

FACULTY OF LIFE SCIENCES

SYLLABUS

FOR

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

Examinations: 2019-20



GURU NANAK DEV UNIVERSITY
AMRITSAR

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SEMESTER-I**Scheme of Courses**

Sr. No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1.	Zoology-A	3	40	4	20
BT-2.	Botany-A	3	40	4	20
BT-3.	Inorganic Chemistry-A	3	40	4	20
BT-4.	Organic Chemistry-A	3	40	4	20
BT-5.	Computer & Bioinformatics Fundamentals	3	40	4	20
BT-6.	Punjabi (Compulsory) OR *ਮੁੱਢਲੀ ਪੰਜਾਬੀ OR **Punjab History & Culture		50		
BT-7.	Communication Skills in English-I		50		
BT-8.	General Microbiology-A	3	40	4	20
BT-9.	Biochemistry - A ***Drug Abuse: Problem, Management and Prevention (Compulsory)	3	40	4	20
			380		
				140	

Total Marks = 520**Note:**

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

SEMESTER-II**Scheme of Courses**

Sr.No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1.	Zoology-B	3	40	4	20
BT-2.	Botany-B	3	40	4	20
BT-3.	Inorganic Chemistry-B	3	40	4	20
BT-4.	Organic Chemistry-B	3	40	4	20
BT-5.	Biostatistics	3	40		
BT-6.	Punjabi (Compulsory) OR		50		
	*ਮੰਝੀ ਪੰਜਾਬੀ OR				
	**Punjab History & Culture				
BT-7.	Communication Skills in English-II		35		15
BT-8.	General Microbiology-B	3	40	4	20
BT-9.	Biochemistry - B	3	40	4	20
	***Drug Abuse: Problem, Management and Prevention (Compulsory)		50		
			365		
				135	

Total Marks = 500**Note:**

- *Special Paper in lieu of Punjabi Compulsory.**
- **For those students who are not domicile of Punjab**
- ***This paper marks will not be included in the total marks.**

SEMESTER-III**Scheme of Courses**

Sr. No.	Name of the Paper	Total Periods per week	Theory Marks	Total Periods per week	Practicals Marks
BT-1	Physical Chemistry-A	3	40	4	20
BT-2	Zoology-C	3	40	4	20
BT-3	Biochemistry-C	3	40	4	20
BT-4	Cell Biology	3	40	4	20
BT-5	Immunology-A	3	40	4	20
BT-6	Genetics	3	40	4	20
BT-7	Agro and Industrial Applications of Microbes-A	3	40	4	20
-----			280		140
Total Marks = 420					

SEMESTER-IV**Scheme of Courses**

Sr. No.	Name of the Paper	Total Periods	Theory	Total Periods	Practicals
		per week	Marks	per week	Marks
BT-1	Physical Chemistry-B	3	40	4	20
BT-2	Botany -C	3	40	4	20
BT-3	Biochemistry-D	3	40	4	20
BT-4	Skill Development in Biotechnology	6	40	4	20
BT-5	Immunology-B	3	40	4	20
BT-6	Molecular Biology	3	40	4	20
BT-7	Agro and Industrial Applications of Microbes-B	3	40	4	20
BT-8	Enzymology	3	40	4	20
ESL-221	Environmental Studies (Compulsory Paper)		100		

		320		160	
Total Marks = 480					

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

SEMESTER V**Scheme of Courses**

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

Total Marks = 420

SEMESTER-VI**Scheme of Courses**

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

Total Marks = 420

BT - 1**Zoology–A****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

Section-A

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

Section-B

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

Section-C

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

Section-D

Integumentary System: Integument and its derivatives in human.

BT-1**Zoology–A (Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4**

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

1. Demonstration of osmosis and diffusion.
2. Analysis of food stuff for the presence of starch, protein and fats.
3. Determination of blood groups of human blood samples.
4. Recording of blood pressure of man.
5. Estimation of hemoglobin content.
6. Study of the following prepared slides: histology of man (compound tissues).
7. Visit to clinical laboratory / hospital for demonstration of ECG, ECHO, X-ray, ultrasound, CT-scan and MRI.

Books:

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

BT – 2

Botany–A

Time: 3 Hrs.

Max. Marks: 40

Periods: 3

Instructions for the Paper Setters:

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

SECTION-A

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

SECTION-B

Apical Meristem: Tunica corpus and Histogen theories, reproductive apex and development of flower. Primary and Secondary growth in stem and root of *Helianthus*.

Study of anomalous structure in stem of *Boerhavia*, *Nyctanthes*, *Mirabilis* and *Dracena*.

SECTION-C

Reproduction in flowering plants: Structure and development of anther and male gametophyte, Structure and development of ovule and female gametophyte; different types of ovules and embryo sacs

SECTION-D

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

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

BT-2**Botany–A (Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus****Plant Anatomy:**

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

Embryology:

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

Taxonomy:

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

BT – 3 Inorganic Chemistry-A**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

Section-A

Introduction, Wemer's coordination theory, naming of co-ordinate complexes.

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

Section-B

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

Section-C

Crystal field theory-Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculation of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value, structure effects of crystal field splitting (Jahn-Teller distortion). Paramagnetism, diamagnetism, ferro and anti ferromagnetism, Microstates and spectroscopic terms, a calculation of spectroscopic terms for $d^1 - d^2$ electronic configurations using LS coupling, Hund's rule for finding the ground state term, limitations of C.F.T.

Section-D

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

Books Recommended:

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

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

- Volumetric Analysis:

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

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

BT - 4**Organic Chemistry–A****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

Section-A

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

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

Section-B

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

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. The SN^1 - SN^2 continuum.

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.

BT-4 Organic Chemistry-A (Practical)**Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.****Organic qualitative analysis:****Complete identification including derivation of following organic compounds:**

- Amides
- Amines
- Carboxylic acids and phenols.

BT - 5**Computers & Bioinformatics Fundamentals****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

Section-A

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

Section-B

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

Section-C

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

Section-D

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

Books Recommended:

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

Computers & Bioinformatics Fundamentals (Practical)**Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.****Practical related to theory shall be carried out for this course.**

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

BT-6

ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕੁਲ ਅੰਕ : 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿੱਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ**ਸੈਕਸ਼ਨ-ਏ**

ਆਤਮ ਅਨਾਤਮ (ਕਵਿਤਾ ਭਾਗ),
 (ਸੰਪ. ਸੁਹਿੰਦਰ ਬੀਰ ਅਤੇ ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ)
 ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
 (ਪ੍ਰਸ਼ਗ ਸਾਹਤ ਵਾਖਾਖਆ, ਸਾਰ)

ਸੈਕਸ਼ਨ-ਬੀ

ਇਤਿਹਾਸਕ ਯਾਦਾਂ (ਇਤਿਹਾਸਕ ਲੇਖ-ਸੰਗ੍ਰਹਿ)
 ਸੰਪਾ. ਸ.ਸ.ਅਮੋਲ,
 ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ। (ਲੇਖ 1 ਤੋਂ 6)
 (ਨਿਬੰਧ ਦਾ ਸਾਰ, ਲਿਖਣ-ਸ਼ੈਲੀ)

ਸੈਕਸ਼ਨ-ਸੀ

(ੳ) ਪੈਰਾ ਰਚਨਾ
 (ਅ) ਪੈਰਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ।

ਸੈਕਸ਼ਨ-ਡੀ

(ੳ) ਪੰਜਾਬੀ ਧੁਨੀ ਵਿਉਂਤ : ਉਚਾਰਨ ਅੰਗ, ਉਚਾਰਨ ਸਥਾਨ ਤੇ ਵਿਧੀਆਂ, ਸਵਰ, ਵਿਅੰਜਨ,
 ਸੁਰ-ਪ੍ਰਬਧ।
 (ਅ) ਭਾਸ਼ਾ ਵੰਨਗੀਆਂ : ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਅਤੇ ਉਪ-ਭਾਸ਼ਾ ਦਾ ਅੰਤਰ, ਪੰਜਾਬੀ
 ਉਪਭਾਸ਼ਾਵਾਂ ਦੇ ਪਛਾਣ-ਚਿੰਨ੍ਹ।

BT-6

ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(In lieu of Compulsory Punjabi)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕੁਲ ਅੰਕ: 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠ-ਕ੍ਰਮ

ਸੈਕਸ਼ਨ-ਏ

ਪੈਂਤੀ ਅੱਖਰੀ, ਅੱਖਰ ਕ੍ਰਮ, ਪੈਰ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ ਅਤੇ ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ ਅਤੇ ਮਾਤ੍ਰਵਾਂ (ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ)
ਲਗਾਖਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ

ਸੈਕਸ਼ਨ-ਬੀ

ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ
(ਸਾਧਾਰਨ ਸ਼ਬਦ, ਸੰਯੁਕਤ ਸ਼ਬਦ, ਮਿਸ਼ਰਤ ਸ਼ਬਦ, ਮੂਲ ਸ਼ਬਦ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ)

ਸੈਕਸ਼ਨ-ਸੀ

ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ : ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਰਿਸ਼ਤੇ-ਨਾਤੇ, ਖੇਤੀ ਅਤੇ ਹੋਰ ਧੰਦਿਆਂ ਆਦਿ ਨਾਲ ਸੰਬੰਧਤ।

ਸੈਕਸ਼ਨ-ਡੀ

ਹਫ਼ਤੇ ਦੇ ਸੱਤ ਦਿਨਾਂ ਦੇ ਨਾਂ, ਬਾਰ੍ਹਾਂ ਮਹੀਨਿਆਂ ਦੇ ਨਾਂ, ਗੁੱਤਾਂ ਦੇ ਨਾਂ, ਇਕ ਤੋਂ ਸੌ ਤਕ ਗਿਣਤੀ ਸ਼ਬਦਾਂ ਵਿਚ

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

Time: 3 Hours

Max. Marks: 50

Instructions for the Paper Setters:-

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

Section A

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

Section B

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

Section C

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

Section D

7. Teachings and impact of Buddhism
8. Jainism in the Punjab

Suggested Readings

1. L. M 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.
5. Chopra, P.N., Puri, B.N., & Das, M.N.(1974). *A Social, Cultural & Economic History of India*, Vol. I, New Delhi: Macmillan India.

BT-7**COMMUNICATION SKILLS IN ENGLISH-I****Time: 3 Hours****Max. Marks: 50****Instructions for the Paper Setters:-**

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

The syllabus is divided in four sections as mentioned below:**Section–A**

Reading Skills: Reading Tactics and strategies; Reading purposes–kinds of purposes and associated comprehension; Reading for direct meanings.

Section–B

Reading for understanding concepts, details, coherence, logical progression and meanings of phrases/ expressions.

Activities:

- Comprehension questions in multiple choice format
- Short comprehension questions based on content and development of ideas

Section–C

Writing Skills: Guidelines for effective writing; writing styles for application, personal letter, official/ business letter.

Activities

- Formatting personal and business letters.
- Organising the details in a sequential order

Section–D

Resume, memo, notices etc.; outline and revision.

Activities:

- Converting a biographical note into a sequenced resume or vice-versa
- Ordering and sub-dividing the contents while making notes.
- Writing notices for circulation/ boards

Recommended Books:

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

BT-8**General Microbiology–A****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

Section-A

Principles of Microbiology- Principles and application of bright field, dark field phase contrast, fluorescence & immunofluorescence, electron microscopy, bacterial nutrition-Introduction, Nutritional forms of bacteria, Transport mechanisms, Microbial culture media, Sterilization-Basic concept, physical and chemical methods of sterilization.

Section-B

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

Section-C

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

Section-D

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

Books Recommended:

1. Davis, B.D., Dulbecco. R., Eisen, H.N. and Ginsberg, H.S. (1990). Microbiology: 4th Edition, Harper & Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (1994). Microbiology: An introduction: 5th Edition, The Benjamin / Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General microbiology, MacMillan Press, 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.

BT- 8**General Microbiology-A (Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

1. 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.

BT - 9**Biochemistry – A****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

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

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 Sugar derivatives, Disaccharides; concept of reducing and non-reducing sugars, Haworth projections of maltose, lactose, and sucrose, Structural and functional properties of Polysaccharides: storage polysaccharides - starch and glycogen; Structural Polysaccharides - cellulose, peptidoglycan and chitin

SECTION-C

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

SECTION-D

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

Books Recommended:

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

**BT-9 Biochemistry-A
(Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

1. Preparation of different solutions/buffers- molarity, molality, Normality percentage.
2. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
3. Determination of pKa value of P-nitrophenol
4. Estimation of carbohydrate in given solution by anthrone method.
5. Study the presence of reducing/non-reducing sugar in biological samples.
6. Estimation of DNA by diphenyl amine method

Books Recommended:

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

Drug Abuse: Problem, Management and Prevention
(COMPULSORY PAPER)

PROBLEM OF DRUG ABUSE

Time: 3 Hours

Max. Marks: 50

Instructions for the Paper Setters:-

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

Section – A

Meaning of Drug Abuse:

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

Section – B

Consequences of Drug Abuse for:

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

Section – C

Management of Drug Abuse:

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

Section – D

Psychiatric Management: Counselling, Behavioural and Cognitive therapy.

Social Management: Family, Group therapy and Environmental Intervention.

References:

1. Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
4. Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
5. Kessel, Neil and Henry Walton. 1982, *Alcoholism. Harmond Worth*: Penguin Books.
6. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
7. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
8. Ross Coomber and Others. 2013, *Key Concept in Drugs and Society*. New Delhi: Sage Publications.

9. Sain, Bhim 1991, *Drug Addiction Alcoholism, Smoking obscenity* New Delhi: Mittal Publications.
10. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab: A Sociological Study*. Amritsar: Guru Nanak Dev University.
11. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
12. Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation*, Cambridge University Press.
13. Verma, P.S. 2017, "*Punjab's Drug Problem: Contours and Characteristics*", Economic and Political Weekly, Vol. LII, No. 3, P.P. 40-43.
14. World Drug Report 2016, United Nations office of Drug and Crime.
15. World Drug Report 2017, United Nations office of Drug and Crime.

BT-1 Zoology-B**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

SECTION-A

Urinogenital System: Structure of kidney and nephron, structure of gonads and urinogenital ducts, Menstrual cycle, Urine formation, osmoregulation.

SECTION-B

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

SECTION-C

Nervous System: Anatomy of brain and cranial nerves of man, Nature, origin and propagation of impulse along the axon, synapse and myoneuronal junctions. Sense Organs

SECTION-D

Skeletal System: Red & White muscle fibre, striped, unstriped and cardiac muscle fibre in man. Ultrastructure, physiological and biochemical basis of skeletal muscle contraction.

BT - 1**Zoology–B (Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4**

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

1. Study the following system of white rat with the help of charts / models / videos :
Digestive, arterial, venous and urinogenital systems.
2. Make a temporary preparation of the following:
Blood smear of mammals.
3. Study of the skeleton of human.
4. Analysis of urine for urea, chloride, glucose and uric acid
5. Estimation of urea, uric acid, creatinine and bilirubin from serum.
6. Estimation of protein and bile pigment in urine.

Books:

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

BT - 2

Botany–B

Time: 3 Hrs.

Max. Marks: 40

Periods: 3

Instructions for the Paper Setters:

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

SECTION-A

Systems of classification: Artificial, Natural and Phylogenetic; Salient features of Bentham & Hooker's, Hutchinson and Engler & Prantl's system of classification, (Details of Bentham & Hooker's system only).

Terminology pertaining to floral description, Criteria for primitive and advanced nature of families and flower.

SECTION-B

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

Ranunculaceae - *Ranunculus*, *Delphinium*

Solanaceae: *Solanum*/*Petunia*

Rutaceae: *Citrus*, *Murraya*

Cruciferae- *Brassica*

Apiaceae (Umbelliferae) - *Coriander*

Asteraceae (Compositae) – *Helianthus*/*Sonchus*/*Ageratum*

Lamiaceae (Labiatae) - *Ocimum*/*Salvia*

SECTION-C

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

Leguminosae – *Lathyrus*, *Cassia* and *Acacia*

Liliaceae: *Asphodelus*/*Asparagus*

Orchidaceae - *Zeuxine*

Poaceae (graminae)- *Triticum*

Evolutionary status of

Ranunculaceae, Compositae, Orchidaceae.

SECTION-D

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

Books Recommended:

1. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
2. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
3. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
4. Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
5. Radford, A.E. (1986). Fundamental of Plant Systematics, Harper and Row, New York
6. Vashistha, P. C. (2016). Botany for degree students. S. Chand and Company, New Delhi.
7. McDonald, M. F. and Copeland, L. O. (2012). Seed Production: Principles and Practices, Springer, New York.
8. Basra, A. (Ed). (2006). Handbook of Seed Science and Technology. CRC Press, New York.

BT - 2**Botany–B (Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus**

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

BT - 3 Inorganic Chemistry-B

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Instructions for the Paper Setters:-

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

SECTION-A**- Acid ligands**

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

SECTION-B**Alkali metal and alkaline earth metal chelators**

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

SECTION-C**Stability of co-ordination compounds**

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

SECTION-D**Metal ions in biological system**

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

Mg: Chlorophyll structure and function in photosynthesis.

Zn: Carboxypeptidase enzyme functions.

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

BT-3 Inorganic Chemistry-B (Practical)

Time: 3 Hrs.
Periods: 4

Max. Marks: 20

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

- Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dryheating test, charcoal cavity test, $\text{Co}(\text{NO}_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis:

Dil H_2SO_4 gp: CO_3^{2-} , NO_2^- , S^{2-} , SO_3^{2-}

Conc, H_2SO_4 gp: Cl^- , Br^- , I^- , NO_3^- , CH_3Coo^-

Individual gp: SO_4^{2-} , PO_4^{3-} , BO_3^{3-}

C. Basic radical analysis:

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

BT - 4**Organic Chemistry–B****Time: 3 Hrs.
Periods: 3****Max. Marks: 40****Instructions for the Paper Setters:-**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Books Recommended:

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

Organic Chemistry (Practical)**Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.****Organic qualitative analysis:****Complete identification including derivation of following organic compounds:**

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

BT-5**Biostatistics****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:-**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Recommended Books:

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

BT-6

ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕੁਲ ਅੰਕ : 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿੱਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ

ਸੈਕਸ਼ਨ-ਏ

ਆਤਮ ਅਨਾਤਮ (ਕਹਾਣੀ ਭਾਗ),
(ਸੰਪ. ਸੁਹਿੰਦਰ ਬੀਰ ਅਤੇ ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ)
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
(ਵਿਸ਼ਾ-ਵਸਤੂ, ਪਾਤਰ ਚਿਤਰਨ)

ਸੈਕਸ਼ਨ-ਬੀ

ਇਤਿਹਾਸਕ ਯਾਦਾਂ (ਇਤਿਹਾਸਕ ਲੇਖ-ਸੰਗ੍ਰਹਿ)
ਸੰਪਾ. ਸ.ਸ.ਅਮੋਲ,
ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ। (ਲੇਖ 7 ਤੋਂ 12)
(ਸਾਰ, ਲਿਖਣ ਸ਼ੈਲੀ)

ਸੈਕਸ਼ਨ-ਸੀ

(ੳ) ਸ਼ਬਦ-ਬਣਤਰ ਅਤੇ ਸ਼ਬਦ ਰਚਨਾ : ਪਰਿਭਾਸ਼ਾ, ਮੁੱਢਲੇ ਸੰਕਲਪ
(ਅ) ਸ਼ਬਦ ਸੁਣਾਓ

ਸੈਕਸ਼ਨ-ਡੀ

(ੳ) ਸੰਖੇਪ ਰਚਨਾ
(ਅ) ਮੁਹਾਵਰੇ ਅਤੇ ਅਖਾਣ

BT-6

ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(In lieu of Compulsory Punjabi)

ਸਮਾਂ: 3 ਘੰਟੇ

ਕੁਲ ਅੰਕ: 50

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿੱਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠ-ਕ੍ਰਮ

ਸੈਕਸ਼ਨ-ਏ

ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ
(ਨਾਂਵ, ਪੜਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ, ਯੋਜਕ ਅਤੇ ਵਿਸਮਿਕ)

ਸੈਕਸ਼ਨ-ਬੀ

ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ : ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ
(ੳ) ਸਾਧਾਰਨ ਵਾਕ, ਸੰਯੁਕਤ ਵਾਕ ਅਤੇ ਮਿਸ਼ਰਤ ਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)
(ਅ) ਬਿਆਨੀਆ ਵਾਕ, ਪ੍ਰਸ਼ਨਵਾਚਕ ਵਾਕ ਅਤੇ ਹੁਕਮੀ ਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)

ਸੈਕਸ਼ਨ-ਸੀ

ਪੈਰ੍ਹਾ ਰਚਨਾ
ਸੰਖੇਪ ਰਚਨਾ

ਸੈਕਸ਼ਨ-ਡੀ

ਚਿੱਠੀ ਪੱਤਰ (ਘਰੇਲੂ ਅਤੇ ਦਫ਼ਤਰੀ)
ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

**BT-6 : Paper-II: Punjab History & Culture (C 320 to 1000 B.C.)
(Special Paper in lieu of Punjabi compulsory)
(For those students who are not domicile of Punjab)**

Time: 3 Hours

Max. Marks : 50

Instructions for the Paper Setters:-

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

Section A

1. Alexander's Invasion and its Impact
2. Punjab under Chandragupta Maurya and Ashoka.

Section B

3. The Kushans and their Contribution to the Punjab.
4. The Panjab under the Gupta Empire.

Section C

5. The Punjab under the Vardhana Emperors
6. Socio-cultural History of Punjab from 7th to 1000 A.D.

Section D

7. Development of languages and Education with Special reference to Taxila
8. Development of Art & Architecture

Suggested Readings

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

BT-7**COMMUNICATION SKILLS IN ENGLISH-II****Time: 3 Hours****Max. Marks: 50**
Theory Marks: 35
Practical Marks: 15**Instructions for the Paper Setters:-**

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

Course Contents:**SECTION-A**

Listening Skills: Barriers to listening; effective listening skills; feedback skills.

Activities: Listening exercises – Listening to conversation, News and TV reports

SECTION-B

Attending telephone calls; note taking and note making.

Activities: Taking notes on a speech/lecture

SECTION-C

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.

Activities: 1) Making conversation and taking turns
2) Oral description or explanation of a common object, situation or concept

SECTION-D

The study of sounds of English,
Stress and Intonation,
Situation based Conversation in English,
Essentials of Spoken English.

Activities: Giving Interviews

PRACTICAL/ ORAL TESTING**Marks: 15****Course Contents:**

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

Questions:

1. Oral Presentation will be of 5 to 10 minutes duration (Topic can be given in advance or it can be student's own choice). Use of audio visual aids is desirable.
2. Group discussion comprising 8 to 10 students on a familiar topic. Time for each group will be 15 to 20 minutes.

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

BT - 8 General Microbiology–B

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Instructions for the Paper Setters:-

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

SECTION-A

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

SECTION-D

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

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.

General Microbiology–B (Practical)

Time: 3 Hrs.
Periods: 4

Max. Marks: 20

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

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

Books Recommended:

1. Cappuccino, J.G. and Sherman, N. (1999). Microbiology: A Laboratory Manual 4th Ed: Harlow, Addition-Wesley.
2. Sambrook, J., Russel, D.W. (2001). Molecular Cloning. A laboratory manual 3rd Ed., Cold Spring Harbor Laboratory Press, New York.
3. Dubey R.C. and Maheshwari (2012) Practical Microbiology 5th edition: S. Chand and company ltd.New Delhi.

BT - 9
Biochemistry - B**Time: 3 Hrs.**
Periods: 3**Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Books Recommended:

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

**BT - 9 Biochemistry-B
(Practical)****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

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

Books Recommended:

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

Drug Abuse: Problem, Management and Prevention
(COMPULSORY PAPER)

DRUG ABUSE: MANAGEMENT AND PREVENTION

Time: 3 Hours

Max. Marks: 50

Instructions for the Paper Setters:-

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

Section – A

Prevention of Drug abuse:

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

Section – B

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

Section – C

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

Section – D

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

References:

1. Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
4. Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
5. Kessel, Neil and Henry Walton. 1982, *Alcoholism*. Harmond Worth: Penguin Books.
6. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
7. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
8. Ross Coomber and Others. 2013, *Key Concept in Drugs and Society*. New Delhi: Sage Publications.

9. Sain, Bhim 1991, *Drug Addiction Alcoholism, Smoking obscenity* New Delhi: Mittal Publications.
10. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab: A Sociological Study*. Amritsar: Guru Nanak Dev University.
11. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
12. Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation*, Cambridge University Press.
13. Verma, P.S. 2017, "*Punjab's Drug Problem: Contours and Characteristics*", Economic and Political Weekly, Vol. LII, No. 3, P.P. 40-43.
14. World Drug Report 2016, United Nations office of Drug and Crime.
15. World Drug Report 2017, United Nations office of Drug and Crime.

BT - 1**Physical Chemistry – A****Time: 3 Hrs.**
Periods: 3**Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A**Chemical Thermodynamics:**

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

SECTION-B

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

SECTION-C**Solutions:**

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

SECTION-D**Phase Equilibria:**

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

BT-1
Physical Chemistry – A Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

1. Surface tension: Determination of surface tension of a given liquid by Stalgotometer. Using number of drops and weight of drops methods
2. Determination of coefficient of viscosity of a pure liquid (Acetone, Ethanol, Propanol, Butanol, Glycol) (Effect of hydrogen bonding on viscosity)
3. Photometry.
Verification of Lambert beer's law for solution of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ (in water) and $\text{K}_2\text{Cr}_2\text{O}_7$ (in water)
4. a) pH of buffer solution
b) Acid base titration HCl vs. NaOH.
c) Determination of ionization constant of a weak acid (CH_3COOH)
5. Study of distribution law of Benzoic acid between benzene and water.
6. Study of distribution law by iodine distribution between water and CCl_4 . Given standard solution $\text{Na}_2\text{S}_2\text{O}_3$.
7. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

BT - 2
Zoology-C**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

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, Entamoeba, Trypanosoma, Leishmania, Giardia, Trichomonas and Plasmodium.

SECTION-B

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

SECTION-C

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

SECTION-

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

BT-2
Zoology – C Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

1. Preparation of blood smear showing different stages of plasmodium
2. Study of permanent slides and specimens of parasitic protozoans, helminth and arthropods: Entamoeba, Giardia, Plasmodium, Trypanosoma, Leishmania, Trichomonae,
3. Anopheles, culex (mouth parts), lice, rat flea, Aedes Aegypti, Tapeworm, Ascaris, Wuchereria, Trichinella, Ancylostoma, Oxyuris.
4. Pathological examination of blood and urine.
5. Blood Tests:
 - (a) Erythrocyte sedimentation rate
 - (b) Bleeding time
 - (c) Clotting time
 - (d) Prothrombin time

Books:

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

BT – 3 Biochemistry – C**Time: 3 Hrs.
Periods: 3****Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Books Recommended:

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

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

1. Absorbance curve of two dyes
2. Determination of reducing sugar using 3,5 dinitrosalicylic acid.
3. Spectral analysis of various plant pigments
4. Separation of lipids from wheat grains.
5. Separation of macromolecules using thin layer chromatography

Books Recommended :

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

BT – 4 Cell Biology**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

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:

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

BT-4
Cell Biology – Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

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

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

-Preparation of Permanent Slides: Principles and procedures- Section cutting of tissues and staining of tissues with Haematoxylin/eosin method.

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

-Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas, testis, ovary, tongue, skin etc.).

Books Recommended:

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

**BT - 5
Immunology-A****Time: 3 Hrs.
Periods: 3****Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

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 epitoe), 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. Austyn, J.M. and Wood K.J. (1993), Principles of Cellular and molecular Immunology, Oxford University Press Inc. New York
2. Paul, W./E. (1995), Fundamental Immunology, 3rd Ed., Raven Press, New York
3. Britch, J.R. and Lennox, E.S. (1995), Monoclonal Antibodies Principles and Application, Wiley Liss.
4. Roitt, I.M. Brostoff, J. and Male, D.K. (1996), Immunology, 4th Edition, Grower Medical Publishing, New York
5. Strites D.P., Terr. A.I. & Parslow T.G. (1997), Medical Immunology, 9th Ed., PHI, Cambridge.
6. Kanfmann, S.H.E., Sher A., Ahmed, R. (2002). Immunology of Infections Diseases, ASM Press, Washington
7. Kuby, J. (2004), Immunology, 5th Edition. W.H. Freeman and Company, New York

BT-5**Immunology-A Practical****Time: 3 Hrs. Max.****Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

1. Differential leucocytes count
2. Total Leucocytes count
3. Total RBC count
4. Blood Group testing
5. Separation of serum & Plasma from blood
6. Isolation of mononuclear cells from peripheral blood viability test by dye exclusion method.
7. Collection of blood sample by different method.

Books Recommended:

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

BT – 6 Genetics**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

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

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.

SECTION-D

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

Basic Microbial Genetics: Conjugation, transduction, transformation

Books Recommended:

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

BT-6
Genetics Practical**Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

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

BT – 7 Agro and Industrial Applications of Microbes – A**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

Historical landmarks in general, agricultural and industrial Microbiology, Basic concept of agriculture and food processing as industry. Differences between microbial industrial processes and chemical industrial processes.

SECTION-B

Characteristics of industrial important microbes, its isolation, screening, selection and identification. Maintenance and preservation of industrially important microbial cultures.

SECTION-C

Strain improvement of industrial important microbes: by using mutational programme and recombination systems (parasexual cycle, protoplast fusion and recombinant DNA techniques), Isolation of mutants (induced, auxotrophic, resistant and revertant mutants), Inoculum development, selection pressure in maintaining the hyper producing microbes, revertant back of higher yielding microbes into lower production, media formulation and process optimization of industrial and agro industrial microbes.

SECTION-D

Microbial association and their interaction with plants, asymbiotic and symbiotic nitrogen fixation (*Rhizobium*, *Azospirillum*, *Azotobacter*, *Anabaena*), nitrogen cycle and role of *Agrobacterium* in sustainable agriculture.

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.

BT-7**Agro and Industrial Applications of Microbes – A Practical****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

1. 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.

BT - 1**Physical Chemistry – B****Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A**Electrochemical Cells:**

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

SECTION-B**Chemical Kinetics:**

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

SECTION-C

Ionic Equilibria and Conductance: Conductivity, equivalent and molar conductance. Variation of equivalent conductance with dilution of weak and strong electrolytes. Arrhenius and Debye Huckel theory. Kohlraush law of independent migration of ions. Transference number and their experimental determination using Hittorf and moving boundary methods. Ionic velocity, ionic mobility. Applications of conductance measurements.

SECTION-D

Determination of degree of ionisation of weak electrolyte, solubility, solubility product of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt, conductometric titrations. Ionic strength. Debye Huckel theory of activity coefficients. Mathematical treatment of multistage equilibria of acids and bases. Salt hydrolysis, calculation of hydrolysis constant, Buffer solutions, Buffer index, Buffer capacity universal buffer preparation. Acid base indicators. Theory of acid base indicators. pH change and selection of indicators in different acid base titrations.

BT-1**Physical Chemistry – B Practical****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

1. Refractometry: Determine refractive index of a given liquid as a criterion for its purity. (Benzene i.e. commercial) benzene + A.R. acetone).
2. Polarimetry: Determine the %age composition of an optically active solution.
3. Calorimetry:
 - a) Determination of Heat of neutralization
 - (i) Strong acid-strong base
 - (ii) Weak acid-strong base.
 - b) Determination of Heat of solution of KCl, NH₄Cl, KNO₃
4. Conductometry:
 - a) Determination of cell constant.
 - b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
 - c) Precipitation titration of Na₂SO₄ vs. BaCl₂.
 - d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH₃COOH.
5. Determination of adsorption isotherm of oxalic acid on charcoal.

BT - 2
Botany – C**Time: 3 Hrs.**
Periods: 3**Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

Water relations, osmosis, transpiration, water potentials, its components, 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: Definition, classification, mode of transmission & control measures of plant diseases. Disease resistance host pathogen interaction. Phytoalexins, PR proteins.

SECTION-D

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

BT-2
Botany – C Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

1. Estimation of relative water content of leaf.
2. Measurement of osmotic potential of different tissues by Chardokov method.
3. Study of Plant pathogens
 - (a) Symptoms of the diseases
 - (b) Morbid anatomy of the plants infected with following diseases.

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

Books:

1. Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company
2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates
3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications
4. Pandey, B.P. (2001) Plant Pathology, S Chand
5. M.J. Carlile, S.C. Watkinson & G.W. Gooday (2001), The Fungi 2nd Ed., Academic Press.
6. G.N. Agrios (1997), Plant Pathology 4th Ed., Academic Press.
7. R.S. Mehrotra (1980) Plant Pathology Tata McGraw Hill New Delhi.

BT – 3 Biochemistry – D**Time: 3 Hrs.**
Periods: 3**Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Books Recommended:

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

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

1. Isolation of 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.

Books Recommended:

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

BT-4**BT – 4 Skill Development in Biotechnology****Periods: 6****Time : 3 Hrs****Max. Marks: 40****Instructions for the Paper Setters:**

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

Food Biotechnology**SECTION-A**

Commercial potential of food fermentation industry; Novel food ingredients: Low calorie sweetener, Plant tissue culture and naturally produced flavor modifiers, natural food coloring agents; Nutraceuticals: Probiotics, Food spoilage: Detection and mechanism of food borne infections (*Clostridium*, *Salmonella*, *Staphylococcus*, *Aspergillus* sp.);

SECTION-B

Preservation: thermal processing, cold preservation, chemical preservatives, food dehydration, food irradiation, biological control; Quality assurance: Biochemical/ microbial testing of food adulterants: milk, butter, oil, jams, jellies, Government regulatory practices and policies (FSSAI, FDA etc.), Food packaging: need and ways (glass, metal, plastics, moulded pulp and aluminium foil). Advanced techniques in food borne pathogens and toxins, biosensors in food industry for detection of food contamination

Dietics and Nutrition Management**SECTION-C**

Energy value of foods, basal metabolic rate definition and its measurement, factors affecting BMR, energy requirements of human beings, nutritional aspects of the carbohydrates, different dietary types, requirements, utilization and functions; special role of non-starch polysaccharides, nutritional aspects of the lipids; nutritional aspects of proteins; nutritive value of proteins

SECTION-D

Methods of protein determination, amino acid imbalance, protein requirements, utilization and functions, nutritional aspects of vitamins and minerals, food processing and loss of nutrients during processing and cooking, naturally occurring antinutrients, balanced diet, recommended dietary allowances for different categories of human beings, disorders related to nutrition-protein energy malnutrition, starvation and obesity.

Books

1. Frazier, W.C. and Westhoff, D.C. (2007). Food microbiology (Tata McGraw-Hill publishing Co. Ltd).
2. Admas, M.R. and Moss, M.O. (2005). Food microbiology (Edition 3, Illustrated Publisher Royal Society of Chemistry).
3. SriLakshmi B. (2003) Food science (New Age International Publishers, India).
4. Jay J.M., Loessner M.J. and Golden D.A. (2005). Modern Food Microbiology, Edition 7, Illustrated Publisher Springer, Printed by Rashtrya Printers Delhi).
5. Sivasankar B. (2004). Food processing and preservation (PHI Private Ltd, New Delhi).
6. Michael P. Doyle, Larry R. Beuchat (2007). Food Microbiology: Fundamentals and Frontiers, ASM Press.

BT-4 Skill Development in Biotechnology (Practical)**Time : 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

1. Detection of Adulteration in food (oil, butter).
2. Determination of crude fibre content in wheat and chickpea.
3. Determination of Gluten content in wheat flour.
4. Isolation of protein concentrates.
5. Determination of fat content in different food products.
6. Determine the BMR

BT - 5
Immunology-B

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Instructions for the Paper Setters:

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

SECTION-A

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

BT-5**Immunology-B Practical****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

1. 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.

BT - 6 Molecular Biology**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Instructions for the Paper Setters:**

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Books Recommended:

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

BT-6
Molecular Biology Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

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

Books Recommended:

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

BT-7**Agro and Industrial Applications of Microbes – B**

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Instructions for the Paper Setters:

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

SECTION-A

Microbes involved in antibiotics production: Penicillin and Streptomycin, pharmaceutical drugs used in food industry, enzymes production: amylases and cellulases, solvent production: Acetone, butanol and ethanol. Biosurfactants: types, source and their applications, vermiculture, composting, microbial inoculants: production of bacterial biofertilizers (*Rhizobium* sp.), mass cultivation of cyanobacteria biofertilizers, bacterial insecticides: *Bacillus* species as bacterial insecticides, biopesticides: types, world scenario of biopesticides use.

SECTION-B

Fermented foods: Sauerkraut and pickles, Biotransformation, organic acids: production of citric acid and acetic acid, vitamins: microbial production of vitamin B12 and vitamin C, amino acids: glutamic acid and lysine production, single cell protein: spirulina and mycoprotein (*Fusarium venenatum*), alcohols, wine, beers, and mycotoxins (Aflatoxins).

SECTION-C

Fuel Biotechnology, transgenic crops (BT cotton and maize) and their potentials in agro industry, probiotic and prebiotic soil treatment with microbes, Mycorrhizal fungi, Biogas production, Biodegradation of xenobiotic compound.

SECTION-D

Introduction to primary and secondary metabolites production, dairy products like curd, yoghurt, cheese, bread, proteases in leather processing industries, Biosensors.

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 University Press.
6. Prescott and Dunn (1999). Industrial Microbiology 4th Edition, By S.K.Jain for CBS Publishers & Distritutors.
7. Purohit, S.S. (2000). Microbiology : Fundamentals and Applications (6th Edition), Agrobios (India).
8. Postgate. J. (2000). Microbes & Man 4th Edition, Cambridge University 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.

BT-7**Agro and Industrial Applications of Microbes – B Practical****Time: 3 Hrs.****Max. Marks: 20****Periods: 4****Note. The question paper will be set by the examiner based on the syllabus.**

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

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.

BT - 8
Enzymology**Time: 3 Hrs.**
Periods: 3**Max. Marks: 40****Instructions for the Paper Setters:**

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

SECTION-A

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

SECTION-B

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

SECTION-C**Enzyme Kinetics:**

A brief concept of bioenergetics and kinetics, Kinetics of single and bi-substrate enzyme catalyzed reactions, Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of K_m and V_{max} values, Lineweaver-Burk plot, Hanes Plot

SECTION-D

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

Books Recommended :

1. Berg J.M., Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
2. Nelson DL and Cox MM. (2013) Lehninger Principles of Biochemistry, 6th Edition. MacMillan Worth Publishers, New Delhi.
3. Palmer T and Bonner PL (2007) Enzymers : Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, Woodhead Publishing.
4. Voet D, Voet JG and Pratt CW (2011). Fundamentals of Biochemistry, 5th Edition. John Wiley & Sons. New York.

BT-8
Enzymology Practical

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

1. Estimation of α -amylase activity from saliva.
2. Assay of acid phosphatase activity.
3. Effect of temperature on enzyme activity.
4. Effect of pH on enzyme activity
5. Determination of K_m for acid phosphatase.

Books Recommended:

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

ESL 221: Environmental Studies (Compulsory Paper)**Time: 3Hrs.****Max. Marks: 100****Teaching Methodologies**

The Core Module Syllabus for Environmental Studies includes class room teaching and field work. The syllabus is divided into 8 Units [Unit-1 to Unit-VII] covering 45 lectures + 5 hours for field work [Unit-VIII]. The first 7 Units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit-VIII comprises of 5 hours field work to be submitted by each candidate to the Teacher in-charge for evaluation latest by 15 December, 2019.

Exam Pattern: **End Semester Examination- 75 marks**
 Project Report/Field Study- 25 marks [based on submitted report]
 Total Marks- 100

The structure of the question paper being:

Part-A, Short answer pattern with inbuilt choice – 25 marks

Attempt any five questions out of seven distributed equally from Unit-1 to Unit-VII. Each question carries 5 marks. Answer to each question should not exceed 2 pages.

Part-B, Essay type with inbuilt choice – 50 marks

Attempt any five questions out of eight distributed equally from Unit-1 to Unit-VII. Each question carries 10 marks. Answer to each question should not exceed 5 pages.

Project Report / Internal Assessment:**Part-C, Field work – 25 marks [Field work equal to 5 lecture hours]**

The candidate will submit a hand written field work report showing photographs, sketches, observations, perspective of any topic related to Environment or Ecosystem. The exhaustive list for project report/area of study are given just for reference:

1. Visit to a local area to document environmental assets: River / Forest/ Grassland / Hill / Mountain / Water body / Pond / Lake / Solid Waste Disposal / Water Treatment Plant / Wastewater Treatment Facility etc.
2. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
3. Study of common plants, insects, birds
4. Study of tree in your areas with their botanical names and soil types
5. Study of birds and their nesting habits
6. Study of local pond in terms of wastewater inflow and water quality
7. Study of industrial units in your area. Name of industry, type of industry, Size (Large, Medium or small scale)
8. Study of common disease in the village and basic data from community health centre
9. Adopt any five young plants and photograph its growth
10. Analyze the Total dissolved solids of ground water samples in your area.
11. Study of Particulate Matter (PM_{2.5} or PM₁₀) data from Sameer website. Download from Play store.
12. Perspective on any field on Environmental Studies with secondary data taken from Central Pollution Control Board, State Pollution Control Board, State Science & Technology Council etc.

Unit-I**The multidisciplinary nature of environmental studies**

Definition, scope and importance, Need for public awareness

(2 lectures)

Unit-II**Natural Resources: Renewable and non-renewable resources:**

Natural resources and associated problems.

- (a) Forest resources: Use and 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, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
- (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
 - Role of an individual in conservation of natural resources.
 - Equitable use of resources for sustainable lifestyles.

(8 Lectures)**Unit-III****Ecosystems**

- 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 ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

(6 Lectures)**Unit-IV****Biodiversity and its conservation**

- Introduction – Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

(8 Lectures)

Unit-V**Environmental Pollution**

Definition

- Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution
- 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

(8 Lectures)**Unit-VI****Social Issues and the Environment**

- From unsustainable to sustainable development
- Urban problems and 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, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and control of Pollution) Act, 1974
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

(7 Lectures)**Unit-VII****Human Population and the Environment**

- Population growth, variation among nations
- Population explosion – Family Welfare Programmes
- 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

(6 Lectures)

Unit-VIII**Field Work**

- 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

(Field work equal to 5 lecture hours)

References:

1. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
2. Down to Earth, Centre for Science and Environment, New Delhi.
3. Heywood, V.H. & Waston, R.T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
4. Joseph, K. & Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
5. Kaushik, A. & Kaushik, C.P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
6. Rajagopalan, R. 2011. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
7. Sharma, J. P., Sharma. N.K. & Yadav, N.S. 2005. Comprehensive Environmental Studies, Laxmi Publications, New Delhi.
8. Sharma, P. D. 2009. Ecology and Environment, Rastogi Publications, Meerut.
9. State of India's Environment 2018 by Centre for Sciences and Environment, New Delhi
10. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.

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

BT-1 rDNA Technology A

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

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

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

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

UNIT I

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

UNIT II

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

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

UNIT III

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

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

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

Books Recommended:

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

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BT-2 Concepts of Plant Tissue Culture**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:**

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

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

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

Unit-I

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

Unit-II

Physiological functions and biosynthesis of major plant growth regulators such as auxins, cytokinins, 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)

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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

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Concepts of Plant Tissue Culture (Practical)**Time : 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

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

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

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

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

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

Unit-I

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

Unit- II

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

Unit-III

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

Unit-IV

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

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

Books Recommended

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

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Animal Tissue Culture (Practical)**Time : 3 Hrs.****Max. Marks: 20****Periods: 4**

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

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

Book Recommended :

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

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BT-4 PATENT LAWS IN BIOTECHNOLOGY**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:**

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

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

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

Unit-I

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

Unit-II

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

Unit - III

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

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Unit IV

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

Books:

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

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

BT-5

BIOPROCESS ENGINEERING – A

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

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

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

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

Unit-1

Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. 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.

Books Recommended:

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

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BIOPROCESS ENGINEERING – A (Practical)

Time: 3 Hrs.
Periods: 4

Max. Marks: 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).

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BT-6 Biophysical and Biochemical Techniques-A**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:**

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

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

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

Unit-I

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

Unit - II

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

Unit III

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

Unit IV

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

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Books:

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

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

Biophysical and Biochemical Techniques (Practical)

Time : 3 Hrs.

Max. Marks: 20

Periods: 4

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

1. To study 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-7 Physical, Organic & Inorganic Aspects of Spectroscopy-A**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:****Section-A:** 8 very short answer type questions are to be set, two from each unit, the maximum length

of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.**Section-C:** This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.**UNIT – I****1. Energy and Electromagnetic Spectrum**

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

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

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

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

UNIT – IV**IV. Applications of UV and IR Spectroscopy**

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

Books Recommended:

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

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

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

Time: 3 Hrs.
Periods: 4

Max. Marks: 20

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

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

Synthesis and electronic spectral studies of d-d bands of $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ and $[\text{Ni}(\text{en})_3]\text{Cl}_2$ complexes. A comparison of their electronics spectra with that of $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ for the calculation of 10 Dq values.

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

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

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

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

BSC. (BIO-TECHNOLOGY) SEMESTER-V

BT-8 Term Paper

Max. Marks: 20

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

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BT-1 rDNA Technology-B

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

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

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

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

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

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rDNA Technology-B (Practical)**Time : 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus**

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

Books Recommended:

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

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BT-2 Applications of Plant Tissue Culture**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:**

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

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

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

Unit I

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

Unit II

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

Unit-III

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

Unit-IV

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

Books:

1. Bhajwani, S.S, & Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.
2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers
3. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

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Applications of Plant Tissue Culture (Practical)

Time : 3 Hrs.

Max. Marks: 20

Periods: 4

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

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

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

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

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

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

Unit- I

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

Unit- II

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

Unit- III

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

Unit-IV

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

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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.

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Animal Biotechnology (Practical)

Time : 3 Hrs

Max. Marks: 20

Periods: 4

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

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

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BT-4 Intellectual Property Rights and Enterepreneurship

Time: 3 Hrs.

Max. Marks: 40

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

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

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

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

Unit I

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

Unit II

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

Unit III

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

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Unit IV

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

Books:

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

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BT-5 BIOPROCESS ENGINEERING – B

Time: 3 Hrs.
Periods: 3

Max. Marks: 40

Note for the Paper Setters/Examiners:

Each question paper will consist of three sections as follows:

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

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

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

Unit-1

Design of a Fermenter:

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

Unit-II

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

Unit-III

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

Unit-IV

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

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BIOPROCESS ENGINEERING – B (Practical)

Time: 3 Hrs.

Max. Marks: 20

Periods: 4

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

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

Books Recommended:

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

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BT-6 Biophysical and Biochemical Techniques- B

Time: 3 Hrs.

Max. Marks: 40

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

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

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

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

UNIT-I

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

UNIT-II

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

UNIT III

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

UNIT-IV

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

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Biophysical and Biochemical Techniques -B (Practical)

Time : 3 Hrs.

Max. Marks: 20

Periods: 4

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

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

Books:

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

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BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-B**Time: 3 Hrs.****Max. Marks: 40****Periods: 3****Note for the paper setters/examiners:****Each question paper will consist of three sections as follows:**

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

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

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

UNIT-I**I. Proton Magnetic Resonance spectroscopy (1H NMR)**

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.

Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, Anisotropic effect. Spin spin splitting, Coupling constant.

UNIT-II**II. Applications of NMR spectroscopy**

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

UNIT- III**III. Mass 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.

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UNIT- IV**IV. Applications of Mass Spectroscopy**

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

Books Recommended:

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

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BT-7 Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical**Time : 3 Hrs.****Max. Marks: 20****Periods: 4****Note: The question paper will be set by the examiner based on the syllabus.**

Record the ^1H NMR spectra of ethyl acetate and ethyl acetoacetate (in CDCl_3 or CCl_4) and show the presence of tautomeric structures.

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

Separation of components of spinach using column chromatography.

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

Compare the IR and ^1H NMR spectra of aspirin and salicylic acid.

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BT-8

Max. Marks: 20

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