018).
5. Jasjit Kaur Randhawa & Samreet Randhawa, "Drug Abuse Problem, Management & Prevention", KLS, ISBN No. 978-81-936570-8-9, (2019).

6. Jasjit Kaur Randhawa & Samreet Randhawa, “ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ-(ਨਸ਼ਾਖੋਰੀ) ਸਮੱਸਿਆ, ਪ੍ਰਬੰਧਨ ਅਤੇ ਰੋਕਥਾਮ”, KLS, ISBN No. 978-81-936570-7-1, (2018).
7. Jasjit Kaur Randhawa, “Drug Abuse -Management & Prevention”, KLS, ISBN No. 978-93-81278-80-2, (2018).
- 8 . Kapoor. T. (1985) Drug epidemic among Indian Youth, New Delhi: Mittal Pub.
9. Modi, Ishwar and Modi, Shalini (1997) Drugs: Addiction and Prevention, Jaipur: Rawat Publication.
10. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
11. Rama Gandotra & Jasjit Kaur Randhawa, “ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ-(ਨਸ਼ਾਖੋਰੀ) ਪ੍ਰਬੰਧਨ ਅਤੇ ਰੋਕਥਾਮ”, KLS, ISBN No. 978-93-81278-87-1, (2018).
12. Sain, Bhim 1991, Drug Addiction Alcoholism, Smoking obscenity New Delhi: Mittal Publications.
13. Sandhu, Ranvinder Singh, 2009, Drug Addiction in Punjab: A Sociological Study. Amritsar: Guru Nanak Dev University.
14. Singh, Chandra Paul 2000. Alcohol and Dependence among Industrial Workers: Delhi: Shipra. 15. Sussman, S and Ames, S.L. (2008). Drug Abuse: Concepts, Prevention and Cessation, Cambridge University Press.
16. World Drug Report 2010, United Nations office of Drug and Crime.
17. World Drug Report 2011, United Nations office of Drug and Crime.

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

BTL151
Zoology-I

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Introduction to Animal Kingdom and its diversification:

Overview and General classification of Kingdom Animalia, General Characteristics of each group upto class level with an example.

Section–B

Digestive System: The alimentary canal and associated glands of Man. Digestion of dietary constituents, regulation of digestive processes and absorption. Extra and intra cellular digestion, enzymatic digestion and symbiotic digestion.

Respiratory System: Respiratory system of man, Transport of O₂ and CO₂, Oxygen dissociation curve of haemoglobin, Bohr effect, chloride shift, Haldane effect and control of breathing.

Section–C

Circulatory System: General plan of circulation in Man, structure of human heart. Origin and regulation of heart beat, Electrocardiogram, Cardiac output and Blood pressure, Composition and functions of blood and lymph, Blood clotting, blood groups including Rh-factor.

Excretory system: Structure of Kidney and nephron. Urine formation and osmoregulation.

Section–D

Skeletal system: Ultrastructure, chemical and physical basis of skeletal muscle contraction.

Neural Integration: Structure and functions of brain, Structure of neuron, resting membrane potential, Origin and propagation of impulse along the axon, synapse and myoneural junction.

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

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

**BTP171
Zoology-I Lab**

**Time: 3 Hours
Periods/week: 4**

**Max. Marks: 20
Practical : 15; Int. Ass.: 05**

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

1. Study the following system of Human with the help of charts / models / videos:
Digestive, Arterial, Venous and Urinogenital systems.
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. Make a temporary preparation of the following:
Blood smear of mammals.
7. Visit to clinical laboratory / hospital for demonstration of ECG, ECHO, X-ray, ultrasound, CT-scan and MRI.

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 Recommended:

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

BTL-152
(Genetics)

Time: 3 Hours
40

Periods/week: 4
10

Max. Marks:

Theory: 30; Int. Ass.:

Note for the paper setters/examiners:

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

Organization of Chromosomes: The structure of prokaryotic and eukaryotic chromosome (macromolecular organization and ultrastructure), karyotype, idiogram, centromere and telomere structure, significance of telomerase, euchromatin and heterochromatin, Special chromosomes: Polytene chromosomes and Lampbrush chromosomes, satellite DNA, the supercoiling of DNA.

Section-B

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.

Section-C

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.

Basic Microbial Genetics: Conjugation, transduction, transformation

Section-D

Extra Chromosomal (Cytoplasmic) Inheritance: features; inheritance of mitochondrial DNA, chloroplast DNA, kappa articles in *Paramecium*, Sigma factor in *Drosophila*, cytoplasmic male sterility (CMS) in maize.

Chromosomal aberrations: Structural: deletion, duplication, inversion, translocation; Numerical: polyploidy, aneuploidy; significance of chromosomal aberrations.

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

BTL172

Genetics Lab

Time: 3 Hours

Periods/week: 4

Max. Marks: 20

Practical : 15; Int. Ass.: 05

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. (BIO-TECHNOLOGY) (SEMESTER-II)

BTL153

Biochemistry-II (Bioenergetics and Enzymology)

Time: 3 Hours

40

Periods/week: 4

10

Max. Marks:

Theory: 30; Int. Ass.:

Note for the paper setters/examiners:

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

Introduction to metabolism, catabolism, anabolism, Laws of Thermodynamics and living system, Free energy change and direction of metabolism, Characteristics of Metabolic pathways, Compartmentation and Interorganmetabolism, Regulation & evolution of metabolic pathways

Section-B

ATP: Structure, Free energy change, energy coupling with ATP (Creatinine phosphokinase, NDP kinase, Adenylate kinase), metabolic roles of ATP; Experimental methods for studying metabolism, Energy rich metabolites, biological oxidation – Reduction reactions

Section-C

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Cofactors, Co-enzyme and Prosthetic group, Mechanism of Enzyme Action: Nature of active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes., Covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis.

Section-D

Enzyme Kinetics: A brief overview of enzyme energetics, MichaelisMenten equation. Derivation of MichaelisMenten equation and determination of Km and Vmax values
Enzyme inhibition: Reversible and Irreversible inhibition, Regulation of enzyme activity
Isozymes and their importance

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)
BTP173
Biochemistry-II (Bioenergetics and Enzymology) Lab

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.

1. Estimation of Alpha-amylase activity from saliva.
2. Assay of acid phosphatase activity.
3. Effect of temperature on enzyme activity.
4. Effect of pH on enzyme activity
5. Determination of Km for acid phosphatase.
6. Competitive and non competitive inhibition.

Books Recommended:

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko, Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain, Sunjay Jain, Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

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

BTL154

General Microbiology-II

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Factors affecting Microbial Growth: Temperature, pH, provision of gases. Introduction to concept of microbial growth in batch and continuous system. Bacterial generation, doubling time and specific growth rate. Monoauxic, diauxic and synchronised growth curve. Sporulation and regeneration of bacteria.

SECTION-B

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)

SECTION-C

Pathogenic microorganisms- Factors contributing towards 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. Bacterial diseases-Diphtheria, Tuberculosis, Typhoid. Fungal diseases-Aspergillosis and Candidiasis.

SECTION-D

Introduction to Industrial Microbiology. Microbes involved in Food (Pickles, Saurkraut, Sausage), Single cell protein (Yeast, Bacteria), Antibiotics (Penicillin, Tetracyclin) and Municipal solid waste transformations.

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. Chander, M. And Puri, P. (2008). A Concise Course in Microbiology. Krishna Brothers Publishers, Old Railway Road, Jalandhar.
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)

BTP174

General Microbiology-II Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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)

BTL155

Biomathematics and Biostatistics

Time: 3 Hours

Credit Hrs.: 3/Week

Max. Marks: 40

Theory: 30; Int. Ass.: 10

Note for the paper setters/examiners:

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

Scientific notation, Significant digits, Rounding off, Scientific notations, Sampling, Problem identification, Concept of population and samples, Random sampling, Data collection, Log, Indices, Design of experiments, differentiation and integration.

Section B

Measurement of central tendency, mean, geometric mean, harmonic mean, Median, Mode, Quartile mean, decile, percentile, Dispersion, Mean deviation, Standard deviation, Geometrical standard deviation, Standard error, Coefficient of variation, Variation, Variance, Coefficient of determinant, moments, skewness and kurtosis.

Section C

Graphical representation of data, scattered diagram, Straight line, Least square test, Correlation coefficient, Regression coefficient, Correction of experimental data and model development.

Section D

Testing of hypothesis, null and alternate hypothesis, type-I, TYPE II errors, level of significance, Normal distribution, Poisson distribution, Binomial distribution, Student 't'-test, 'F'-test, chi-square test, Wilcoxon test, analysis of variance (one way anova)

Reference Books:

1. Kothari, C.R. (2004) Research Methodology Methods and Techniques, New Age International Publications, New Delhi
2. Arora, P.N. & Malhan, P.K. : Biostatistics (Himalaya Publication House)
3. Robert R. Sokal and F. James Rohlf Introduction to Biostatistics

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)
BTL156
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 Listening and Speaking 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 and E-mail Writing.
vi) Do as directed change of voice Units 42-46 (6 x 5=30 Marks)
vii) Translation from Vernacular (Punjabi/ Hindi) to English(Isolated Sentences) (1 x 7 = 7 Marks)

Prescribed Book:

Murphy's English Grammar (by Raymond Murphy) CUP

Recommended Books:

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press

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

BTL157
ਲਾਜ਼ਮੀ ਪੰਜਾਬੀ

ਸਮਾਂ : 3 ਘੰਟੇ

ਥਿਊਰੀ ਅੰਕ : 37
ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ : 13
ਕੁਲ ਅੰਕ : 50

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਭਾਗ ਦੂਜਾ - ਵਾਰਤਕ ਅਤੇ ਰੇਖਾ-ਚਿੱਤਰ)
ਡਾ. ਮਹਿਲ ਸਿੰਘ (ਸੰਪਾ.), ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਕਿਸੇ ਲੇਖ ਅਤੇ ਰੇਖਾ-ਚਿੱਤਰ ਦਾ ਸਾਰ/ਵਿਸ਼ਾ-ਵਸਤੂ/ਨਾਇਕ ਬਿੰਬ)

ਭਾਗ-ਦੂਜਾ

ਇਤਿਹਾਸਿਕ ਯਾਦਾਂ

ਸ. ਸ. ਅਮੋਲ (ਸੰਪਾ.), ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
(ਨਿਬੰਧ 7 ਤੋਂ 12 ਤਕ ਸਾਰ/ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸ਼ੈਲੀ)

ਭਾਗ-ਤੀਜਾ

(ੳ) ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ-ਰਚਨਾ - ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਮੁੱਢਲੇ ਸੰਕਲਪ
(ਅ) ਸ਼ਬਦ-ਸ਼੍ਰੇਣੀਆਂ

ਭਾਗ-ਚੌਥਾ

(ੳ) ਦਫ਼ਤਰੀ ਚਿੱਠੀ ਪੱਤਰ
(ਅ) ਮੁਹਾਵਰੇ ਅਤੇ ਅਖਾਣ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਸਿਲੇਬਸ ਦੇ ਚਾਰ ਭਾਗ ਹਨ ਪਰ ਪ੍ਰਸ਼ਨ-ਪੱਤਰ ਦੇ ਪੰਜ ਭਾਗ ਹੋਣਗੇ।
2. ਪਹਿਲੇ ਚਾਰ ਭਾਗਾਂ ਵਿਚ 02-02 ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰੇਕ ਭਾਗ ਵਿਚੋਂ 01-01 ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ। ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ (08) ਅੰਕ ਹੋਣਗੇ।
3. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਪੰਜਵੇਂ ਭਾਗ ਵਿਚ ਸਾਰੇ ਸਿਲੇਬਸ ਵਿਚੋਂ 01-01 ਅੰਕ ਦੇ ਛੇ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ 05 ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ ਦੇਣਾ ਲਾਜ਼ਮੀ ਹੋਵੇਗਾ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਨੋਟ : ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਇਨ੍ਹਾਂ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁੱਲ ਅੰਕ 37+13 = 50 ਹਨ।

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

BTL157

ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In Lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟੇ

ਥਿਊਰੀ ਅੰਕ : 37

ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ : 13

ਕੁਲ ਅੰਕ : 50

ਪਾਠ-ਕ੍ਰਮ

ਭਾਗ-ਪਹਿਲਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ :

ਪਾਤ੍ਰ, ਵਧੇਤਰ (ਅਗੇਤਰ, ਮਧੇਤਰ, ਪਿਛੇਤਰ), ਪੰਜਾਬੀ ਕੋਸ਼ਗਤ ਸ਼ਬਦ ਅਤੇ ਵਿਆਕਰਨਕ ਸ਼ਬਦ

ਭਾਗ-ਦੂਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਪ੍ਰਕਾਰ :

(ੳ) ਸੰਯੁਕਤ ਸ਼ਬਦ, ਸਮਾਸੀ ਸ਼ਬਦ, ਦੋਜਾਤੀ ਸ਼ਬਦ, ਦੋਹਰੇ/ਦੁਹਰੁਕਤੀ ਸ਼ਬਦ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ।

(ਅ) ਸਿਖਲਾਈ ਤੇ ਅਭਿਆਸ

ਭਾਗ-ਤੀਜਾ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਰਚਨਾ :

ਇੱਕ-ਵਚਨ ਬਹੁ-ਵਚਨ, ਲਿੰਗ-ਪੁਲਿੰਗ, ਬਹੁਅਰਥਕ ਸ਼ਬਦ, ਸਮਾਨਅਰਥਕ ਸ਼ਬਦ, ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਲਈ ਇੱਕ ਸ਼ਬਦ, ਸ਼ਬਦ ਜੁੱਟ, ਵਿਰੋਧਅਰਥਕ ਸ਼ਬਦ, ਸਮਨਾਮੀ ਸ਼ਬਦ

ਭਾਗ-ਚੌਥਾ

ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ :

ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ, ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ

ਅੰਕ-ਵੰਡ ਅਤੇ ਪ੍ਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਭਾਗ ਪਹਿਲਾਂ ਵਿਚੋਂ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਤਿੰਨ ਪ੍ਰਸ਼ਨਾਂ ਦਾ ਉੱਤਰ ਦੇਣੇ ਲਾਜ਼ਮੀ ਹਨ। ਹਰ ਪ੍ਰਸ਼ਨ ਦੇ ਚਾਰ-ਚਾਰ ਅੰਕ ਹਨ। **(3×4)=12 ਅੰਕ**
2. ਭਾਗ ਦੂਸਰਾ ਵਿਚੋਂ ਦੋ-ਦੋ ਅੰਕ ਦੇ ਪੰਜ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ। ਸਾਰੇ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹਨ। **(5×2)=10 ਅੰਕ**
3. ਭਾਗ ਤੀਸਰਾ ਵਿਚੋਂ ਚਾਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨੇ ਲਾਜ਼ਮੀ ਹਨ। **(2×5)=10 ਅੰਕ**
4. ਭਾਗ ਚੌਥਾ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣ ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਹੱਲ ਕਰਨਾ ਹੋਵੇਗਾ। **(1×5)=05 ਅੰਕ**

ਨੋਟ: ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ 13 ਅੰਕਾਂ ਦੀ ਹੈ, ਜੋ ਕਾਲਜ ਵੱਲੋਂ ਨਿਰਧਾਰਿਤ ਦਿਸ਼ਾ ਨਿਰਦੇਸ਼ਾਂ ਅਨੁਸਾਰ ਇਨ੍ਹਾਂ ਅੰਕਾਂ ਤੋਂ ਵੱਖਰੀ ਹੋਵੇਗੀ। ਇਸ ਪੇਪਰ ਦੇ ਕੁਲ ਅੰਕ 37+13 = 50 ਹਨ।

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

BTL157

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 Setter:

The question paper consists of five units: I, II, III, IV and V. Units I, II, III and IV will have two questions each. Each question carries 8 marks. The students are to attempt one question from each unit approximately in 800 words. Unit-V consists of 7 short answer type questions to be set from the entire syllabus. Students are to attempt any 5 questions in about 20 words each. Each question carries 1 mark.

Note: The examiner is to set the question paper in two languages: English & Hindi.

Unit-I

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

Unit-II

3. The Punjab under the Gupta Emperors.
4. The Punjab under the Vardhana Emperors

Unit-III

5. Political Developments 7th Century to 1000 A.D.
6. Socio-cultural History of Punjab from 7th Century 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, Part-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.

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

BTL158

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

Drug Abuse: Management and Prevention

Time: 3 Hours

Max. Marks: 50

Instructions for the Paper Setters:

Section–A (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying 05 marks. Answer to any of the questions should not exceed two pages.

Section–B (20 Marks): It will consist of four essay type questions. Candidates will be required

to attempt two questions, each question carrying 10 marks. Answer to any of the questions should not exceed four pages.

Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed 5 pages.

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. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
2. Gandotra, R. and Randhawa, J.K. 2018. ਡਰੱਗਜ਼ ਦੁਰਵਰਤੋਂ (ਨਸ਼ਾਖੋਰੀ) ਪ੍ਰਬੰਧਨ ਅਤੇ ਰੋਕਥਾਮ। Kasturi Lal & Sons, Educational Publishers, Amritsar- Jalandhar.
3. Inciardi, J.A. 1981. The Drug Crime Connection. Beverly Hills: Sage Publications.
4. Modi, Ishwar and Modi, Shalini (1997) Drugs: Addiction and Prevention, Jaipur: Rawat Publication.
5. Randhawa, J.K. and Randhawa, Samreet 2018. Drug Abuse-Management and Prevention. Kasturi Lal & Sons, Educational Publishers, Amritsar- Jalandhar.
6. Sain, Bhim 1991, Drug Addiction Alcoholism, Smoking obscenity New Delhi: Mittal Publications.

7. Sandhu, Ranvinder Singh, 2009, Drug Addiction in Punjab: A Sociological Study. Amritsar: Guru Nanak Dev University.
8. Singh, Chandra Paul 2000. Alcohol and Dependence among Industrial Workers: Delhi: Shipra.
9. World Drug Report 2011, United Nations office of Drug and Crime.
10. World Drug Report 2010, United Nations office of Drug and Crime

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

BTL201 Fundamentals of Biotechnology

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Emergence, scope and basics of biotechnology

Historical perspective, Appraise the interplay of science & technology in the development of biotechnology, Definition, areas and overview of the Fundamentals of Biotechnology, Biotechnology Research in India. Biotechnology Institutions in India (Public and Private Sector), Biotech Success Stories, Biotech Policy Initiatives. careers and employment opportunities in biotechnology

Section B

Applications of Biotechnology: An Overview

Applying Biotechnology to Modern life styles: Healthcare – Biopharma : Recombinant human insulin; molecular diagnostics : PCR for infectious disease (viral / bacterial), blood screening and genetic testing, Gene therapy, genetic counseling); Agriculture & food production (Genetically engineered food, Seed banks, aquaculture); Green biotechnology (Bioremediation, Biofuels, Conservation); Forensics & biodefense.

Section C

Bio business and IPRs in Biotechnology

Commercialization of Biotechnology: Concerns and Consequences, Biotechnology Industry Practices & Government regulations, Concept and market potential of Bio business, Requirements and Objectives of Patent, Patentable and non-patentable inventions, process of writing and filing a patent, patenting genes/ gene fragments /SNPs/ proteins / stem cells Patents related to bacteria, viruses, fungi and medicinal plants. IPR: Introduction, types (Trade secret, Copyright, trademark)

Section D

Biotechnology & Society

Ethical Issues & Regulating the use of Biotechnology: Human cloning, GM foods and GMOs, stem cell; The future of Biotechnology.

Books:

1. David P Clark & Nanette J. Pazdernik (2017) *Biotechnology – Applying the Genetic Revolution*, Elsevier Academic Press.
2. Bernard R Glick, Jack J Pasternak and Cheryl L Patten (2010) *Molecular Biotechnology: Principles and applications of Recombinant DNA*, ASM Press.
3. Singh, B.D. (2018). *Biotechnology expanding horizons*, Kalyani Publishers, New Delhi.
4. Singh, I. and Kaur, B (2010) *Patent law and Entrepreneurship*, 3rd Edition, Kalyani Publishers.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP221 Fundamentals of Biotechnology Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

1. Good laboratory practices followed in biotechnology laboratory.
2. Introduction, use and maintenance of basic equipments in a biotechnology laboratory (Auto-pipettes, weighing balance, pH meter, Water bath, dry bath, Spectrophotometer, centrifuges, light microscope, electrophoretic apparatus, vortex mixer, magnetic stirrer, rocker, laminar hoods, autoclave, sonicator, UV transilluminator, hot air oven, BOD incubator).
3. Handling and disposal of hazardous reagents (acids, carcinogenic chemicals like acrylamide, ethidium bromide) and concept of chemical hoods.
4. Different steps for patent with the help of example.

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

BTL202 Immunology-I

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

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

Section-B

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.

Section-C

Antigen, Epitope (B cell & T Cell epitioe), Immunogen, Factors influencing immunogenicity, Immunoglobulins, classes and structure; affinity and avidity; Complement fixing antibodies and complement cascade.

Section-D

MHC class I and class II molecules, structure T & B Cells and function of class I and class II MHC molecules, structure of T-cell antigen receptors.

Books Recommended:

1. Roitt, I.M. Brostoff, J. and Male, D.K. (2012), Immunology, 8th Edition, Elsevier , New York
2. Judy Owen, Jenni Punt, Sharon Stranford, Patricia Jone. (2018), Immunology, 7th Edition. W.H. Freeman and Company, New York
3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai (2011) Cellular and Molecular Immunology; 7th Edition, Saunders
4. Doan (2012) Lippincott's Illustrated Reviews Immunology ; 2nd Edition, Wolters Kluwer India Pvt

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP222 Immunology-I Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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. Separation of Plasma from blood
5. Collection of blood sample by different method.
6. Haemagglutination assay
7. Haemagglutination inhibition assay

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)

BTL203 Chemistry-II (Organic)

Time: 3 Hours

Periods/week: 4

Max. Marks: 40

Theory: 30; Int. Ass.: 10

Note for the paper setters/examiners:

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

Reactive intermediates

Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species

Bonding

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Waals interactions, resonance, hyperconjugation, hydrogen bonding and Inductive and electrometric effects.

Section-B

Aromaticity

Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes

Section-C

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.

Section-D

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 real arrangements in SN^1 reactions, solvent effects, substitution and elimination as competing reactions.

Books Recommended:

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

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP223 Chemistry-II (Organic) Lab

Time: 3 Hours

Periods/week: 4

Max. Marks: 20

Practical : 15; Int. Ass.: 05

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.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL204 Botany-II

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Nutrition, Transport and Stress responses in plants: Macronutrients and micronutrients and their deficiency symptoms; Water relations, osmosis, transpiration, water potential & its components, ascent of sap and transport of organic solutes. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Section-B

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C3, C4 and CAM pathways.

Section-C

Plant Pathology & epidemiology: Definitions, classification, mode of transmission & control measures of plant diseases; host-pathogen interaction, Disease resistance, phytoalexins, PR proteins. A brief account of the following plant diseases with respect to casual agents, symptoms, epidemiology and their control measures : Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

Section-D

Biodiversity: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; Characteristics of a population; population growth curves; population regulation; Major terrestrial biomes; biogeographical zones of India.

Books Recommended:

1. Sharma, P.D. *Plant Pathology*. India: Rastogi Publication, 2011. Print.
2. Sharma, P.D. *Ecology and Environment*. 8th ed. India: Rastogi Publications, 2010. Print.
3. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. *Plant Physiology and Development*. 6th ed. USA: Sinauer Associates Inc., 2015. Print.
4. Hopkins, W.G. and Huner, A. *Introduction to Plant Physiology*. 4th ed. USA: John Wiley and Sons, 2008. Print.
5. Shibu, J., Singh, H.P., Batish, D.R. and Kohli, R.K. *Invasive Plant Ecology*. New York, USA: CRC Press, Taylor and Francis Group, Boca Raton, 2013. Print.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP224 Botany-II Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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. Demonstrate the transpiration pull by mercury method.
4. Demonstration that O_2 is evolved during photosynthesis.
5. Separation of pigments by paper chromatography/TLC method
6. 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, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL205 Biochemistry-III (Metabolism of Carbohydrates and Lipids)

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

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

SECTION-B

Kreb's cycle: - Amphibolic nature of kreb's cycle, regulation and enzymes of kreb's cycle, glyoxylate pathway. Electron transport chain: - Mitochondrial electron chain, oxidative phosphorylation, chemiosmotic hypothesis, ATP synthase and regulation of ATP sy

SECTION-C

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

SECTION-D

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

Books Recommended:

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP225 Biochemistry-III (Metabolism of Carbohydrates and lipids) Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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

1. Determination of reducing sugar using 3,5 dinitrosalicylic acid.
2. Spectral analysis of various plant pigments
3. Separation of lipids from wheat grains.
4. Separation of macromolecules using thin layer chromatography
5. To perform Hb1Ac
6. Oral glucose tolerance test

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL206 Molecular Biology

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

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

Section-B

RNA synthesis and processing RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, genetic code

Section-C

Protein synthesis and processing Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, aminoacyl tRNA synthetase and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

Section-D

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

Books Recommended:

1. George M Malacinski (2015) Freifelders Essentials Of Molecular Biology, 4Th/Ed, Jones & Bartlett
2. David P. Clark, Nanette J. Pazdernik, Michelle R. McGehee (2018), 3rd edition, Molecular Biology, Academic Cell
3. Pk Gupta(2018) MOLECULAR BIOLOGY , 2nd Edition, Rastogi Publications
4. James D. Watson, A. Baker Tania, P. Bell Stephen , Gann Alexander, Levine Michael, Losick Richard (2017)Molecular Biology of the Gene, 7th Ed, Pearson Education

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP226 Molecular Biology Lab

Time: 3 Hours

Periods/week: 4

Max. Marks: 20

Practical : 15; Int. Ass.: 05

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. BIOTECHNOLOGY (SEMESTER–III)

ESL–221: ENVIRONMENTAL STUDIES–I (COMPULSORY)

Time: 3 Hrs.

Max. Marks: 50

Theory Lectures: 1½ Hours/ Week

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections. Each unit of the syllabus should be given equal weightage of marks. Paper to be set in English, Punjabi and Hindi

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

Section–B: (24 Marks): It will consist of five questions. Candidates will be required to attempt four questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

Section–C: (10 Marks): It will consist of two questions. Candidate will be required to attempt one question (carrying ten marks) only. Answer to the question should not exceed 5 pages.

Unit-I

The Multidisciplinary Nature of Environmental Studies:

- Definition, scope & its importance.
- Need for public awareness.

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.

Unit-II

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)

Unit-III

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.

Unit-IV

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 (Suvudha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

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

BTL251 Industrial Biotechnology-I

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

History of general and industrial Microbiology, Basic concept of Industrial fermentation and its significance in industry. Differences between microbial industrial processes and chemical industrial processes.

Section-B

General study and characterization of industrial important microbes. Methods of isolation, screening, selection and Identification of industrial microbes. Maintenance and preservation of industrially important microbial cultures.

Section-C

Strain improvement of industrial important microbes: by using mutational programme and recombination systems (par sexual cycle, protoplast fusion and recombinant DNA techniques), Isolation of mutants (induced, auxotrophic, resistant and revert ant mutants), Inoculums Development, media formulation and process optimization of Industrial and agro industrial microbes.

Section-D

Introduction to primary and secondary metabolites production. Dairy products like curd, yoghurt, Cheese, bread, proteases in leather processing industries.

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.
10. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2001), Principles of Fermentation Technology 2nd ed., Pergamon Press, Oxford.
11. Frazier, W.C. and Westhoff, D.C. (2003) Food Microbiology. 18th Edition, Tata McGraw Hill, Inc., New York.
12. Industrial Biotechnology: Approach to Clean Technology · Jogdand, S.N. Himalaya Publishing House 2006. ISBN: ISBN number: 9788183184250.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTP271 Industrial Biotechnology-I Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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.

Books Recommended:

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

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTL252 Immunology-II

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells. Monoclonal antibodies: its production and uses.

Section-B

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

Section-C

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.

Section-D

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

Books Recommended:

1. Roitt, I.M. Brostoff, J. and Male, D.K. (2012), Immunology, 8th Edition, Elsevier , New York
2. Judy Owen, Jenni Punt, Sharon Stranford, Patricia Jone. (2018), Immunology, 7th Edition. W.H. Freeman and Company, New York
3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai (2011) Cellular and Molecular Immunology; 7th Edition, Saunders
4. Doan (2012) Lippincott's Illustrated Reviews Immunology ; 2nd Edition, Wolters Kluwer India Pvt
5. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2006). Kuby Immunology, 4th ed., W.H. Freeman and Company, New York

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTP272 Immunology-II Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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 Line of identity, partial identity and non identity
5. 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. BIOTECHNOLOGY (SEMESTER-IV)

BTL253 Biochemistry-IV (Metabolism of Proteins and Nucleic acid)

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Amino Acid Metabolism: Transamination reactions of amino acids, urea cycle, catabolism of essential amino acids, Inborn errors of Metabolism and amino acid degradation.

Section-B

Amino Acid Metabolism: Biosynthesis of essential amino acids, Regulation of amino acid biosynthesis by feed back inhibition

Section-C

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

Section-D

Nucleic Acid Metabolism: Degradation of purines and pyrimidines , nucleotides, salvage pathway.

Books Recommended:

1. David L. Nelson and Michael Cox (2017) Lehninger Principles of Biochemistry, 7th ed, WH Freeman
2. Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto (2019) Biochemistry, 9th Ed., WH Freeman
3. Ferrier (2017) Lippincott's Illustrated Reviews Biochemistry, 7th Ed, Wolters Kluwer India Pvt. Ltd.
4. J L Jain , Sunjay Jain , Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTP273 Biochemistry-IV lab (Metabolism of Proteins and Nucleic Acid)

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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

1. Isolation of Casein from milk
2. Determination of fat content in milk.
3. Estimation of cholesterol in a given sample.
4. Purification of protein using salt precipitation.
5. Quantitative estimation of amino acids using the ninhydrin reaction.

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTL254 Skill Development in Biotechnology

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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: Biofertilizers

Biofertilizers: Introduction and types and importance of biofertilizers, Microorganisms used in biofertilizers production, Biological Nitrogen fixation VIZ: Rhizobium: Process of nodule formation, Role of Nif and Nod gene in, Enzyme nitrogenase and its component, Different methods of application of biofertilizers, Strategies of Mass production and packing, Registration of biofertilizers.

Section B: Herbal Biotechnology

Introduction to medicinal plants and their medicinal value, Phytochemicals, Essential oil: definition, extraction and applications in domestic life, industry and other purposes (Eucalyptus, Lavender, Rosa grass, Tulsi)

Section C: Clinical and molecular diagnostics

Collection of blood samples, preparation and use of different anticoagulants, estimation of CBC, TLC, DLC, bleeding count, clotting time, ESR, PCB, principles of X-ray, MRI, ultrasonography, CT scan, ECG, ECHO, Overview of vector borne diseases: Dengue, Chickengunia, PCR based diagnosis of Bacterial, viral & fungal diseases (covid-19, Swine flu, Tuberculosis, Candidiasis)

Section D: Bioentrepreneurship

Overview of bioindustries, public/private funding opportunities; Innovation-focused thinking. Preparation of a business plan: socio-economic cost benefit analysis; Statutory and legal aspects. Business and market strategy: pricing, financing, market linkages, branding

Books

1. Fundamentals of Foods, Nutrition and Diet Therapy, (English, Mudambi Sumati R.), New Age International publication,
2. Clinical Dietetics and Nutrition, by Antia F P (Author), Oxford publication.
3. Alpers.D.H. , Stenson W.F.and Bier.D.M., (2002). Manual of Nutritional Therapeutics, 4th edition, Lippincott Williams & Wilkins, Philadelphia, USA.
4. Research paper and e notes.
5. F. Bakkali, S. Averbeck , D. Averbeck, M. Idaomar. (2008). Biological effects of essential oils – A review. Food and Chemical Toxicology 46: 446–475.
6. R. Amorati,M. C. Foti, L. Valgimigli. (2013). Antioxidant Activity of Essential Oils. Journal of Agriculture and Food Chemistry. 61:10835–10847.
7. A Sharma, D.S. Cannoo. (2016). Comparative evaluation of extraction solvents/techniques for antioxidant potential and phytochemical composition from roots of *Nepeta leucophylla* and quantification of polyphenolic constituents by RP-HPLC-DAD. Food Measure. doi 10.1007/s11694-016-9349-5
8. Sharma and D. S. Cannoo. (2013). Phytochemical composition of essential oils isolated from different species of genus *NEPETA* of Labiatae family: a review. Pharmacophore, 4 (6): 181-211.
9. Sarikurkcu, B. Tepe, D. Daferera, M. Polissiou, Mansur Harmandar. (2008). Studies on the antioxidant activity of the essential oil and methanol extract of *Marrubium globosum* subsp. *globosum* (Lamiaceae) by three different chemical assays. Bioresource Technology, 99: 4239–4246.

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)
BTP274 Skill Development in Biotechnology Lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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

1. Isolation of Rhizobium from root nodules
2. Production of commercial biofertilizers using Rhizobium.
3. Extraction of essential oils through oil distillation apparatus.
4. To measure total polyphenolic content of the essential oil.
5. Total flavanoid content of the essential oil.
6. Investigating the antioxidant potential of the oils by DPPH assay.
7. Antimicrobial activity of essential oils.
8. Estimation of CBC/DLC/TLC/Bleeding count/Clotting time/ESR/PCB
9. Estimation of BMR
10. Estimation of lipid profile
11. Estimation of blood glucose

B.Sc. BIOTECHNOLOGY (SEMESTER–IV)

BTL255 Fundamental of Bioinformatics

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Computers: General introduction to computers, organization of computers, Computer hardware and software. Data Storage Devices: Primary and secondary Storage devices. Input/Output Device: Key-tape/diskette devices, light pen mouse and joystick. Printed Output: Serial, line, page, printers; plotters, visual output; voice response units.

Section-B

Introduction to bioinformatics: History, Milestones and Applications, Local and Global alignments, Gap Penalties, Pairwise sequence alignments (Needleman-Wunsch, Smith-Watermann Algorithms), Significance of Sequence Alignment.

Section-C

Scoring Matrices: PAM, BLOSUM,

Multiple Sequence Alignment: Progressive Alignment, Iterative Alignment Methods,

Database Searching: BLAST and its types

Section-D

Primary and Secondary databases, Online resources of Bioinformatics: Introduction about: NCBI, EBI, DDBJ, Expasy, PUBMED, PDB, UNIPROT, Pfam, Prosite.

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. BIOTECHNOLOGY (SEMESTER–IV)
BTP275 Fundamental of Bioinformatics Lab**

**Time: 3 Hours
Periods/week: 4**

**Max. Marks: 20
Practical : 15; Int. Ass.: 05**

Note: The question paper will be set by the examiner based on the syllabus. Practical related to theory shall be carried out for this course.

1. Ms-Office: word, Excel, Power-point
2. Introduction about Various Databases: NCBI, EMBL, UNIPROT, PUBMED
3. GenBank Format, FASTA format etc
4. Basic Local Alignment Search tools (BLAST)
5. Multiple Sequence Alignment using Clustal Omega
6. Prediction of Protein functional domain using PFAM/PROSITE

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTL256 Zoology-II

Time: 3 Hours
Periods/week: 4

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

Note for the paper setters/examiners:

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

Origin of Life on Earth: Origin of earth and primitive earth conditions, Theories of origin of life (Theory of Extraterrestrial contact- Import of life through meteorites, Special creation theory, Oparin Haldane Theory, Abiogenesis , Evidences against theory of spontaneous generation of life, Biogenesis, Theory of chemical evolution, Miller & Urey Experiment). Evolution of Prokaryotes and Eukaryotes (unicellularity to multicellularity).

Section-B

Evolution: Definition, Scope and History, Theories of Evolution (Lamarckism, Darwinism, Hugo de Vries and Modern theory of Evolution). Geological time scale.

Section-C

Introduction to Parasitology (pertaining to various terminologies in use). Brief account of Life history, mode of infection and pathogenicity of the following pathogens with reference to man, prophylaxis and treatment.

Pathogenic Protozoans: Entamoeba, Trypanosoma, Giardia and Plasmodium.

Pathogenic Helminths: Tape Worm, Ascaris and Ancylostoma.

Section-D

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

Books Recommended:

1. Garcia, L.S. (2001), Diagnostic Medical Parasitology, (4th ed), ASM Press Washington.
2. Panikar, C. K. and Ghosh Sougata. (2018). Textbook of Medical Parasitology (8th Edition), Jaypee Brothers Medical Publishers (P Ltd.), New Delhi.
3. Harrison A. (2000). Principles of Medicine.
4. Loker, Eric S. and Bruce V. Hofkin (2015). Parasitology: A Conceptual Approach, Garland Science, Taylor & Francis Group, New York and London.
5. Zimmer, C. 2000. Parasite Rex: Inside the Bizarre World of Nature's Most Dangerous Creatures, The Free Press, New York.

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

BTP276 Zoology-II lab

Time: 3 Hours
Periods/week: 4

Max. Marks: 20
Practical : 15; Int. Ass.: 05

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

1. Study of Evolutionary phenomenon with the help of charts / models / videos:

Homology, Analogy and Mimicry.

2. Study of the skeleton of human.

3. Study of the following prepared slides: histology of man (compound tissues).

4. Study of following prepared slides/specimen :

Pathogenic Protozoans: Entamoeba, Trypanosoma, Giardia and Plasmodium.

Pathogenic Helminths: Tape Worm, Ascaris and Ancylostoma.

Arthropod vectors of human diseases: Anopheles, Culex, Aedes Mosquitoes, Rat flea.

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-IV)

BTP277 Industrial/Institutional Visit

Max. Marks: 20

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

B.Sc. BIOTECHNOLOGY (SEMESTER-IV)

ESL-222: ENVIRONMENTAL STUDIES-II (COMPULSORY)

Time: 3 Hrs.

Max. Marks: 50

Theory Lectures: 1½ Hours/ Week

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections. Each unit of the syllabus should be given equal weightage of marks. Paper to be set in English, Punjabi and Hindi

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

Section-B: (24 Marks): It will consist of five questions. Candidates will be required to attempt four questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

Section-C: (10 Marks): It will consist of two questions. Candidate will be required to attempt one question (carrying ten marks) only. Answer to the question should not exceed 5 pages.

Unit-I

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.

Unit-II

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.

Unit-III

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.

Unit-IV

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.

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-501 rDNA Technology 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

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 : 15

Int. assessment: 05

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. Spectrophotometric quantification of DNA and determination of purity.
4. Agarose Gel Electrophoresis.
5. Restriction enzyme digestion of the isolated DNA with 6, 5 and 4 cutters.
6. Agarose Gel Electrophoresis of the digested fragments.

Books Recommended:

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

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

BT-502 Concepts of Plant Tissue Culture

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

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
BT-502

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

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

BT-503 Animal Tissue Culture

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

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 : 15

Int. assessment: 05

Total : 20

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

1. Sterilization techniques: Theory and Practical

-Glass ware sterilization

-Media sterilization

-Laboratory Sterilization

2. Sources of contamination and decontamination measures.

3. Preparation of Hanks Balanced salt solution

4. Preparation of Minimal Essential Growth medium.

5. Isolation of lymphocytes for culturing and perform cell viability test.

6. Isolation of macrophages from blood for culturing

Book Recommended :

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

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

BT-504 PATENT LAWS IN BIOTECHNOLOGY

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

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-505 BIOPROCESS ENGINEERING – 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-1

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

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 : 15
Int. assessment: 05
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-506 Biophysical and Biochemical Techniques-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

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: 15+05 (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

BT-507: Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs.

Max.Marks:30+10 (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. 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

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 Benjamin / 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: 15+05 (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. Convert cyclohexanone to cyclohexanol and hydrazine of cyclohexanone. Compare the UV-Vis and IR spectra of the 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 fluorescence 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-508
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-601 rDNA Technology-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

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 λ 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 : 15

Int. assessment: 05

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. 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–VI)

BT-602 Applications of Plant Tissue Culture

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

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 : 15

Int. assessment: 05

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-603 Animal Biotechnology

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

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

Unit- II

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

Unit- III

Applications: Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; Bioreactors for large scale culture of cells; micro carrier cultures; Stem cells-characterization of embryonic stem cells & their 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 : 15

Int. assessment: 05

Total : 20

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

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

Book Recommended :

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

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-604 Intellectual Property Rights and Enterepreneurship

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

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-605 BIOPROCESS ENGINEERING – 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-1

Design of a Fermenter:

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

Unit-II

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

Unit-III

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

Unit-IV

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

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BIOPROCESS ENGINEERING – B (Practical)

Time: 3 Hrs.

Periods: 4

Max Marks: 20

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-606 Biophysical and Biochemical Techniques- 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

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 : 15

Int. assessment: 05

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)

BT-607: Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs.

Periods: 3

Theory : 30

Total assessment: 40

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

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 : 15

Int. assessment: 05

Total : 20

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

1. Record the ^1H NMR spectra of ethyl acetate and ethyl acetoacetate (in CDCl_3 or CCl_4) and show the presence of the tautomeric structures.
2. Preparation of benzillic acid from benzaldehyde. (Green Chemistry Experiment)
3. Separation of components of spinach using column chromatography.
4. Prepare *p*-nitroacetanilide and make comparison of ^1H NMR spectral data of aniline, acetanilide (starting material) and *p*-nitroacetanilide product.
5. Compare IR and ^1H NMR spectra of aspirin and salicylic acid

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-608

Max. Marks: 20

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

SYLLABUS

FOR

M. Sc.

BIOTECHNOLOGY

(Two years/Four semesters)

2020-21

Eligibility for M.Sc. 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. 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	6	-	6	4
2	MBT102	Cell Biology	100	25	125	6	4	10	6
3	MBT103	Molecular Biology	100	25	125	6	4	10	6
4	MBT104	Biochemistry	100	25	125	6	4	10	6
5	MBT105	General Microbiology, Microbial Physiology & Biotechnology	100	25	125	6	4	10	6
Total Marks					600	Total Periods		46	-
						Course Hours		-	28

M. Sc. 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	6	4	10	6
2	MBT202	Enzymology and Enzyme Technology	100	25	125	6	4	10	6
3	MBT203	Biophysical and Biochemical Techniques	100	25	125	6	4	10	6
4	MBT204	Genetic Engineering	100	25	125	6	4	10	6
5	MBT205	Computer Applications & Data Analysis	100	25	125	6	4	10	6
Total Marks					625	Total Periods		50	-
						Course Hours		-	30

* denotes Internal Assessment

M. Sc. Biotechnology – Semester-III

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	MBT301	Animal Tissue Culture & Animal Biotechnology	100	25	125	6	4	10	6
2	MBT302	Plant Tissue Culture & Plant Biotechnology	100	25	125	6	4	10	6
3	MBT303	Immunology	100	25	125	6	4	10	6
4	MBT304	Bioprocess Engineering and Technology	100	25	125	6	4	10	6
5	MBT305	Seminar	50**	-	50	2 Credit hours/Teacher			
Total Marks					550	Total Periods		40***	-
						Course Hours		-	24***

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

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

***Denotes additional 2 Credit hours/Teacher for MBT-305

M. Sc. Biotechnology – Semester-IV

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	MBT401A Or MBT401B	Genomics and Proteomics Or Introduction to Bioinformatics	100	-	100	6	-	6	4
2	MBT402A Or MBT402B Or MBT402C	Medical Biotechnology Or Advances in Plant Biotechnology Or Microbial Biotechnology	100	-	100	6	-	6	4
3	MBT403	Intellectual Property Rights, Bioethics and Biosafety	100	-	100	6	-	6	4
4	MBT404	Research Project	Thesis: Presentation/Viva:		75**	6 Credit hours/Teacher			
5	MBT405	Educational Tour/Industrial Visit	50	-	50**	-	-	-	-
Total Marks					425	Total Periods		18***	-
						Course Hours		-	12***

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

** Denotes no internal assessment in the subject (MBT-404 to MBT-405)

***Denotes additional 6 Credit hours/Teacher for MBT-405

**M.Sc. Biotechnology (Semester – I)
Introductory Biomathematics and Biostatistics**

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)
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 and First cell, Evolution of metabolism
Diversity of cell size and shape: General organization of prokaryotic and eukaryotic cells,
Origin of cells: Assembly of macromolecules (proteins and nucleic acid), mechanism of assembly, evolutionary steps in the origin of cells (Chemical evolution).
Cell biology techniques: Microscopy-light, phase-contrast, fluorescence, confocal, scanning electron microscopy. Use of radioisotopes, cell culture, fractionation of cells contents.

SECTION -B

Cell motility: Cilia, flagella of eukaryotes and prokaryotes, their molecular mechanism
Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
Regulators of cell cycle progression: MPF, families of cyclins and cyclin dependent kinases, Growth factors, cell cycle inhibitors.

SECTION -C

Cell signaling: Mechanism of signal transduction, Modes of cell signaling, steroid hormone receptors, G-protein coupled receptors, second messengers, c- AMP pathway of signal transduction ; c GMP, phospholipids and calcium ions , Ras, Raf , MAP kinase pathway , JAK –STAT pathway, bacterial and plant two component systems, bacterial chemotaxis and quorum sensing,

SECTION -D

Cellular communication: Extracellular matrix; Matrix structural proteins, Matrix polysaccharides, Adhesion proteins, cell-matrix interactions. Adhesion junctions, Tight junctions, Gap junctions
Protein Sorting and Transport : Targeting proteins to endoplasmic reticulum, Protein export from ER; Protein sorting and export from Golgi Apparatus, Mechanism of vesicular transport

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)
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)**

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, 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, nucleic acid hybridization – cot curves.

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)**

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)**

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)**

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)**

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 Cummins.

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

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

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)**

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)
Enzymology and Enzyme Technology (Theory)**

MBT 202

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

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. Membrane bound Enzymes- Lipid-protein interaction and Effect of fluidity on enzyme activity. Immobilization of Enzymes: Techniques of immobilization, Properties and applications of immobilized enzymes.

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-II)
Enzymology and Enzyme Technology (Practical)
MBT 202

Practical : 19 marks
Int. assessment: 06 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-II)
Biophysical and Biochemical Techniques (Theory)**

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)**

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)**

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 (digoxigenin and biotin), Cloning vectors: Plasmids, M13, phagemids, insertion and replacement lambda vectors

Section-B

Cloning vectors: Cosmids, Artificial chromosome vectors (YACs; BACs); yeast vectors, Expression vectors: principle of recombinant protein expression as His- and GST-tags by cloning in pET and pGEX; Expression strategies for heterologous genes: codon optimization, Hosts: expression in bacteria and yeast, Inclusion bodies; Methodologies to reduce formation of inclusion bodies, in vitro transcription & in vitro translation, siRNA technology.

Section-C

Linkers; Adaptors; Homopolymeric tailing, strategies for making cDNA libraries; Transformation; Northern and Southern, hybridization, cloning differentially expressed genes (mRNA differential display and subtractive cloning). DNA-Protein Interactions (Electromobility shift assay)

Section-D

PCR and Its Applications: Primer design; DNA polymerases (Taq & Pfu); Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; SOEing; Site specific mutagenesis;

Books Recommended:

Text/References

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.

M. Sc. Biotechnology (Semester-II)
Genetic Engineering (Practical)
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 & Data Analysis (Theory)
MBT205**

Time: 3 Hours

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

Instruction for paper setters and candidates

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

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-B

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

Section -C

Developing the familiarity with SPSS Processor: Entering and editing data in SPSS editor. Inserting and defining variables and cases. Working with descriptive statistics - Frequency tables, Graphical representation of statistical data (histogram, Boxplot, line charts, scatter plot, P-P plots, Q-Q plots). Hypothesis Testing - Sample & Population, concept of confidence interval, Testing normality assumption in SPSS

Section-D

SPSS: Testing the differences between group means - t – test (one sample, independent – sample, paired sample), ANOVA-GLM 1 (one way). Regression Analysis: The method of Least Squares, Assessing the goodness of fit, Simple regression. Non-parametric tests - Categorical testing: Pearson's Chi-square test.

Recommended Books:

1. Balaguruswamy: "Programming in ANSIC".
2. Scaum Outline Series: "Programming inC".
3. Dennis & Ritchie: "Programming inC".
4. Stephen G. Kocher: "CProgramming".
5. Statistical Methods for Research: A Step by Step Approach Using IBM SPSS.2010. By- K. Kalyanaraman;Hareesh N. Ramanathan;P.N. Harikumar. Atlantic Publishers.
6. Statistics Made Simple: Do it Yourself on PC. by Sarma K.V.S. Prentice-Hall of India Pvt.Ltd (2004) ISBN: 9788120317413.
7. SPSS 20.0: A Guide to Statistical Analysis for Reseachers Paperback – 2018. by Dr. Dinesh Gabhane , Dr. S.B. Kishor, Ms. MadhuriBankar. Himalaya Publishing House; First edition (2018). ISBN-13: 978-9352993062

M. Sc. Biotechnology (Semester- II)
MBT205 – Computer Applications & Data Analysis (Practical)

Time: 3 Hours

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

1. Write programme to demonstrate conditional statements using c language.
2. Write programme to manipulate matrices.
3. To demonstrate array function.
5. Use of SPSS software: Entering and editing data.
6. Plotting histogram, Boxplot, line charts, scatter plot from the given data.

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

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

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.

Section-B

Detection of contamination, preservation, storage and shipment of cells. Constituents of serum, Serum free medium, design of serum free medium, Advantages and disadvantages of serum supplemented and serum free medium.

Section-C

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-D

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. Cell synchronization, cell transformation, cell immobilization techniques

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)**

MBT-301

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

1. Introduction to cell culture laboratory and instruments (Inverted microscope, CO2 incubator, Refrigerated centrifuges, Bio-safety cabinets, cryo cans, Water Bath, Deep freezers etc) used in the lab
2. Preparation of tissue culture medium
3. Sterilization of medium by membrane filtration technique
4. Maintenance of a cell line
5. Trypsinization of monolayer and sub culturing of cells
6. Counting of viable cells by trypan blue dye with the help of haemocytometer
7. Cryopreservation and revival of cells.
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)**

MBT 302

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 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)

MBT 302

Practical : 19 marks
Int. assessment: 06 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-II)
Immunology (Theory)**

MBT303

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. Kuby, 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)**

MBT-303

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-III)
Bioprocess Engineering & Technology (Theory)
MBT 304

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: Historical development of bioprocessing as industry. Scale up of a bioprocesses and its parameters from lab, pilot plant and industrial scales. 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.

SECTION –B

Bioreactors type: Introduction, Basic function of a bioreactor, microbial, animal and plant bioreactors (Waldhof-type acetators and cavitators, tower bioreactor, cylindrical vessels, air lift bioreactors, deep jet bioreactor, cyclone column, packed tower, rotating disc bioreactor). Aseptic operation and contamination. Sterilization of bioreactors and medium, 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. Basic concepts of Valves and stream traps (Gate valves, plug valves, ball valves, butterfly valves, Diaphragm valves, pressure control valves, safety valves, steam traps only).

SECTION –C

Mass and Gas transfer in Microbial systems: Introduction, The oxygen requirement for industrial bioreactors, oxygen demand and supply. 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.

SECTION –D

Sterilization

Introduction, design of batch sterilization process, del factor, sterilization cycle, Richards rapid method for design of sterilization cycles, 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 Ollis, 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)
MBT304

Practical : 19 marks
Int. assessment: 06 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 K_{La} volumetric oxygen transfer rate in the bioreactor by dynamic gassing out technique.

M. Sc. Biotechnology (Semester-III)
Seminar
MBT305

To make the students conversant with latest happening in the field of Biotechnology and to improve their communicational skill, seminars covering latest topics in Biotechnology have been included in the curriculum. Each candidate will select topic 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
MBT401A**

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

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
MBT401B

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 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:

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

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

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

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)
Advances in Plant Biotechnology
MBT402B**

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 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

Hairy Root Research: Recent Scenario and Exciting Prospects Production of hairy root cultures, hairy roots for high-value metabolite production, Biotransformation, Plant Cell Immobilization and free cell suspension cultures.

SECTION-B

Gene Silencing Techniques and Crop Improvement, Overview of different strategies for gene silencing, RNA interference, Construction of RNA interference vectors, Applications of RNA interference in crop improvements

SECTION-C

Reactive Oxygen Species (ROS) in Plants, ROS in biotic and abiotic stress, ROS in plant growth and development. Hormonal Regulation of Plant Growth and Development. Interplay of different hormones for plant growth and development.

SECTION-D

Production of transgenic plants, Crop improvement through transgenics, *Agrobacterium* mediated genetic transformation of plants, Direct DNA transfer methods for genetic transformation, Applications of transgenic plant production.

References:

1. Cellular and Molecular Biology of Plant Seed Development. Larkins, Brian A.; Vasil, Indra K. (Eds.), Vol. 4, 1997, ISBN 978-0-7923-4645-6
2. Mei-Liang Zhou, Xue-Mei Zhu, Ji-Rong Shao, Yi-Xiong Tang & Yan-Min Wu (2011) Production and metabolic engineering of bioactive substances in plant hairy root culture. *Appl Microbiol Biotechnol* 90:1229–1239
3. Klaus Apel and Heribert Hirt (2004) Reactive Oxygen Species: Metabolism, Oxidative Stress, and Signal Transduction. *Annu. Rev. Plant Biol.* 2004. 55:373–99

4. Ron Mittler, Sandy Vanderauwera, Nobuhiro Suzuki, Gad Miller, Vanesa B. Tognetti, Klaas Vandepoele, Marty Gollery, Vladimir Shulaev, Frank Van Breusegem (2011) ROS signaling: the new wave? *Trends in Plant Science*. 16 (6), 300-309
5. Matthew, L. (2004), RNAi for plant functional genomics, *Comparative and Functional Genomics*, 5, 240-244.
6. Umesh Balkrishna Jagtap, Ranjit Gajanan Gurav and Vishwas Anant Bapat Role of RNA interference in plant improvement. *Naturwissenschaften* (2011) 98:473–492
7. William M Gray (2004) Hormonal Regulation of Plant Growth and Development. *PLoS Biology*. 2 (9) e311
8. Stephen Depuydt and Christian S. Hardtke (2011) Hormone Signalling Crosstalk in Plant Growth Regulation. *Current Biology* 21: R365–R373
9. Hopkins W.G. (2006) *Plant Biotechnology*, Infobase Publishing, pp 153
10. Grierson, D. and Covey, S.N. (1984). *Plant Molecular Biology*, Black Publishers, New York
11. Old, R.W. and Primrose S.B. (1991). *Principles of Gene Manipulation, An Introduction to Genetic Engineering*, Blackwell Scientific Publications, Oxford.

**M. Sc. Biotechnology (Semester-IV)
Microbial Biotechnology
MBT402C**

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 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)
Intellectual Property Rights, Bioethics and Biosafety
MBT-403**

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 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. Introduction to Indian Patent law, Basic requirements of patentability, Patentable subject matter.

SECTION –B

World Trade Organization 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. Recent Development in Patent System. Compulsory licensing, Patent infringements and revocation. Patentability of Biotechnological invention

SECTION –C

Ethical issues of patenting in Biotechnology, Disclosure Requirements. Collaborative and competitive research, Challenges for the Indian Biotechnological research and industries. Introduction to Biosafety, Overview of biosafety, Biological Safety Cabinets,, Genetically modified organisms (GMOs), Concerns and Challenges, National and International Regulatory Mechanism for GMOs, Cartagena Protocol

SECTION –D

Biosafety of Genetically Engineered Products, Ecological Safety Assessment of Recombinant Organisms, Good Laboratory Biosafety Practices, Web-based Information of Biosafety on GMO. Introduction to Bioethics, Different Approaches to Ethics, Biological Weapons and Their Social and Ethical Implications. NGOs for Biosafety and Bioethics. Public and Private sector organizations for biosafety and bioethics

References:

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.
6. Intellectual Property rights in the WTO and Developing countries (2001) by Watal, J. Oxford University Press, New Delhi.
7. Law Relating to Intellectual Property Rights, 1st Edition (2007) by Ahuja, V.K
8. Patent law and Entrepreneurship, 3rd Edition, Kalyani publishers (2010) by Singh, I. and Kaur, B
9. New developments in biotechnology: Patenting life-special report (1990) Office of Technology Assessment (OTA), US Congress (Washington D.C. Dekker).
10. Draft manual of patent practice and procedure (2008) Patent Office, India.
11. Intellectual Property Bulletin.

**Research Project
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.

Educational Tour/Industrial Visit

MBT405

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.