

**PANJAB UNIVERSITY CHANDIGARH- 160 014 (INDIA)**

(Estded. under the Panjab University Act VII of 1947-enacted by the Govt. of India)



**FACULTY OF SCIENCE**

**SYLLABI**

***FOR***

**B.Sc. (HONOURS) BIOTECHNOLOGY**

**Semester System**

**EXAMINATIONS 2017-2018**

**--:O:--**

**B.Sc. (Hons.) Biotechnology (Semester System)**  
**Examinations 2017-2018**

**B.Sc. (Hons.) 1<sup>st</sup> year (1<sup>st</sup> Semester)**

Sr. No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	English	BIOT-Sem-I-I-T	50	-	-
2.	Punjabi/HCP	BIOT - Sem-I--II-T	50	-	-
3.	Mathematics / A Life Sciences -B	BIOT-Sem-I-III-TA/TB	75	BIOT-Sem-I-III- PA/PB	25
4.	Chemistry	BIOT-Sem-I-IV-T	75	BIOT- Sem -I-IV-P	25
5.	Physics	BIOT-Sem-I-V-T	75	BIOT-Sem-I-V-P	25
6.	Introduction to Biotechnology	BIOT-Sem-I-VI-T	75	BIOT-Sem-I-VI- P	25

**Total Marks = 500**

**B.Sc. (Hons.) 1<sup>st</sup> year (2<sup>nd</sup> Semester)**

S.No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	English	BIOT-Sem-II-I-T	50	-	-
2.	Punjabi/HCP	BIOT - Sem-II--II-T	50	-	-
3.	Statistics & Computer Fundamentals	BIOT-Sem-II-III-T	75	BIOT-Sem-II-III-P	25
4.	Basic Biochemistry	BIOT-Sem-II-IV-T	75	BIOT-Sem-II-IV-P	25
5.	Cell Biology	BIOT-Sem-II-V-T	75	BIOT-Sem-II-V-P	25
6.	General Microbiology	BIOT-Sem-II-VI-T	75	BIOT-Sem-II-VI-P	25

**Total Marks = 500**

**The Environment, Road Safety Education and Violence Against Women & Children is a compulsory qualifying paper, which the students have to study in the B.Sc. 1<sup>st</sup> year (2<sup>nd</sup> Semester). If the student/s failed to qualify the paper during the 2<sup>nd</sup> Semester, he /she/they be allowed to appear/qualify the same in the 4<sup>th</sup> or 6<sup>th</sup> Semester/s.**

**B.Sc. (Hons.) 2<sup>nd</sup> year (3<sup>rd</sup> Semester)**

S. No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	Biochemistry	BIOT-Sem-III-I-T	75	BIOT-Sem-III-I-P	25
2.	Genetics	BIOT-Sem-III-II-T	75	BIOT-Sem-III-II-P	25
3.	Immunology-I	BIOT-Sem-III-III-T	75	BIOT-Sem-III-III-P	25
4.	Plant Tissue Culture	BIOT-Sem-III-IV-T	75	BIOT-Sem-III-IV-P	25
5.	Animal Cell Culture	BIOT-Sem-III-V-T	75	BIOT-Sem-III-V-P	25

**Total Marks = 500****B.Sc. (Hons.) 2<sup>nd</sup> year (4<sup>th</sup> Semester)**

S.No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	Immunology-II	BIOT-Sem-IV-I-T	75	BIOT-Sem-IV-I-P	25
2.	Biophysical and Biochemical Techniques	BIOT-Sem-IV-II-T	75	BIOT-Sem-IV-II-P	25
3.	Plant Biotechnology	BIOT-Sem-IV-III-T	75	BIOT-Sem-IV-III-P	25
4.	Animal Biotechnology	BIOT-Sem-IV-IV-T	75	BIOT-Sem-IV-IV-P	25
5.	Agro & Industrial Biotechnology	BIOT-Sem-IV-V-T	75	BIOT-Sem-IV-V-P	25

**Total Marks = 500**

**B.Sc. (Hons.) 3<sup>rd</sup> year (5<sup>th</sup> Semester)**

S. No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	Molecular Biology	BIOT-Sem-V-I-T	75	BIOT-Sem-V-I-P	25
2.	Enzymology	BIOT-Sem-V-II-T	75	BIOT-Sem-V-II-P	25
3.	Environmental Biotechnology	BIOT-Sem-V-III-T	75	BIOT-Sem-V-III-P	25
4.	Tools in Bioinformatics	BIOT-Sem-V-IV-T	75	BIOT-Sem-V-IV-P	25
5.	Intellectual property rights and Ethical Issues in Biotechnology and Entrepreneurship	BIOT-Sem-V-V-T	100	-----	

**Total Marks = 500****B.Sc. (Hons.) 3<sup>rd</sup> year (6<sup>th</sup> Semester)**

S.No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	Genetic Engineering	BIOT-Sem-VI-I-T	75	BIOT-Sem-VI-I-P	25
2.	Bioprocess Engineering and Technology	BIOT-Sem-VI-II-T	75	BIOT-Sem-VI-II-P	25
3.	Food Biotechnology	BIOT-Sem-VI-III-T	75	BIOT-Sem-VI-III-P	25
4.	Genomics and proteomics	BIOT-Sem-VI-IV-T	75	BIOT-Sem-VI-IV-P	25
5.	On Job Training	----	--	BIOT-Sem-VI-V-P	100

**Total Marks = 500**

**B.Sc. (Hons.) 1<sup>st</sup> year (1<sup>st</sup> Semester)**

Sr. No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	English	BIOT-Sem-I-I-T	50	-	-
2.	Punjabi/HCP	BIOT - Sem-I--II-T	50	-	-
3.	Mathematics / A Life Sciences -B	BIOT-Sem-I-III-TA/TB	75	BIOT-Sem-I-III- PA/PB	25
4.	Chemistry	BIOT-Sem-I-IV-T	75	BIOT- Sem -I-IV-P	25
5	Physics	BIOT-Sem-I-V-T	75	BIOT-Sem-I-V-P	25
6	Introduction to Biotechnology	BIOT-Sem-I-VI-T	75	BIOT-Sem-I-VI- P	25

**Total Marks = 500**

**Paper: English**  
**Code No: BIOT-Sem-I-I-T**

**Semester I**

Note: (i) There will be one paper of 40 marks, 5 marks are reserved for the internal assessment and 5 for the Practical work. Total is 50.

(ii) The paper shall consist of Two Units, Unit I will be text specific and Unit II shall deal with different aspects of Communication and Language Skills.

(iii) For Unit I, the prescribed text is **Varieties of Expression** Ed. A.H.Tak. Foundation Books. Only four Prose chapters and two dramas have been recommended for study. The relevant sections, however, are as follows:

**Unit I**

**Prose:** Chapters 1-4

**Drama:** Dramas 1-2

**Unit II**

**Note (iv)** No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end. Unit II shall consist of the following:

*Business Communication:* It shall focus on different aspects of communication in general and business communication in particular, communication within organizations, types of communication, and significance of positive attitude in improving communication.

*Writing Skills:* This section shall focus on letters of all kinds, tender notices, auction notices, public notices; and memos.

**Practical Work:**

Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. business, commerce, accounts etc. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of commerce. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

**Note:** *In case of private candidates and students of School of Open Learning, the marks obtained by them out of 40 will be proportionately increased out of 50).*

**Testing Scheme:**

The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Unit I shall be as follows:

Section I (It is text-based and corresponds to Unit I in the syllabus)

Q.1 It shall consist of six short questions. Three from Prose and three from drama (not exceeding 50-60 words) out of which, a student will be expected to attempt any **two** from **Prose** and **two** from **Drama**.

This question shall be based upon the prescribed text **Varieties of Expression** and cover a wide range of issues, topics and problems. **10 marks**

Q.2 It shall consist of four long questions-**Two** from **Prose** and **two** from **Drama**(not exceeding 100-150 words) out of which a student will be expected to attempt **two**-one from Prose and one from Drama.

**5 marks**

Note; The question 1 &2 should be so designed as to cover all the chapters prescribed (Prose & Drama)

Q.3. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given **five** words in one column and asked to match them with words/meanings in the next column. **5 marks**

## **UNIT II**

Q.4 This question shall test a student's ability to write letter of various kinds (not more than 200 words). Again, there will be internal choice here.

**5 marks**

Q.5.Memos/Tender Notices/Auction Notices/Public Notices.

**10 marks**

Q.6 One short question to test the students' understanding of various aspects of Business Communication.

**5 Marks**

BIOT - Sem-I--II-T

ਸਮੈਸਟਰ ਪਹਿਲਾ  
ਦਸੰਬਰ 2017 ਦੇ ਇਮਤਿਹਾਨ ਲਈ

Course Title : PUNJABI

Course Number : 111

ਕੁੱਲ ਅੰਕ : 50

ਲਿਖਤੀ : 45

ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ: 5

ਸਮਾਂ: 3 ਘੰਟੇ

ਪਾਠਕ੍ਰਮ

ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਅਧਿਐਨ  
ਪੱਤਰ-ਵਿਹਾਰ  
ਵਿਆਕਰਣ

ਕੋਰਸ

ਆਤਮ-ਅਨਾਤਮ (ਕਵਿਤਾ ਤੇ ਕਥਾ ਸੰਗ੍ਰਹਿ),  
ਸੰਪਾਦਕ : ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ ਤੇ ਡਾ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਪ੍ਰਕਾਸ਼ਕ: ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ,  
ਅੰਮ੍ਰਿਤਸਰ, 2006

ਆਤਮ-ਅਨਾਤਮ ਪੁਸਤਕ ਦੇ ਕਵਿਤਾ ਭਾਗ ਵਿਚੋਂ ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ 5 ਅੰਕ  
(2 ਵਿਚੋਂ 1)

ਆਤਮ-ਅਨਾਤਮ ਪੁਸਤਕ ਵਿਚਲੀਆਂ ਕਵਿਤਾਵਾਂ ਦਾ ਵਿਸ਼ਾ ਦੱਸ ਕੇ ਸਾਰ 3+5 = 8 ਅੰਕ  
ਲਿਖਣਾ (2 ਵਿਚੋਂ 1)

ਕੋਰਸ ਵਿਚਲੀ ਪਾਠ-ਪੁਸਤਕ (ਆਤਮ-ਅਨਾਤਮ) ਦੀਆਂ ਕਵਿਤਾਵਾਂ ਨਾਲ 5 ਅੰਕ  
ਸੰਬੰਧਤ ਪੁਸਤਕ ਵਿੱਚੋਂ

ਦਿੱਤੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ (7 ਚੋਂ 5)

ਸਰਕਾਰੀ ਅਤੇ ਅਖਬਾਰ ਦੇ ਸੰਪਾਦਕ ਨੂੰ ਚਲੰਤ ਮਸਲਿਆਂ ਬਾਰੇ ਪੱਤਰ ਲਿਖਣਾ 7 ਅੰਕ  
(ਦੋ ਚੋਂ ਇਕ)

ਵਿਆਕਰਣ: (3+3+4=10 ਅੰਕ)

ੳ) ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹ

ਅ) ਵਾਕਾਂ ਨੂੰ ਹਰ ਪੱਖੋਂ ਸੋਧ ਕੇ ਲਿਖਣਾ

ੲ) ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਾਕਾਂ ਵਿਚ ਵਰਤੋਂ

ਪੁਸਤਕ ਵਿਚ ਸ਼ਾਮਲ ਕਵੀਆਂ ਦਾ ਜੀਵਨ, ਰਚਨਾ ਤੇ ਯੋਗਦਾਨ 10 ਅੰਕ

ਵਿਸ਼ੇਸ਼ ਨੋਟ : ਸਮੁੱਚੇ ਪਾਠ ਕ੍ਰਮ ਲਈ ਹਫ਼ਤੇ ਵਿਚ 6 ਪੀਰੀਅਡ



**BIOT - Sem-I--II-T****OR****HISTORY AND CULTURE OF PUNJAB – I****Instructions for the paper-setter and candidates: (for paper in Semester I & II)**

1. The syllabus has been divided into four Units.  
There shall be 9 questions in all. The first question is compulsory and shall be short answer type containing 10 short questions spread over the whole syllabus to be answered in about 25 to 30 words each. The candidates are required to attempt any 5 short answer type questions. Each question will carry 1 mark. Rest of the paper shall contain 4 units. Each Unit shall have two essay type questions and the candidate shall be given internal choice of attempting one question from each Unit-IV in all. Each question will carry 10 marks.
2. For private candidates, who have not been assessed earlier for internal assessment, the marks secured by them in theory paper will proportionately be increased to maximum marks of the paper in lieu of internal assessment.  
**The paper-setter must put note (2) in the question paper.**
3. One question from Unit-IV shall be set on the map.

**Explanation:**

1. Each essay type question would cover about one-third or one-half of a topic detailed in the syllabus.
2. The distribution of marks for the map question would be as under:  
Map : 06 Marks  
Explanatory Note : 04 Marks  
In case a paper setter chooses to set a question of map on important historical places, the paper setter will be required to ask the students to mark 6 places on map of 1 mark each and write explanatory note on any two of 2 marks each.
3. The paper-setter would avoid repetition between different types of question within one question paper.

**PAPER : HISTORY AND CULTURE OF PUNJAB FROM THE EARLIEST TIMES TO 1849**

Max. Marks	:	50
Theory	:	45
Internal Assessment	:	05
Time	:	3 Hours

**Objectives:** To introduce the students to the history of the Punjab region.**Pedagogy:** Lectures, library work and discussions.**UNIT I**

1. Harappan Civilization: extent and town planning and socio-economic life.
2. Life in Vedic Age: socio-economic and religious.
3. Growth of Jainism and Buddhism in Punjab on the region.

**UNIT II**

4. Society and Culture under Maurayas
5. Society and Culture under Gupta
6. Cultural Reorientation: main features of Bhakti; origin and development of Sufism

**UNIT III**

7. Evolution of Sikhism: teaching of Guru Nanak; Institutional Development -Manji, Masand, Sangat and pangat.
8. Transformation of Sikhism: martyrdom of Guru Arjan; martyrdom of Guru Tegh Bahadur; impact.
9. Institution of Khalsa: new baptism; significance

**UNIT IV**

10. Changes in Society in 18<sup>th</sup> century: social unrest; emergence of misls and institutions-rakhi, gurmata, dal khalsa.
11. Society and Culture of the people under Maharaja Ranjit Singh
12. MAP (of undivided physical geographical map of Punjab): Major Historical Places: Harappa, Mohenjodaro, Sanghol, Ropar, Lahore, Amritsar, Kiratpur, Anandpur Sahib, Tarn Taran, Machhiwara, Goindwal, Khadur Sahib.

**Suggested Readings:**

1. Joshi, L.M (ed.) : History and Culture of the Punjab, Part-I, Publication Bureau, Punjabi University, Patiala, 1989 (3<sup>rd</sup> edn.)
2. Joshi, L.M and Singh, Fauja (ed.) : History and Culture of the Punjab, Vol. I, Punjabi University, Patiala, 1977
3. Prakash, Buddha : Glimpses of Ancient Punjab, P.U., Patiala, 1983
4. Thapar, Romila : A History of India, Vol. I, Penguin Books, 1966
5. Basham, A.L : The Wonder That was India, Rupa Books, Calcutta (18<sup>th</sup> rep.),1992
6. Sharma, B.N : Life in Northern India, Munshi Ram Manohar Lal, Delhi, 1966
7. Singh, Kirpal : History and Culture of the Punjab, Part II(Medieval Period), Publication Bureau, Punjabi University, Patiala 1990(3<sup>rd</sup> edn.).
8. Singh, Fauja(ed.) : History of the Punjab, Vol.III, Punjabi University, Patiala 1972
9. Grewal, J.S. : The Sikhs of the Punjab, the New Cambridge History of India, Orient Orient Longman, Hyderabad,1990.
10. Singh, Khuwant : A History of the Sikhs, vol I: 1469-1839, Oxford University Press Delhi, 1991.
11. Chopra, P.N.,Puri, B.N.:A Social, Cultural and Economic History of India, Vol. II, and Das, M.N. Macmillan, Delhi, 1974.
12. Hussain ,Yusuf : Glimpse of Medieval Indian Culture, Asia Publishing House, Bombay, 1973(rep.).

Note: The following categories of the students shall be entitled to take option of History & Culture of Punjab in lieu of Punjabi as compulsory subject:

- A. That the students who have not studied Punjabi upto class 10<sup>th</sup>.
- B. Ward of / and Defence Personnel and Central Govt. Employee/Employees who are transferrable on all India basis.
- C. Foreigners

**Paper: Mathematics**  
**Code No: BIOT-Sem-I-III-TA**

**Theory: 67 Marks**  
**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Objectives: -**

**Mathematics**

- To study the different concepts of limits, differentiation, integration and calculus so as to apply these concepts in biotechnology.
- To learn solutions to quadratic, cubic equations, differential equation, linear equation and thus study the applications in biotechnology.

**Paper: Mathematics**

**UNIT – I**

**Numbers**

Different kinds of numbers, integer, rational and irrational, surds and their properties, Fractional indices.

Complex numbers, conjugate, modulus and argument of a complex number.

**UNIT – II**

**Set, relation and function**

Set, product sets, relations, functions (polynomials, trigonometric, exponential), graphical representation of functions

**Limit**

Sequences, limits of sequences, series, limits of functions

**Unit III**

**Calculus**

Differentiation: Calculating gradients of chords first and higher order derivatives. Applications increasing and decreasing functions, maximum and minimum points, Derivatives as rates of change.

**Integration**

Finding a function from its derivative, definite integral, indefinite integral, calculating areas for bounded regions.

**Differential Equations**

Forming differential equations solving first order differential equation and second order differential equation with constant co-efficients, growth equation, applications.

## UNIT – IV

Linear Programming

Elementary statistics

**Representation of Data:** Discrete data, continuous data, histogram, polygons, frequency curves, The Mean, variability of data-The standard deviation, Median, quintiles, percentile  
Skewness

### Reference Books:

1. Arya J.C, Lardner R.W (1990). Mathematics for the biological sciences(Prentice Hall. International, New Delhi).
2. Mathematics: Text book for class XI & XII (2006) (National Council of Education Research and Training, New Delhi).

### Mathematics (Practicals)

**Practical : 22 Marks**  
**Internal Ass.: 3 Marks**

1. Computation of mean, variance and standard deviation using given (preferably biological) data (2 to 3 practicals).
2. Sets (Venn-Diagram, Union, Intersection, Difference of sets, Symmetric Difference of sets, Complement of sets) (2 practicals).
3. Relations (graphical representation of relation from set A to set B or set A to set A) (1 practical).
4. Histogram, frequency polygon, ogives, pie chart, bar diagrams (2 to 3 practical).
5. Solving linear programming problem using graphical methods (2 practical).

**Paper: Life Sciences**

**BIOT-Sem-I-III-TB**

**Theory: 67 Marks**

**Internal Ass.: 8 Marks**

### Instructions for paper setters and candidates

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

### Life Sciences

- To increase scientific vocabulary and understanding of a variety of life science concepts.
- To learn about the anatomy and physiology of animals and animal systems.
- To study ecology and ecosystems.

### Unit-I

**An introduction to life on earth.**

**Plant Anatomy and Physiology:-**

Structure of land plants.

Nutrition and Transport phenomena in plants.

Plant reproduction and development.  
Plant responses to the environment.

### **Unit-II**

**Ecology:-** Community interactions.  
**Ecosystems:-** Definition and components.  
Food chain and food web.  
Habitat.  
Ecological succession.  
Types of succession.  
Animal behaviour:-Definition and learning.

### **Unit-III**

**Animal Anatomy and Physiology:-**  
Homeostasis and organization of animal body.  
Circulation.  
Respiration.  
Nutrition and digestion.  
Urinary system and homeostasis.  
The immune response.

### **Unit-IV**

**Animal Anatomy and Physiology:-**  
The endocrine system.  
Nervous system.  
The senses.  
Action and support by the muscles and skeleton system.  
Reproduction.

#### **Reference Books:**

1. Life Sciences (2001) by Rastogi and Dubey, S. Chand & Co., New Delhi.
2. Basics of Biotechnology–I: Introduction to Life Sciences (2005) by Sobti & Sharma, Vishal Publishing Co. Jalandhar.
3. Ecology- Principles and applications (2004) by Chapman and Reiss, Cambridge University Press, Cambridge, U.K.
4. Microbial Ecology- fundamentals and applications, (2000) by R. Atlas and R. Bartha, Benjamin / Cummings Science Publishing, California.
5. Animal Physiology (2008) by R. C. Sobti, Narosa publishing house Pvt. Ltd, New Delhi.

#### **BIOT-Sem-I-III-PB**

#### **Life Sciences (Practical)**

**Practical : 22 Marks**  
**Internal Ass.: 3 Marks**

1. To study cell structure from onion leaf peels.
2. To study ultra structure of cell organelles through photographs.
3. To study digestive, Respiratory, Circulatory, Endocrine and Reproductive system of Human body through charts/ model.

4. Study of the slides/specimens and identification with reasons – Bacteria, oscillatoria, Spirogyra, Rhizopus, Mushroom, yeast, liverwort, moss, fern, lichen, one monocotyledon and dicotyledon.
5. Study of the slides/specimens and identification with reasons – Amoeba, Hydra, Tapeworm, Roundworm, Earthworm, Cockroach, Pila, Starfish, Shark Labeo, Frog, Lizard, Pigeon and Rabbit.

**Paper: Chemistry**

**Theory: 67 marks**

**Code No: BIOT-Sem-I-IV-T**

**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Objectives: -**

- To learn the concepts of chemical thermodynamics, chemical equilibrium and their applications.
- To learn about compounds of carbon , their sources, mechanism of reactions and utility in daily life
- To study concepts of stereochemistry and spectra of organic molecules.

**UNIT – I**

a) **Chemical bonding:** Elementary treatment of valence bond theory and molecular orbital theory. Ionic bonding, multiple bonds, multi-center bonds, metallic bonding, hydrogen bonding and its significance.

b) **Periodic properties:** Position of elements in the periodic table, effective nuclear charge and its calculation, atomic and ionic radii, ionization energy, electron affinity, electronegativity. Trends in periodic table and application in predicting and explaining the chemical behavior.

c) **Molecular Spectroscopy:** Difference between atomic and molecular spectroscopy, absorption and emission spectroscopy, regions of electromagnetic spectrum. Infrared and Raman spectra, basic principle and information from Infrared and Raman spectra. Principle of NMR, chemical shift values and its applications. Importance of mass spectroscopy in chemistry and biology

**UNIT – II**

a) **Solutions:** Ideal and non- ideal solutions, method of expression concentrations of solution, activity and activity coefficients, dilute solution, Osmotic pressure, its law and measurements, Elevation of boiling point and depression of freezing points.

b) **Chemical kinetics:** Scope, rate of reaction, influencing factors such as concentration, temperature, pressure, solvent *etc.* theories of chemical kinetics. Arrhenius equation, concept of activation energy.

### UNIT – III

a) **Photochemistry:**

Absorption of light, Lambert-Beer Law, Photochemical principles: Stark-Einstein Law of Photochemical equivalence, Quantum yield of photochemical reaction (with example). Fluorescence and Phosphorescence.

b) **Coordination compounds:** Introduction, Wener's coordination theory, naming of coordination compounds, isomerism and stereochemistry in coordination compounds

### UNIT – IV

a) **Fundamentals:** inductive effect electromeric effect, resonance, hyperconjugation, types of reagents, electrophiles and nucleophiles, types of organic reaction intermediates, carbocations, free radicals, carbenes (with example). Nomenclature and classification of Alkyl halide, method of formation, chemical reaction, mechanisms and stereochemistry of nucleophilic substitution reaction of Alkyl halides,  $SN_2$ , and  $SN_1$  reaction with energy diagram.

b) **Carboxylic Acids and derivatives:** Structure of carboxylic acids and derivatives. Acidity of carboxylic acids, effects of substitution on acidic strengths, chemical properties of carboxylic acids. HVZ reaction with mechanism. Relative stability and reactivity and reactivity of acid chloride, esters, anhydrides, amides, mechanism of esterification.

**Reference Books:**

1. Bruce H Mahan (1987). University Chemistry Edition 3<sup>rd</sup> (Narosa Publishers).
2. R. T. Morrison, R. N. Boyd (2001). Organic Chemistry (Prentice-Hall of India Pvt. Ltd).
3. J.D Lee. (2008). Concise Inorganic Chemistry, (Wiley-India).
4. B. R. Puri, L. R. Sharma. (1989). Principles of inorganic chemistry (Shoban Lal Nagin Chand and Co).
5. Walter J Moore (1986). Basic physical chemistry (Prentice Hall of India).

**BIOT-Sem-I-IV-P**

**Chemistry (Practical)**

**Practical: 22 Marks  
Internal Ass.: 3 Marks**

1. Inorganic qualitative analysis
2. Four ions including interfering ions.
3. Iodimetry and Iodometry
4. Redox titrations using ceric sulphate, potassium dichromate and potassium permanganate
5. Complexometric titration using EDTA of  $Ca^{++}$ ,  $Mg^{++}$  and  $Zn^{++}$
- 6 Analysis of a given organic compound (solid): Elemental Analysis,

**Reference Books:**

1. L. Saland (1989). Practical chemistry labs: A resource manual (Walch Education).
2. J. Leonard, B. Lygo, G. Procter (1998). Advanced practical organic chemistry. (CRC publications).
3. P. Kelter, M. Mosher, A. Scott (2008). Chemistry: The practical science (Publisher Houghton Mifflin).
4. G. Svehla (1996). Vogel's quantitative inorganic analysis (Prentice Hall)

**Paper: Physics**  
**Code No: BIOT-Sem-I-V-T**

**Theory: 67 Marks**  
**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Objectives: -**

Physics is one of the important basic sciences and Biotechnology is based upon these. Introduction to basic course of Physics will enhance the grasping of subject.

**UNIT – I**

Science, Physics and Life Sciences- An introduction to apparent differences and the underlying overlap (atomic nature of matter). Units of measurement and ranges (from the smallest to the largest known) for different physical quantities viz. mass, length, time, current, temperature, luminosity, etc. with suitable examples from bio/physical sciences.

**UNIT – II**

Coulomb's law for point charges; electric field due to point charge and electric dipole (on axial line and equator line), electric flux; Gauss's theorem and its applications (line of charge and sheet of charge).

Electric potential due to point charge, group of charges and dipole (on axial line and equatorial line), potential difference as line integral of electric field, capacitance; series and parallel arrangements, energy stored in the electric field of capacitor, current, current density, equation of continuity, Ohm's law in vector form.

**UNIT - III**

Interference of waves, phase and path differences, theory of interference fringes, Young's experiment, coherent sources, Lloyd's mirror, Fresnel Biprism, intensities of maxima and minima.

Diffraction of light, rectilinear propagation, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at single slit, Rayleigh criterion for resolving power, Resolving power of telescope and microscope, Compound Microscope ( Principle, construction, ray diagram, formula for magnifying power), fluorescent microscope(concept only), Polarization, introduction.

**UNIT – IV**

Quantum theory of light, X-rays diffraction, Compton effect, Bragg's law, de Broglie wave equation, phase velocity and group velocity, electron microscope, Uncertainty Principle (statement only), applications of Uncertainty Principle ( particle in a box, existence of electron in Nucleus and atom ).

Radioactivity and its laws ; half-life and mean life, uses of radioactivity.



**Reference Books:**

1. H.S. Hans & S.P. Puri : Mechanics (Tata Mcgraw Hill 1984)
2. Electricity and Magnetism : Berkeley physics course vol. II.
3. AjoyGhatak : Optics (Tata Mcgraw Hill 2004)
4. Jenkins &White : Fundamental of optics (Tata Mcgraw Hill 1991)
5. D.P. Khandelwal : Text book of optics and atomic physics (Himalaya Pub. 2005)
6. Arthur Beiser : Modern Physics (Tata Mcgraw Hill 1981)

**BIOT-Sem-I-V-P****Physics (Practical)**

**Practical : 22 Marks**  
**Internal Ass.: 3 Marks**

Introduction and practice the concepts of proper measurement, data recording, and data presentation; stress to be laid on use of proper units, least count, error & its propagation, graph plotting & least square fitting. (Simple measuring devices available in the lab may be used to create basic data).

1. Resolving power of Telescope/Microscope.
2. Rotation of the plane of polarization of a solution using a Polarimeter.
3. Use of C.R.O. as a display & measuring device.
4. Capacitance by flashing and quenching of a neon lamp.

**Reference Books:**

1. Laboratory Manual of Physics for Undergraduate classes by D. P. Khandelwal
2. B.Sc. Physics Practicals by C. L. Arora.

**Paper: Introduction to Biotechnology****Theory: 67 Marks****Code No: BIOT-Sem-I-VI-T****Internal Ass.: 8 Marks****Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Objectives: -**

This course will introduce the basic concepts of biotechnology to the students. They will learn about the history of biotechnology; the foundations of modern biotechnology; the role of biotechnology in fermentation industry, environment and modern medicine and the ethical implications of biotechnology.

**Unit-I**

Advent, scope and basics of biotechnology

Bacteria as workhorses of biotechnology; *E. coli* as the model bacterium

Yeast and fungi in Biotechnology

Introduction to multicellular organisms as research models: *Drosophila melanogaster*,

*Caenorhabditis elegans*, *Daniorerio*, *Musmusculus*

*Arabidopsis thaliana* as model for plant genetics,

Role of viruses and bacteriophages in biotechnology

### **Unit-II**

Structure and function of the cell: the basic unit of life

Prokaryotic and Eukaryotic cells

Biomolecules in a cell (DNA, RNA and proteins)

Introduction to genomics, transcriptomics, proteomics and metabolomics; bioinformatics and its role in biotechnology.

Introduction to basic techniques like sterilization, centrifugation, electrophoresis, chromatography, sonication.

Fundamentals of recombinant DNA technology: Restriction Enzymes, Vectors and their properties.

### **Unit-III**

Applications of biotechnology: today and tomorrow

Basics of Biotechnology in fermentation and pharmaceutical processes.

Green technology to control pollution.

Role of biotechnology in diagnostics, introduction to gene therapy.

### **Unit-IV**

Biotechnology and society: genetically modified organisms (GMOs) - transgenic plants and animals and their applications in biotechnology.

Public concerns and risks associated with genetic engineering: Bioterrorism and biowarfare.

Ethical, social and legal implications of biotechnology.

### **Reference Books:**

1. Comprehensive Biotechnology, Murray Moo-Young, 2<sup>nd</sup> edition (2011), Pergamon Press.
2. Introduction to Biotechnology, William J. Thieman & Michael A. Palladino, 3<sup>rd</sup> edition (2012), Benjamin Cummings.
3. Biotechnology Expanding Horizons, BD Singh, 4<sup>th</sup> edition (2012), Kalyani Publishers.
4. The Ethics of Biotechnology (Biotechnology in the 21st Century), Jonathan Morris, Chelsea House Pub (L), 1<sup>st</sup> edition (2005).
5. Biotechnology, Applying the Genetic Revolution, David P. Clark & Nanette J. Pazdernik, 1<sup>st</sup> edition (2008), Academic Cell.
6. Molecular Biotechnology, Sandy B. Primrose, 2<sup>nd</sup> edition (1991), Blackwell Scientific Publications, ISBN.
7. Biotechnology: Demystifying the concepts, David Bourgaize, Thomas R. Jewell & Rodolfo G. Buiser, 1<sup>st</sup> edition (1999), Benjamin Cummings.
8. Ethical Issues in Biotechnology, Richard Sherlock & John D. Morrey, 1<sup>st</sup> edition (2002), Rowman & Littlefield Publishers.

**BIOT-Sem-I-VI-P****Introduction to Biotechnology (Practical)****Practical : 22 Marks**  
**Internal Ass.: 3 Marks**

1. Introduction and use of basic equipments in a biotechnology laboratory (Auto-pipettes, pH meter, centrifuges, light microscope, electrophoretic apparatus, vortex mixer, magnetic stirrer, rocker, laminar hoods, autoclave, sonicator)
2. Handling and disposal of hazardous reagents (acids, carcinogenic chemicals like acrylamide, ethidium bromide) and concept of chemical hoods
3. Good laboratory practices followed in biotechnology laboratory (sterility, DNase/ RNase free space, separate area for protein work, possible means of contamination and its control etc)
4. Cell disruption and cell lysis of animal/plant/bacterial cell
5. Separation and estimation of extracellular and intracellular proteins
6. Quantification of nucleic acids by colorimetry (orcinol)
7. Introduction to bioinformatic tools used in biotechnology

**Semester – II****B.Sc. (Hons.) 1<sup>st</sup> year (2<sup>nd</sup> Semester)**

S.No.	Course/Paper	Code			
		Theory		Practical	
		Course No.	Marks	Course No.	Marks
1.	English	BIOT-Sem-II-I-T	50	-	-
2.	Punjabi/HCP	BIOT - Sem-II--II-T	50	-	-
3.	Statistics & Computer Fundamentals	BIOT-Sem-II-III-T	75	BIOT-Sem-II-III-P	25
4.	Basic Biochemistry	BIOT-Sem-II-IV-T	75	BIOT-Sem-II-IV-P	25
5.	Cell Biology	BIOT-Sem-II-V-T	75	BIOT-Sem-II-V-P	25
6.	General Microbiology	BIOT-Sem-II-VI-T	75	BIOT-Sem-II-VI-P	25

**Total Marks = 500**

## **ENVIRONMENT, ROAD SAFETY EDUCATION AND VIOLENCE AGAINST WOMEN AND CHILDREN (SEMESTER – II)**

*Note: The syllabus has 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topic from 2 to 11 and one each for the topics 1 and 12 to 15.*

### **1. Environment Concept:**

Introduction, concept of biosphere – lithosphere, hydrosphere, atmosphere; Natural resources – their need and types; Principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

### **2. Atmosphere:**

Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

### **3. Hydrosphere:**

Types of aquatic systems; Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

### **4. Lithosphere:**

Earth crust, soil – a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

### **5. Forests:**

Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban Forests, Chipko Andolan.

### **6. Conservation of Environment:**

The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems – soil, water, air, wildlife, forests.

### **7. Management of Solid Waste:**

Merits and demerits of different ways of solid waste management– open dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

### **8. Indoor Environment:**

Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

### **9. Global Environmental Issues:**

Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

**10. Indian Laws on Environment:**

Indian laws pertaining to Environmental protection: Environment (Protection) Act, 1986; General information about laws relating to control of air, water and noise pollution. What to do to seek redressal.

**11. Biodiversity:**

What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

**12. Noise and Microbial Pollution:**

Pollution due to noise and microbes and their effects.

**13. Human Population and Environment:**

Population growth and family welfare programme, Human Health. HIV-AIDS. Human Rights.

**14. Social Issues:**

Environmental Ethics: Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

**15. Local Environmental Issues:**

Environmental problems in rural and urban areas. Problem of Congress Grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

**Practical**

Depending on the available facility in the college, a visit to vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

**Examination Pattern:**

**A qualifying paper of 50 marks comprising of fifty multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong answer or un-attempted question), and of 1 hour duration.**

**The students have to obtain 33% marks to qualify the paper. The marks are not added / included in the final mark sheet.**

## UNIT II (ROAD SAFETY)

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
3. Traffic Engineering – Concept & Significance.
4. Traffic Rules & Traffic Signs.
5. How to obtain Driving License.
6. Traffic Offences, Penalties and Procedures.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.
10. Traffic Police-Public Relationship.

### **Note : Examination Pattern :**

- The Environment and Road Safety paper is 70 marks.
- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted questions).
- The paper shall have two units: **Unit I (Environment) and Unit II (Road Safety)**.
- Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.
- The entire syllabus of Unit II is to be covered in 10 hours.
- All the questions are to be attempted.
- Qualifying Marks 33 per cent i.e. 23 marks out of 70.
- Duration of examination: 90 minutes.
- The paper setter is requested to set the questions strictly according to the syllabus.

### **Suggested Readings**

1. The Motor Vehicle Act, 1988 (2010), Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

### **Websites:**

- (a) [www.chandigarhpolice.nic.in](http://www.chandigarhpolice.nic.in)
- (b) [www.punjabpolice.gov.in](http://www.punjabpolice.gov.in)
- (c) [www.haryanapolice.gov.in](http://www.haryanapolice.gov.in)
- (d) [www.hppolice.nic.in](http://www.hppolice.nic.in)

## SYLLABUS ON “VIOLENCE AGAINST WOMEN & CHILDREN” AT UNDER-GRADUATE LEVEL

### UNIT III OF COMPULSORY PAPER ON ENVIRONMENT & ROAD SAFETY EDUCATION

#### AS PART OF SEMESTER - II

#### Unit – III

#### VIOLENCE AGAINST WOMEN & CHILDREN

**1. Concept and Types of Violence:** Meaning and Definition of violence; Types of Violence against women – domestic violence, sexual violence (including rape), sexual harassment, emotional/psychological violence; Types of Violence against children – physical violence, sexual violence, verbal and emotional abuse, neglect & abandonment.

**2. Protective Provisions of IPC on Domestic Violence & Sexual Violence against Women:**

**Dowry Death** – Section 304B;

**Rape** – Sections 375, 376(1), 376A, 376B, 376C, 376D and 376E;

**Cruelty** – Section 498A;

**Insult to Modesty** – The Indian Penal Code does not define the word eve-teasing; there are three sections which deal with crime of eve-teasing. These are Sections, 294, 354 and 509 of Indian Penal Code. Section 509 of the Indian penal code defines (Word, gesture or act intended to insult the modesty of a woman), Section 294 – (Obscene acts and songs) and Section 354 (Assault or criminal force to woman with intent to outrage her modesty);

**Hurt & Grievous Hurt Provisions** – Sections 319 to 326;

**Acid Attacks** – Sections 326A and 326B;

**Female Infanticide** – Section 312, Section 313 of Indian Penal Code (Causing miscarriage without women’s consent) and section 314;

**Sexual Harassment** – For providing protection to working women against sexual harassment, a new section 354 A is added; 354 B (Assault or use of criminal force to women with intent to disrobe); 354 C Voyeurism; 354 D (Stalking). All these provisions are added in IPC to protect women against acts of violence through Criminal Law (Amendment) Act, 2013; Human Trafficking and Forced Prostitution- Sections 370 and 370A

**3. Protective Laws for Women:**

**3.1 Provisions of Protection of Women Against Domestic Violence Act 2005** – Definition, Powers of the Magistrate and Protection Officers, Protection order, Residence order, Monetary relief, Custody order and Compensatory order.

**3.2 The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013** – Definition, Internal Complaint Committee, Local Complaint Committee, Procedure adopted by Committee for punishing accused.

**4. Protective Provisions of IPC regarding Sexual Violence against Children:**

**Section 293**(sale etc. of obscene objects to young persons); 294 (obscene acts & songs); 305 (abetment of suicide of child); 315 to 317 (act causing death after birth of a child etc.); 361 (kidnapping from lawful guardianship); 362 (abduction); 363 (punishment for kidnapping); 363A



(kidnapping or maiming a minor for purposing of begging); 364A (kidnapping for ransom etc.); 366 (kidnapping etc. to compel woman for marriage etc.); 366A (procuration of minor girl for illicit forced intercourse); 366B (importation of girl from foreign country); 367 (kidnapping/abduction in order to subject person to grievous hurt, slavery etc.); 369 (kidnapping adductive child under 10 year with intent to steal from its person); 372 & 373 (selling & buying minor for purposes of prostitution etc.).

**4.1 The Protection of Children from Sexual Offences Act, 2012:** An overview of the POCSO, relevant legal provisions and guidelines for the protection of children against sexual offences along with punishments; role of doctors, psychologists & mental experts as per rules of POCSO.

**Note: Instructions for Examination:**

- Unit III of the paper dealing with Violence against Women and Children is of 30 Marks.
- It shall have 30 multiple-choice questions (with one correct and three incorrect choice options and no deduction of marks for wrong or un-attempted questions).
- Minimum two questions from each topic must be covered.
- All the questions are to be attempted
- Qualifying Marks 33 percent
- Duration of Examination 30 Minutes
- The Paper Setter is requested to set the questions strictly according to the syllabus.

**Pedagogy:**

- The entire syllabus of Unit III is to be covered in ten hours in total, with each lecture of one-hour duration.
- The purpose behind imparting teaching-learning instructions is to create basic understanding of the contents of the Unit III among the students.

**RELEVANT READING MATERIAL**

Ahuja, Ram (1998), *Violence against Women*, New Delhi: Rawat Publication  
 NRHM, *Child Abuse*, A Guidebook for the Media on Sexual Violence against Children  
 The Indian Penal Code (Universal Law Publishing Co. Pvt. New Delhi).  
 The Protection of Children from Sexual Offences Act, 2012  
 The Protection of Women from Domestic Violence Act 2005  
 The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013  
 UNO, *United Nations Secretary-General's Study on Violence against Children*, adapted for Children and Young People

## Unit IV (Drug Abuse)

### Drug Abuse: Problem, Prevention and Management

**Note :** This is a compulsory qualifying paper, which the students have to study and qualify during three year of degree course.

The paper/Topic “Drug Abuse: Problem, Prevention and Management” having 2 credit/50 marks (40 theory+10 Internal) at undergraduate level, as a fourth part of the paper ‘Environment, Road Safety Education and Violence against Women and Children’ from the academic session 2017-18.

#### Main Objective

This module introduces to the students the problem of drug abuse and its adverse consequences for the society. The students would get an understanding of why drug abuse is such a serious problem to our society. The course also appries them of how to prevent and manage this menace.

#### Learning objectives of the course

1. Understand the meaning of the term drug.
2. Understand the difference between use, misuse and abuse of drugs.
3. Differentiate between commonly abused legal and illegal drugs.
4. Become aware of common signs and symptoms of drug abuse.
5. Understand the causes and consequences of drug abuse
6. Identify and access safety measures for support to stay away/give up drug abuse
7. Become aware of the interventions for the prevention and management of drug abuse.

#### Pedagogy of the course work

1. 70 % Lectures (Including expert lectures)
  2. 30% assignments, discussion, seminars and class tests.
- A visit to drug de-addiction centre could also be undertaken

#### Course content

##### UNIT I: Problem of Drug Abuse

**a) Concept and overview :** what are drugs and what constitutes drug abuse? Historical perspective of drug abuse. How drug abuse is different from drug dependence and drug addiction? Physical and psychological dependence: concepts of drug tolerance and withdrawal symptoms.

##### **b) Types of drugs often abused and their effects**

**Stimulants:** tobacco Amphetamines: dl-amphetamine (Benzedrine ®), dextroamphetamine (Dexedrine®). Cocaine.

**Depressants :** Alcohol. Barbiturates: phenobarbitone (Nembutal®), secobarbital (Seconal®), Benzodiazepenes: diazepam (valium ®), alprazolam (Xanax®), flunitrazepam (Rohypnol®)

**Narcotics:** Morphine, heroin ('Chitta' / 'Brown Sugar'), pethidine, oxycodone.

**Hallucinogens:** cannabis ['Bhang', marijuana ('Ganja'), hashish ('Charas'), hash oil]. MDMA (3,4- methylenedioxy methamphetamine) /'Ecstasy' / 'Molly'. LSD (lysergic acid diethylamide).

**Miscellaneous:** cough/cold medicines: diphenhydramine (Benadryl®), chlorpheniramine maleate+ codeine+alcohol (Corex®). Iodex®, Vicks®, Amrutanjan® and correction fluid (Whitener).

## **UNIT II: Theories of consequences of drug abuse**

a) **Theories of drug abuse:** Physiological theory. Psychological theory. Sociological theory.

b) **Consequences of drug abuse:** For individuals, families, society and economy.

## **Unit III: Extent and nature of the problem**

Magnitude of the menace of drug abuse. Vulnerable age groups. Characteristic and features of proneness. Signs and symptoms of drug abuse.

Physical indicators. Academic indicators. Behavioural and psychological indicators.

## **UNIT IV: Prevention and management of drug abuse**

Legislations, public policies and programs for the prevention and cure of drug abuse. Prevention of drug abuse. Management of drug abuse. Medical management. Working of drug De-addiction Centres. Role of Family, School and media.

### **Suggested readings:**

1. Clayton, J.M and Scott, M.A (2014). Drugs and Drugs Policy: the control of consciousness alteration. New Delhi: Sage Publications India Pvt. Ltd.
2. Kapoor, T. (1985). Drug epidemic among Indian Youth, New Delhi: Mittal Pub
3. Modi, I and Modi S.(1997). Drugs: Addiction and prevention, Jaipur: Rawat Publication.
4. Ahuja, R (2003). Social problems in India, Rawat Publication, Jaipur
5. 2003 National Household survey of Alcohol and Drug Abuse. New Delhi, Clinical Epidemiological Unit, AIIMS, 2004
6. World Drug Report, (updated every year), United Nations office of Drug and Crime.
7. Extent, pattern and Trend of Drug use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
8. The Narcotic Drugs and Psychotropic substances Act, 1985. (New Delhi: Universal, 2012).
9. Government of India (2015).Scheme of assistance for prevention and alcoholism and substance (Drugs) abuse and for social defence services-Guidelines. Ministry of social Justice and Empowerment. New Delhi.

**Paper: English**  
**Code No: BIOT-Sem-II-I-T**

**Semester II**

Note: (i) There will be one paper of 40 marks, 5 marks are reserved for the Internal assessment and 5 for the Practical work. Total is 50.

(ii) The paper shall consist of Two Units, Unit I will be text specific and Unit II shall deal with different aspects of Communications and Language Skills.

(iii) For Unit I, the prescribed text is **Varieties of Expression** Ed. A.H.Tak. Foundation Books. Only four Prose chapters and two dramas have been recommended for study. The relevant sections, however, are as follows:

**Unit I**

Prose: Chapters 5-8

Drama: Dramas 3-4

**Unit II**

**Note (iv)** No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end. Unit II shall consist of the following:

*Writing Skills:* This section shall focus on précis-writing, curriculum vitae; short, formal reports (not exceeding 200 words) and advertisements relating to product promotion etc.,

*Modern Forms of Communication:* Here special emphasis shall be given to teaching the format of E-mails, Fax Messages, Audio-Visual Aids and Power-Point Presentations. Apart from this, the students shall also be given basic lessons in Effective Listening, Non-Verbal Communication, How to Prepare for an Interview & Group Discussion etc

**Practical Work:**

Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. business, commerce, accounts etc. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of commerce. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

**Note:** *In case of private candidates and students of School of Open Learning, the marks obtained by them out of 40 will be proportionately increased out of 50.*

**Testing Scheme:** The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Unit I (It is text-based and corresponds to Unit I in the syllabus)

Q.1 It shall consist of six short questions. Three from Prose and three from drama (not exceeding 50-60 words) out of which, a student will be expected to attempt any four. **Two** from **Prose** and **two** from

**Drama.** This question shall be based upon the prescribed text **Varieties of Expression** and cover a wide range of issues, topics and problems. **10 marks**

Q.2 It shall consist of four long questions-**Two** from **Prose** and **two** from **Drama**(not exceeding 100-150 words) out of which a student will be expected to attempt **two**-one from Prose and one from Drama.

**5 marks**

**Note;** The question 1 &2 should be so designed as to cover all the chapters prescribe (Prose & Drama)

Q.3. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given **five** words in one column and asked to match them with words/meanings in the next column.

**5 marks**

## **UNIT II**

Q.4 Short Survey Report (150-200 words) with internal choice.

**5 marks**

Q.5. Precis of 200 words.

**10 marks**

Q.6 Definition/Format of modern forms of communication to be tested.

**ਸਮੈਸਟਰ ਦੂਜਾ**  
**ਅਪ੍ਰੈਲ / ਮਈ 2018 ਦੇ ਇਮਤਿਹਾਨ ਲਈ**

ਕੁੱਲ ਅੰਕ : 50

ਲਿਖਤੀ : 45

ਇੰਟਰਨਲ ਅਸੈਸਮੈਂਟ: 5

ਸਮਾਂ: 3 ਘੰਟੇ

**ਪਾਠਕ੍ਰਮ**

1. ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਅਧਿਐਨ
2. ਪੱਤਰ-ਵਿਹਾਰ
3. ਵਿਆਕਰਣ

**ਕੋਰਸ**

ਆਤਮ-ਅਨਾਤਮ (ਕਵਿਤਾ ਤੇ ਕਥਾ ਸੰਗ੍ਰਹਿ)

ਸੰਪਾਦਕ : ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ ਤੇ ਡਾ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਪ੍ਰਕਾਸ਼ਕ: ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ, 2006

1. ਆਤਮ-ਅਨਾਤਮ ਪੁਸਤਕ ਦੇ ਕਹਾਣੀ ਭਾਗ ਵਿਚੋਂ ਪ੍ਰਸੰਗ ਸਹਿਤ 5 ਅੰਕ  
ਵਿਆਖਿਆ (2 ਵਿਚੋਂ 1)
2. ਆਤਮ-ਅਨਾਤਮ ਪੁਸਤਕ ਵਿਚਲੀਆਂ ਕਹਾਣੀਆਂ ਦਾ ਵਿਸ਼ਾ ਦੱਸ ਕੇ ਸਾਰ 3+5 = 8 ਅੰਕ  
ਲਿਖਣਾ (2 ਵਿਚੋਂ 1)
3. ਕੋਰਸ ਵਿਚਲੀ ਪਾਠ-ਪੁਸਤਕ (ਆਤਮ-ਅਨਾਤਮ) ਦੀਆਂ ਕਹਾਣੀਆਂ ਨਾਲ 5 ਅੰਕ  
ਸੰਬੰਧਤ ਪੁਸਤਕ ਵਿੱਚੋਂ ਦਿੱਤੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ (7 ਚੋਂ 5)
4. ਸਰਕਾਰੀ ਅਤੇ ਅਖਬਾਰ ਦੇ ਸੰਪਾਦਕ ਨੂੰ ਚਲੰਤ ਮਸਲਿਆਂ ਬਾਰੇ ਪੱਤਰ ਲਿਖਣਾ 7 ਅੰਕ  
(2 ਵਿਚੋਂ 1)
5. ਵਿਆਕਰਣ: (3+3+4=10 ਅੰਕ)  
ੳ) ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹ  
ਅ) ਵਾਕਾਂ ਨੂੰ ਹਰ ਪੱਖੋਂ ਸੋਧ ਕੇ ਲਿਖਣਾ  
ੲ) ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਾਕਾਂ ਵਿਚ ਵਰਤੋਂ
6. ਪੁਸਤਕ ਵਿਚ ਸ਼ਾਮਿਲ ਕਹਾਣੀਕਾਰਾਂ ਦਾ ਜੀਵਨ, ਰਚਨਾ ਤੇ ਯੋਗਦਾਨ 10 ਅੰਕ  
ਵਿਸ਼ੇਸ਼ ਨੋਟ : ਸਮੁੱਚੇ ਪਾਠ ਕ੍ਰਮ ਲਈ ਹਫ਼ਤੇ ਵਿਚ 6 ਪੀਰੀਅਡ

OR  
**SEMESTER II**

**HISTORY AND CULTURE OF PUNJAB-II**

**Instructions for the paper-setter and candidates: (for paper in Semester I & II)**

1. The syllabus has been divided into four Units.  
There shall be 9 questions in all. The first question is compulsory and shall be short answer type containing 10 short questions spread over the whole syllabus to be answered in about 25 to 30 words each. The candidates are required to attempt any 5 short answer type questions. Each question will carry 1 mark. Rest of the paper shall contain 4 units. Each Unit shall have two essay type questions and the candidate shall be given internal choice of attempting one question from each Unit-IV in all. Each question will carry 10 marks.
2. For private candidates, who have not been assessed earlier for internal assessment, the marks secured by them in theory paper will proportionately be increased to maximum marks of the paper in lieu of internal assessment.  
**The paper-setter must put note (2) in the question paper.**
3. One question from Unit-IV shall be set on the map.

**Explanation:**

1. Each essay type question would cover about one-third or one-half of a topic detailed in the syllabus.
2. The distribution of marks for the map question would be as under:  
Map : 06 Marks  
Explanatory Note : 04 Marks  
  
In case a paper setter chooses to set a question of map on important historical places, the paper setter will be required to ask the students to mark 6 places on map of 1 mark each and write explanatory note on any two of 2 marks each.
3. The paper-setter would avoid repetition between different types of question within one question paper.

**PAPER: HISTORY AND CULTURE OF PUNJAB IN THE COLONIAL AND POST  
TIMES**

**INDEPENDENCE**

Max. Marks	:	50
Theory	:	45
Internal Assessment	:	05
Time	:	3 Hours

**Objectives:** To introduce the students to the history of Punjab region in the Modern times.

**Pedagogy:** Lectures, library work and discussions.

**UNIT I**

1. Introduction of Colonial Rule in Punjab: Annexation of Punjab, Board of Administration
2. Western Education: Growth of Education and rise of middle classes
3. Agrarian Development: Commercialization of agriculture; canalization and colonization.

**UNIT II**

4. Early Socio Religious Reform: Christian Missionaries; Namdharis; Nirankaris.
5. Socio Religious Reform Movements: activities of Arya Samaj; Singh sabhas; Ahmadiyahs.
6. Development of Press & literature: growth of press; development in literature

**UNIT III**

7. Emergence Of Political Consciousness: Agrarian uprising 1907; Ghadar Movement.
8. Gurudwara Reform Movement: Jallianwala Bagh; foundation of SGPC and Akali Dal; Morchas; Activities of Babbar Akalis.
9. Struggle for Freedom: activities of revolutionaries - Naujawan Bharat Sabha; Kirti Kissan Movement; participation in mass movements – non co-operation, civil disobedience, Quit India.

**UNIT IV**

10. Partition and its Aftermath: resettlement; rehabilitation
11. Social Concerns In Post Independence Punjab: language; immigration; socio-economic issues.
12. MAP(Physical geographical map of undivided Punjab): Major Historical places: Delhi, Kurukshetra, Jaito, Ferozepur, Ambala, Amritsar, Lahore, Ludhiana, Qadian, Jalandhar, Lyallpur, Montgomery.

**Suggested Readings:**

1. Singh, Kirpal :History and Culture os the Punjab, Part II(Medieval Period), Publication Bureau, Punjabi University, Patiala 1990(3<sup>rd</sup> edn.).
2. Singh, Fauja(ed.) :History of the Punjab, Vol.III, Punjabi University, Patiala 1972.
3. Grewal, J.S. :The Sikhs of the Punjab, the New Cambridge History of India, Orient Longman, Hyderabad,1990.
4. Singh, Khuwant :A History of the Sikhs, vol I: 1469-1839, oxford University Press,. Delhi, 1991.
5. Chopra, P.N.,Puri, B.N. And Das,M.N. :A Social, Cu.ltural and Economic History of India, Vol.II, Macmillan, delhi, 1974.



**Paper: Statistics & Computer Fundamentals**  
**Code No: BIOT-Sem-II-III-T**

**Theory: 67 Marks**  
**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Objectives: -**

- To learn applications of statistics in the field of biology.
- To study concepts of probability, averages, distributions, tests of deviations, correlation and linear regression.
- To learn to design experiments and analysis of results by tests of significance or analysis of variance.

**UNIT – I**

An introduction, types of data, collection, classification and tabulation of the primary data, secondary data, discrete data and continuous data, diagrammatic and graphical representation of grouped data, frequency distribution {univariate and bivariate}, cumulative frequency distribution and their graphical representation, histogram frequency polygon.

Concept of central tendency or location and their measures, partition values: quantiles, deciles and percentiles, dispersion and their measures, relative dispersion.

**UNIT – II**

Binomial distribution, Poisson distribution as a limiting form of binomial distribution and properties of these distributions, moments, moment generating function, cumulate generating function, geometric distribution and exponential distribution and properties of these distributions.

Normal distribution

Correlation and regression analysis

Hypothesis testing

Markov models

Cluster analysis

- Nearest neighbor search
- Search using stem numbers
- Search using text signature

Concepts of Probability.

**UNIT – III**

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

Introduction to computers and its uses: Milestones in hardware and software-batch oriented/online/real time applications.

Compute as systems: Basic concepts, stored programs, functional units and their interrelation-communication with computer.

#### UNIT – IV

Data storage devices:

Primary storage: Storage address and capacity, type of memory.

Secondary storage devices: Magnetic tape-data representation and R/W; Magnetic disks, fixed and removable, data representation and R/W; Floppy and hard disks, optical disks CD-Rom, mass storage devices.

Input/output devices: Key-tape/diskette devices, light pin Mouse, joystick, source data automation.

Printed outputs: Serial, line, page, printers, plotters, voice response units.

#### **Reference Books:**

1. P.N. Arora & P.K. Malhotra (1996). Biostatistics (Himalaya Publishing House, Mumbai).
2. Sokal & Rohlf (1973). Introduction to biostatistics (Toppan Co. Japan).
3. W.J. Evens, G.R. Grant (2005). Statistical methods in bioinformatics: An introduction (Springer).
4. P.K. Sinha (2004). Computer fundamentals (BPB).
5. Suresh K. Basandra (2008). Computers today (Galgotia Publications Pvt.Ltd., New Delhi).

#### **BIOT-Sem-II-III-T**

##### **Statistics and Computer Fundamentals (Practical)**

**Practical: 22 Marks**  
**Internal Ass.: 3 Marks**

1. Presentation of data by frequency tables, diagrams and graphs.
2. Calculation of measures of central tendencies, skewness and Kurtosis.
3. Calculation of dispersion.
4. Fitting of binomial distribution and Poisson distribution.
5. Probability
6. Basics of computer: Basic commands-File creation, copying, moving and deleting in DOS & windows, Using e-mail, browsers, search engines.

#### **Reference Books:**

1. W.J. Evens, G.R. Grant (2005). Statistical methods in bioinformatics: An introduction (Springer).
2. P.K. Sinha (2004). Computer fundamentals (BPB).
3. Suresh K. Basandra (2008). Computers today (Galgotia Publications Pvt. Ltd., New Delhi).

**Paper: Basic Biochemistry**  
**Code No: BIOT-Sem-II-IV-T**

**Theory: 67 Marks**  
**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Course Objectives**

To make student conversant with the biochemical aspect of cell, chemical structure & function of various biomolecules.

**UNIT – I**

Water: Physico chemical properties of water, dissociation and association constants. pH and buffers, pI, pKa, Henderson Hasselbatch equation and its implications.

Carbohydrates: Structure of important mono, di-, oligo- and polysaccharides, glycoproteins, peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides.

**UNIT II**

Lipids: Classification of lipids and fatty acids, general functions of major lipid subclasses, acylglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpenes, sterols, steroids: Prostaglandins.

**UNIT – III**

Vitamins and hormones: Types of vitamins and their chemistry, vitamins as cofactors, steroids and peptide hormones.

**UNIT IV**

Proteins: Structure of amino acids, nonprotein and rare amino acids and their chemical reactions. Structural organization of proteins (primary, secondary, tertiary and quaternary domain structure), protein classification and function. Forces stabilizing primary, secondary and tertiary structure.

**Reference Books:**

1. Lehninger A.L., Nelson D.L. and Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).
2. Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).
3. Rawn J.D. (1989). Biochemistry (Neil Patterson Publishers).
4. G.L. Zubay, W.W. Parson, D.E. Vance. (1995). Principles of biochemistry: Student study art notebook (Wm.C. Brown).
5. Bucke C. (1999). Carbohydrate biotechnology protocols (Humana Press).
6. H.R. Horton, A.J. Scism, L.A. Moran, R.S. Ochs, J.D Rawn, K.G. Scrimgeour. (2006). Principles of biochemistry (Prentice Hall).

**BIOT-Sem-II-IV-P****Basic Biochemistry (Practical)****Practical: 25 Marks  
Internal Ass.: 3 Marks**

1. Preparation of physiological buffers.
2. Verification of Beer-Lamberts law for p-nitrophenol.
3. Determination of pKa value of p-nitrophenol.
4. Estimation of carbohydrates in given solution by Anthrone method.
5. The determination of acid value and saponification value of a fat.
6. Methods of protein estimation.

**Paper: Cell Biology****Theory: 67 Marks****Code No: BIOT-Sem-II-V-T****Internal Ass.: 8 Marks****Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Course Objectives**

- To understand the detailed overview of eukaryotic cell and its inner components
- To understand the processes of cell transport and cell locomotion
- Introduction to stem cells and their applications

Practical skills will be imparted to the students through critically designed practical related to the subjects.

**Unit I**

Cell as a basic unit of living systems: the cell theory, pre-cellular evolution, artificial creation of "cells", broad classification and ultrastructure of cell types (PPLOs, Bacteria, eukaryotic microbes, plant and animal cells), tissue, organ and organism at different level of organization of other genetically similar cells; biochemical composition of cells (proteins, lipids, carbohydrates, nucleic acids and metabolic pool).

Ultrastructure of cell membrane and cell organelle: structure and function of cell organelles, ultrastructure of cell membrane, cytosol, golgi bodies, vacuoles, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin microtubules etc), mitochondria, chloroplast, lysosomes, peroxisomes, nucleus (nuclear membrane, nucleoplasm, nucleolus)

**Unit II**

Cellular transport: Passive & active transport, permeases, sodium, potassium, Calcium, ATPase pumps, lysosomal and vacuolar membrane, ATP dependent proton pumps, co-transport, symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis, entry of viruses and toxins into cells.

### Unit III

Cell locomotion: Amoeboid, Flagellar and Ciliar.

Chromosomes: discovery, morphology, chemical composition, structural organization of chromatids, centromere, telomere, chromatin, nucleosome organization, euchromatin and heterochromatin, special chromosomes (polytene, lampbrush chromosomes), banding patterns in human chromosomes.

### Unit IV

Basics of stem cells: Introduction to concepts in stem cell biology, Cell differentiation in multicellular organisms: (renewal, potency: Totipotent, pluripotent, multipotent); types of stem cells: early embryonic stem cells, blastocyst embryonic stem cells, fetal stem cells, umbilical cord stem cells, adult stem cells; applications; ethical issues related to stem cells.

#### Reference Books:

1. The World of the Cell (2008) Becker, Klein Smith & Hardin Pearson education Inc
2. Cell and Molecular Biology (2010) E.D.P De Robertis and E.M.F. De Robertis, Jr.
3. Molecular Cell Biology (2007) Lodish et al. Freeman & Co
4. Molecular Biology of the Cell (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter.
5. The Cell: A Molecular Approach (2013) Geoffrey M. Cooper and Robert E. Hausman
6. Cells and Cell Function: Advanced Level (2007) Sally Morgan
7. Stem Cells: An Insider's Guide (2013) Paul Knoepfler

**BIOT-Sem-II-V-P**

**Paper: Cell Biology (Practical)**

**Practical: 22 Marks  
Internal Ass.: 3 Marks**

1. To study the parts and function of a light microscope
2. To prepare a wet mount of onion peel for microscopy
3. Counting of cells using haemocytometer
4. Subcellular fractionation of spinach cells
5. To study cell locomotion of amoeba
6. To study flagellar motility in bacteria by hanging drop technique
7. To study cell transport in cell membrane by following experiments
  - 1) Diffusion through artificial membrane: transport of albumin and glucose solution through dialysis bag.
  - 2) To study the effect of membrane disrupting agents in beet root
8. Quantitative analysis of cell membrane lipids by TLC

**Paper: General Microbiology**  
**Code No: BIOT-Sem-II-VI-T**

**Theory: 67 Marks**  
**Internal Ass.: 8 Marks**

**Instructions for paper setters and candidates**

- Set nine questions in all from three sections. All questions carry equal marks.
  - Section A will cover Unit I & II
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – B will cover Unit – III & IV
- Set 2 questions from each unit out of which any 2 are to be attempted
  - Section – C will be compulsory and will have 7 – 10 short answer type (not objective type) questions covering the whole syllabus.

**Course Objectives**

Microbes play significant role in understanding medical science and industries so study of microbes from basic to advance level, with understanding of biochemistry, cell structure and application makes this paper significant.

**UNIT – I**

History of Microbiology: A. Leewenhook, L. Pasteur, R. Koch, J. Lister, J.Tyndall, Koch postulates, discovery of antibiotics.

Principle of microscopy: Bright field, dark field, phase contrast, fluorescent, electron microscopy.

**UNIT – II**

Microbial classification: Bacteria, fungi

Morphology of bacteria, viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, sporulation/ germination process.

**UNIT – III**

Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rate, monoauxic, diauxic and synchronous growth. Chemostat

Physical and chemical agents to kill microbes, sterilization and pasteurization processes.

**UNIT –IV**

Normal micro flora in human/ animals. Types of microbial pathogens and diseases caused by them. Microbial interactions like symbiosis and antibiosis. Host defense mechanism against pathogens.

**Reference Books:**

1. Tortora, G.J., Funke, B.R. and Case, C.L. (2009) Microbiology: An introduction (Benjamin/ Cummings publishing company, Inc).
2. R. Y. Stanier, M. Doudoroff, E. A. Adelberg (1999). General microbiology (MacMillian Press London).
3. M.J. Pelczar, E.C. Sun Chan, N.R. Krieg (2007). Microbiology (Tata McGraw Hill Publication, New Delhi). 5<sup>th</sup> edition.
4. H.G. Schlegel, C.Zaborosch, M. Kogut (1993).General microbiology (Cambridge University Press).
5. S.C. Prescott, C.G. Dunn (1959). Industrial microbiology (McGraw- Hill).
6. Purohit, S.S. (2003). Microbiology: Fundamentals and applications (Agrobios, India)
7. Postgate, J.R. (2000). Microbes and man (Cambridge University Press).

**BIOT-Sem-II-VI-P****General Microbiology (Practicals)****Practical: 22 Marks  
Internal Ass.: 3 Marks**

1. Cleaning of glass wares, preparation of media, cotton plugging and sterilization.
2. Isolation of microorganisms from air, water and soil samples.
3. Dilution and pour plating techniques.
4. Gram staining, spore staining, motility
5. Growth curve of microorganisms.
6. Antibiotics sensitivity of microbes using antibiotic discs.
7. Testing of water quality.

**Reference Books:**

1. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual, (Pearson Benjamin Cummings).

**SEMESTER 3<sup>rd</sup>**  
**B.Sc. (Hons.) 2<sup>nd</sup> year (3<sup>rd</sup> Semester)**

**Paper: Biochemistry**

**Course No.: BIOT-Sem-III-I-T**

Theory : 67 marks  
Int. assessment : 08 marks  
Total : 75 marks  
Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: To familiarize the students with the biochemical activities taking place at cellular level, highlighting the enzymatic reactions, metabolic pathways and biochemical aspect.*

**Unit- I**

Metabolism: Metabolic pathways, biochemical reaction mechanism, energy rich metabolites. Coupled reactions, substrate level phosphorylation. Importance of ATP: Structural basis of high phosphoryl transfer potential of ATP. Sources of cellular energy, activated carriers. Regulation and evolution of metabolic pathways.

**Unit- II**

Carbohydrate metabolism: Biosynthesis and degradation of glucose; feeder pathways of glycolysis; Krebs cycle, amphibolic nature of the Krebs's cycle; regulation of Krebs cycle, regulation of gluconeogenesis. Glycogen metabolism.  
Mitochondrial electron transport chain, oxidative phosphorylation; regulation of ATP synthesis.

**Unit- III**

Lipid Metabolism: Biosynthesis and degradation of fatty acids;  $\beta$  oxidation of saturated, unsaturated and polyunsaturated fatty acids. Formation of ketone bodies, their function and physiological significance. Fatty acid synthesis: multifunctional enzyme complex in eukaryotes, function of citrate. Regulation of fatty acid metabolism.  
Cholesterol metabolism: Biosynthesis of cholesterol and its regulation.

**Unit- IV**

Amino acid metabolism: Biosynthesis of nutritionally non-essential amino acids; catabolism of carbon skeleton of amino acids. Conversion of amino acids to specialized products; amino acids as precursors of porphyrins, bile pigments and biogenic amines.  
Nucleic acid metabolism: Biosynthesis of purine and pyrimidine nucleotides; salvage reactions. Catabolism of purines and pyrimidines, urea cycle.



**Reference Books:**

1. Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).
2. Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).
3. Rawn J.D. (1989). Biochemistry (Neil Patterson).
4. Voet D., Voet, J.G. (2004). Biochemistry (John Wiley & Sons).
5. Voet, D., Voet, J.G. and Pratt, C.W. (2008). Fundamentals of biochemistry: Life at the molecular level (John Wiley & Sons).

**BIOT-Sem-III-I-P****Biochemistry (Practical)**

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Estimation of DNA by the diphenylamine reaction.
2. Determination of reducing sugars using 3, 5-dinitrosalicylic acid and Benedict's test.
3. Determination of iodine number of fat.
4. Determination of extinction coefficient of nucleic acids.
5. Biuret assay for protein estimation.
6. Quantitative estimation of amino acids using ninhydrin reaction.
7. Estimation of RNA by means of orcinol reaction.

**Paper: Genetics****Course No.: BIOT-Sem-III-II-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: The focus of this course is on the science of heredity with emphasis on the basics of Mendelian and molecular genetics. It will familiarize students with chromosome organization, linkage, chromosome mapping, chromosome aberrations, mutations and microbial genetics.*

**Unit – I**

Mendelian laws of inheritance, Sex determination in drosophila, plants and animals, sex linkage, Non-disjunction as a proof of chromosomal theory of inheritance. Numerical chromosome aberration polyploidy, aneuploidy, Chromosomal aberrations: duplications, inversions, translocations, position effects.

### Unit – II

Gene interactions, sex linked inheritance. Crossing over: molecular mechanism and cytological proof, Recombination, linkage, gene mapping, Three point testcross, interference, coincidence, recombination frequencies, Tetrad analysis, somatic cell hybridization for gene linkage studies, Hereditary defects.

### Unit – III

Population genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies, Chi-square test, probability, pedigree analysis.

Mutation: Spontaneous versus induced mutations, types of mutations, mutagenic agents: Physical, chemical and radiation, molecular basis of mutations, mechanisms of DNA repair, mutations frequency, correlation between mutagenicity and carcinogenicity,

### Unit – IV

Basic microbial genetics: Conjugation, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathway, one gene – one enzyme hypothesis. Extra chromosomal inheritance: mitochondrial and chloroplast genetic systems.

#### Reference Books:

1. Birge, E.A. (2006). Bacterial and bacteriophage genetics (Springer).
2. Dale J., Park S. (2005) Molecular genetics of bacteria (John Wiley and Sons Inc).
3. Freifelder, D. (2005). Molecular biology (Jones and Bartlett).
4. Synder, L., Champness W. (2007). Molecular genetics of bacteria (ASM Press).
5. Turn N.J, Trempy J.E. (2006). Fundamental bacterial genetics (Wiley Blackwell).
6. T.A. Baker, J.D. Watson, S. Bell. (2004). Molecular biology of the gene (Benjamin B. Cummings).
7. A.J.F. Griffiths, S.R. Wessler, R.C. Lewontin, S.B. Carroll (2007). Introduction to genetic analysis (W.H. Freeman & Co Ltd).
8. Strickberger M.W. (2006) 3<sup>rd</sup> edition. Genetics (Macmillan).
9. Verma P.S (2012) Genetics (S.Chand & Company Ltd.)
10. Sanders M.F. and Bowman J.L.(2012) Genetic Analysis (Pearsons)

#### BIOT-Sem-III-II-P

#### Genetics (Practical)

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Examination of permanent slides of various stages of mitosis and meiosis and different types of chromosomes.
2. Demonstration of law of segregation and independent assortment (use of dried peas, colored peas, capsules *etc.*).
3. Numerical for segregation and independent assortment.

4. Use of Chi-square for prediction of phenotype/genotype frequencies of parents from progeny and vice-versa, epistasis.
5. Detection of blood groups (ABO & Rh factors).
6. Calculation of variance in respect of pod length and number of seeds/pod.
7. Calculation of gene frequencies and random mating (colored beads, capsules).
8. Dermatographics: Palm print taking and finger tip patterns.

**Paper: Immunology-I**

**Course No.: BIOT-Sem-III-III-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

**Objectives:** *To understand general aspects of immune system like different components of the immune system, Generation and functions of these components, Knowledge of basic immunological techniques.*

**Unit-I**

**1. Introduction**

- i) Overviews of immune system – Historical perspectives
- ii) Innate and acquired immunity
- iii) Clonal nature of immune response.

**2. Cells of the immune system :** Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, Natural killer cells and lymphocyte activated killer cells, eosinophils, neutrophils & mast cells.

**Unit-II**

**3. Organs of the immune system :** Primary and secondary lymphoid organs, systemic function of immune system.

**4. Lymphocyte Trafficking:** Cell surface proteins, Cell Adhesion molecules ( Integrin, Selectin, Cadherin family and Ig Superfamily).

**5. Antigen – Immunogenicity Vs. antigenicity,** factors effecting immunogenicity, nature of immunogen, epitopes, heptans and antigenicity, pattern recognition receptors.

**Unit-III**

**6. Immunoglobulins:** Structure of antibody, antibody effector function, antibody classes and biological activities, antigenic determinants on Immunoglobulins, Immunoglobulins superfamilies.

**7. Major histocompatibility complex:** General organization and inheritance, MHC molecules and genes, genetic map, cellular distribution, regulation of MHC expression and disease susceptibility, antigen presentation.

### Unit-IV

8. **Hybridoma Technology:** Production of Monoclonal Antibodies, applications of polyclonal and monoclonal antibodies.
9. **Antigen–Antibody interactions :** Strength of interaction, cross reactivity, antibody affinity, avidity. Antigen-antibody interactions as tools for research and diagnosis: precipitation and agglutination reactions, immunodiffusion, immunoelectrophoresis, immunoassays, Enzyme linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), western blot, Immunofluorescence.

#### Reference Books:

1. Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).
2. Immunology- A short course (2009) by Richard Coico, Geoffrey Sunshine (Wiley Blackwell).
3. Fundamentals of immunology (1999) by William Paul (Lippincott Williams & Wilkins).
4. Immunology (2001) by Ivan Maurice Roitt, Jonathan Brostoff, David K. Male (Mosby).
5. Kindt TJ, Goldsby RA, Osborne BA, Kuby J. Immunology. (6th Ed.) WH Freeman & Co. New York; 2006.
6. Delves PJ, Martin SJ, Burton DR, Roitt IM. Roitt's essential immunology. Wiley Blackwell; 2011.

#### BIOT-Sem-III-III-P

#### Basic Immunology (Practicals)

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Lymphoid organs and their microscopic organization.
2. Differential leucocytes count.
3. Separation of serum from blood.
4. Separation of plasma from blood.
5. Ouchterlony Double Diffusion
6. Radial immuno diffusion test using specific antibody and antigen.
7. Agglutination (Blood group testing).

**Paper: Plant Tissue Culture**  
**Course No.: BIOT-Sem-III-IV-T**

Theory	: 67 marks
Int. assessment	: 08 marks
Total	: 75 marks
Time	: 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: To introduce the students with fundamentals and applications of plant tissue culture. This course will expose students to the methods of culturing, maintaining and regenerating plants species.*

**Unit – I**

Cellular totipotency and differentiation in plants.

Plant Culture Media and their composition.

Sterilization techniques for glassware and tissue culture media.

Micropropagation: Establishment of aseptic culture, various stages, advantages and disadvantages.

**Unit –II**

Organogenesis; somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Cell/callus line selection for resistance to herbicide, stress and diseases. Role of tissue culture in rapid clonal propagation, production of pathogen - free plants and "synthetic seeds" haploid and Triploid plant production & their application.

**Unit – III**

Protoplast and somatic hybridization: Isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids, applications of protoplast hybridization technology.

**Unit – IV**

Secondary metabolites: Secondary Plant products from cultured cells and their industrial applications.

Cryopreservation of germplasm: Short term and long term conservation of plant genetic resources, *In situ* and *Ex situ* conservation of plants

**Reference Books:**

1. Razdan, M.K. (2007). Introduction to plant tissue culture (India Book House Pvt. Ltd).
2. Narayanaswamy, S (1994). Plant cell and tissue culture (Tata Mc-Graw Hill Publishing Co.Ltd, New Delhi).
3. Rudolf, E. (1994). Plant cell biotechnology (Spinger Verlag).
4. Bhojwani, S.S., Razdan, M.K. (1996), Plant tissue culture: Theory and practice (Elsevier Science, Netherlands).

5. Gamborg, O.L., Phillips, G.C. (1995). Plant cell, tissue and organ culture: Fundamental methods (Illustrated, Publisher Springer).
6. HS Chawla (2003). Plant biotechnology: A practical approach (Science Publishers, USA). Plant Tissue Culture and Biotechnology

### **BIOT-Sem-III-IV-P Plant Tissue Culture (Practical)**

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Laboratory design set up for a plant tissue culture laboratory.
2. How to clean glass/plastic ware.
3. Preparation of complex nutrient medium (Murashige and Skoog's medium).
4. To select, prune, sterilize and prepare an explant for culture.
5. To culture different explants for raising callus cultures.
6. Significance of growth hormones in culture medium.
7. To demonstrate various steps of micropropagation.

### **Paper: Animal Cell Culture**

**Course No.: BIOT-Sem-III-V-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

#### **Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: The major emphasis of this course is to introduce the students to the field of Animal cell-culturing and its importance to mankind. The students will also learn the techniques involved in animal cell culture.*

#### **Unit – I**

History of development of cell cultures, natural surroundings for animal cells, simulating natural conditions for animal cells, metabolic capabilities of animal cells.

Biology of cultured cells : The culture environment, cell adhesion, proliferation, differentiation, signaling, evolution of cell lines. Equipments and materials for animal cell culture technology.

#### **Unit II**

Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements.

Serum & protein free defined media and their application.

Animal cell culture Techniques: Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary culture, transformed animal cells.

### Unit – III

Established/continuous cell lines, commonly used animal cell lines, their origin and characteristics. Maintenance and growth kinetics of cells in culture, differentiation of cells, Measurement of growth and viability of cells in culture. Cytotoxicity assays & their applications,

### Unit – IV

Characterization of Cell lines and their authentication, Cell fusion and production of monoclonal antibodies.

Transformation and immortalization, cryopreservation.

Bio-Safety & Bioethics.

### Reference Books:

1. R. Ian Freshney, (2010) 6th Edition, Wiley-Blackwell. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications
2. P.R. Yadav and Rajeev Tyagi, Discovery Publishing House, (2006) Biotechnology of Animal Tissues
3. Julio, E., Celis. (2006) Cell Biology. A laboratory handbook, Vol. I-IV (Elsevier Academic)
4. Butler, M (1996) Mammalian cell biotechnology. A practical approach (IRL, Oxford University Press)
5. Gareth, E.J. (Edition Illustrated, Humana Press) (1996) Human cell culture protocols.

### BIOT-Sem-III-V-P

### Animal Cell Culture (Practical)

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

1. Fumigation of animal cell culture laboratories.
2. Maintenance of aseptic conditions and sterilization method.
3. Preparation of Minimal Essential Growth medium for cell culture.
4. Isolation of lymphocytes for culturing.
5. Checking availability of cells by Teypan blue
6. Determination of cell count

### B.Sc. (Hons.) 2<sup>nd</sup> year (4<sup>th</sup> Semester)

### Paper: Immunology-II

### Course No.: BIOT-Sem-IV-I-T

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

### Instructions for paper setters and candidates:-

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.

- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: This course will introduce students to the principles of advanced Immunology, both at the molecular and cellular levels.*

#### Unit-I

1. **B Cell Activation, Differentiation:** B-Cell Activation and Proliferation, In Vivo Sites for Induction of Humoral Responses, T-dependent and T-independent antigens.
2. **Organization and expression of Immunoglobulins gene:** Genetic model, multigene organization, generation of antibody diversity.

#### Unit-II

3. **Receptors and Signaling:** T-Cell Receptors: Structure and Roles, T-Cell Receptor Complex.
4. **T-Cell Maturation, Activation, and Differentiation:** Thymic Selection of the T-Cell Repertoire, T<sub>H</sub>-Cell Activation, T-Cell Differentiation, Cell Death and T-Cell populations, Peripheral-T-Cells.
5. **Complement system:** Function, Components- Classic, Alternative, Mannose binding proteins, activation, Regulation of the Complement System, Biological Consequences of Complement Activation.

#### Unit-III

6. **Hypersensitivity:** Type I, Type II, Type III and Type IV Hypersensitivity reactions and their implications.
7. **Autoimmunity:** Organ specific autoimmune diseases : Hashimoto's Thyroiditis, Insulin-dependent Diabetes Mellitus, Grave's disease, Myasthenia Gravis.  
**Systemic Autoimmune Disease:** Systemic lupus Erythematosus (SLE).

#### Unit-IV

8. **Transplantation immunology-** Immunologic Basis of Graft Rejection, Clinical Manifestations of Graft Rejection, General Immunosuppressive Therapy, Specific Immunosuppressive Therapy, Immune Tolerance to Allografts, Clinical Transplantation
9. **Vaccines and Vaccination** – principles of vaccination, passive & active immunization, immunization programs, adjuvants, bacterial vaccines, viral vaccines, polysaccharide vaccines, DNA vaccines, recombinant vaccines, vaccines to other infectious agents, tumor vaccines.

#### Reference Books:

1. Kindt TJ, Goldsby RA, Osborne BA, Kuby J. Immunology. (6th Ed.) W.H. Freeman & Co. New York; 2006.
2. Delves PJ, Martin SJ, Burton DR, Roitt IM. Roitt's essential immunology. Wiley-Blackwell; 2011
3. Peakman M, Vergani D, Pyne DJ, Woodward M. Basic and clinical immunology. (1<sup>st</sup> Ed.) Churchill Livingstone; 1997.
4. Roitt I, Brostoff J, Male D. Immunology. (6th Ed.) Harcourt Health Sciences, 2001.
5. Clinical Immunology and serology: A laboratory perspective (1997) by Stevens C.D (F A Davis Company, Philadelphia).



**BIOT-Sem-IV-I-P****Immunology-II (Practical)**

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Performing enzyme linked immunosorbent assay (ELISA).
2. Rocket immuno-electrophoresis for antigen antibody interaction.
3. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods.
4. Total leucocyte count (TLC).
5. Isolation of IgG from serum.

**Paper: Biophysical and Biochemical Techniques****Course No.: BIOT-Sem-IV-II-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: To enable the students learn important tools and techniques based on biophysical and biochemical principles so that they can understand application of these techniques in biotechnology*

**Unit – I**

Principle, working and applications of Spectrophotometry (UV& visible) and spectrofluorimetry, Atomic absorption spectrophotometry: Equipment used and applications  
 Infrared and Raman spectroscopy. ORD and circular dichroism, Nuclear Magnetic Resonance and Electron Spin Resonance spectroscopy, Magnetic Resonance Imaging.  
 Electrophoresis: Principle, types & applications.

**Unit – II**

Microscopy: Properties; Light and Bright field Microscopy, Dark field Microscopy; Phase contrast, Fluorescent and Confocal microscopy,  
 Electron microscopy: Scanning and Transmission Electron Microscopy.  
 Centrifugation: Principle, types & applications.

**Unit – III**

Crystallography: Physical basis of crystallization; formation of crystals; Mounting of crystals  
 X-ray diffraction: Braggs law; Diffraction of x-rays by crystals  
 Overview of chromatography; Gas chromatography and HPLC

**Unit – IV**

Radioisotope techniques: Radiotracers; GM counter, proportional and scintillation counters, autoradiography.

Mass spectrometry: Physical basis; Instrument used; ionization modes; Applications  
Collaboration of MS with other techniques: GCMS and LCMS.

### Reference Books:

1. K Wilson, J Walker (2000) Principles and techniques of biochemistry and Molecular Biology Seventh Edition, (Cambridge University Press).
2. SR Mikkelsen, E Cortin (2004). Bioanalytical Chemistry (2004) (John Wiley & Sons)
3. David Sheehan (2009). Physical Biochemistry: Principles and Applications, Second Edition. (John Wiley & Sons)
4. P. Carmona, R. Navarro, A, Hernanz (1997) Spectroscopy of biological molecules: Modern trends (Illustrated, Publisher Springer)
5. Bernard Valeur (2001). Molecular fluorescence: Principles and application (Wiley-VCH).Plenum USA].
6. Plummer D.T. (2004). An introduction to practical biochemistry (Tata McGraw Hill Publishers Co. Ltd., New Delhi).
7. Bansal, D.D., K Hardori, R & Gupta, M.M. (1985). Practical biochemistry (Standard Publication, Chandigarh).

### BIOT-Sem-IV-II-P      Biophysical And Biochemical Techniques (Practicals)

Practical : 22 marks  
Int. assessment : 03 marks  
Total : 25marks  
Time : 3 hours

1. Identification of the provided sample using some of the spectroscopic techniques.
2. Quantitative analysis by UV/Visible spectrophotometry.
3. Use and care of light microscope.
4. Demonstration of radioisotopic techniques
5. Gel filtration chromatography

### Paper: Plant Biotechnology

Course No.: BIOT-Sem-IV-III-T

Theory : 67 marks  
Int. assessment : 08 marks  
Total : 75 marks  
Time : 3 hours

### Instructions for paper setters and candidates:-

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: The objective of this course is to familiarize the students with different aspects of plant molecular biotechnology and techniques for plant genetic manipulations.*

### Unit – I

Genetic material of plant cells with an introduction to chloroplast and mitochondrial DNA.  
Plant Promoter, Plant Selection markers and reporter genes.  
Transformation of plant cells; different type of vectors including viral vectors and their benefits.

### Unit –II

Modes of gene delivery in plants: Particle bombardment, electroporation, microinjection;  
Advantages and disadvantages  
Agrobacterium mediated gene transfer, natural pathogen mode of infection,  
vir gene functions, Ti / Ri plasmids, Screening and selection of transformants, PCR and  
hybridization methods; Transgene selection and silencing; Generation and maintenance of  
transgenic plants.

### Unit – III

Transgenic plants: Genetic modification of plants for herbicide resistance, Pest resistance, virus  
resistance Bacterial and fungal resistance. Delayed fruit ripening, improved protein composition.  
Bt cotton, golden rice and some others as examples.

### Unit – IV

Plant cell as factories for production of industrial enzymes, biodegradable plastics, antibodies,  
edible vaccines; manipulation of metabolic pathways for production of fatty acids, industrial oils,  
terpenoids, flavanoids.

#### Reference Books:

1. Draper, J.R., Scott. P., Armitage, R. Walden (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
2. Ashihara et al. (2011) Plant Metabolism and Biotechnology, John Wiley & Sons, Ltd. ISBN: 978-0- 470-74703-2
3. Old, R.W., and Primrose, S.B. (2004). Principles of Gene Manipulation : An Introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford.
4. Peter J. Lea and Richard C. Leegood, Plant Biochemistry and Molecular Biology, Wiley Publishing.
5. Singh R.P. & Jaiwal P.K. (2003) Plant Genetic Engineering Vol. 1 – 4. SCI Tech Publishing LLC, U.S.A.
6. Gupta, P.K. (1990). An Introduction to Biotechnology, Rastogi Publications, Meerut.

#### BIOT-Sem-IV-III-P Plant Biotechnology (Practicals)

Practical : 22 marks  
Int. assessment : 03marks  
Total : 25 marks  
Time : 3 hours

1. Aseptic culture techniques for establishment and maintenance of cultures
2. Preparation of stock solutions of MS basal medium and plant growth regulator stocks.
3. Micropropagation of Tobacco plant by leaf disc culture.
4. Isolation of plant genomic DNA by modified CTAB method.
5. DNA check run by Agarose Electrophoresis.
6. Agrobacterium tumefaciens-mediated plant transformation.

**Paper: Animal Biotechnology**  
**Course No.: BIOT-Sem-IV-IV-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: The major emphasis of this course is to introduce the students to the advances in the field of Animal and their importance to mankind.*

**Unit-I**

**Organotypic and histotypic cultures:** *Organotypic culture:* Gas and nutrient exchange, structure integrity, growth, differentiation, advantages and applications. Methods, advantages and applications of histotypic culture.

**Three dimensional culture and tissue engineering:** Concept of tissue engineering, components of tissue engineering, cells imaging in 3D construct.

**Unit-II**

***In vitro* fertilization (IVF)** in Humans and Embryo Transfer in Livestock.

**Cell culture based vaccines:** Cells as virus host/cell culture based vaccines, cells as protein factory/cell expression system and cells as antigen presenter/personalized vaccine.

**Scaling up of the animal cell culture:** different methods of scale up at laboratory and industrial level.

**Unit-III**

**Transgenic animals and their applications:** Concept of transgenics, Methods of gene transfer, selection of clone containing DNA insert and application of transgenic animals (Food, environment, recombinant proteins, drugs *etc.*). Safety and ethical issues of transgenic animals.

**Unit-IV**

**Production of various products of human use using animal cell culture:**

Antibiotics production

Human Growth factors

Insulin and other Hormones

**Essential Readings:**

1. Culture of animal cells (2009). RI Freshney, Sixth ed. John Willey & Sons.
2. Culture of animal cells: A manual of basic technique and specialized applications. John Wiley & Sons, (2011).
3. Animal cell culture and technology by Michaelis Butler. BIOS Scientific Publisher (2003).
4. Animal cell biotechnology XVI 2<sup>nd</sup> Edition (2007) by Ralf Partner Humana Press.

5. Textbook of animal biotechnology (2012) by B Singh, S K Gautam, and M S Chauhan..
7. Principles of tissue engineering by Robert Lanza, Robert Langer, Joseph P. Vacanti. Academic Press, (2011) - Science - 1344 pages.
8. Transgenic animal technology, 2<sup>nd</sup> Edition: A Laboratory Handbook by Carl A. Pinkert. Academic Press; 2<sup>nd</sup> edition (2002).

**BIOT-Sem-IV-IV-P                      Animal Biotechnology (Practicals)**

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Growing the cell monolayers, *in vitro*.
2. Trypsinization of the monolayers and cell counting using hemocytometer.
3. To check the viability of the cells using Trypan Blue dye exclusion assay.
4. Checking the cytotoxicity of the compounds using MTT Assay.

**Paper: Agro & Industrial Biotechnology**

**Course No.: BIOT-Sem-IV-V-T**

Theory : 67 marks  
 Int. assessment : 08 marks  
 Total : 75 marks  
 Time : 3 hours

**Instructions for paper setters and candidates:-**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: This course will introduce students to the concepts of agriculture as industry. This course will help students to understand the application of fundamental concepts like transgenic approaches to improve crop plants, microbial culture maintenance, and metabolite purification at industrial level.*

**Unit I**

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

Maintenance and preservation of industrially important microbial cultures.

Differences between microbial industrial process and chemical industrial process.

**Unit II**

Improvement programme of industrial microbes, mutational programme of penicillin producing microorganisms, selection pressure in maintaining the hyper producer, lowering of production due to reversal of mutations, media formulation and process optimization of industrial and agro industrial microbes.

### Unit III

Microbes in agro industries and industrial biotechnology: Introduction of primary and secondary metabolites, production of vitamin B12, alcohol, wine, beer, cheese, bread, citric acid, gluconic acid, antibiotics (penicillin), enzymes (amylases, cellulases, lipases and proteases) and their industrial applications.

### Unit IV

Emerging technologies in agro industries: production of vermiculture, composting, herbicides and biopesticides, production of biofertilizers: Blue green algae, azolla, fungi, mycorrhiza (VAM), bacteria – *Azospirillum*, microbial biotransformations, single cell proteins (bacterial, fungal and algal).

#### Reference Books:

1. Marwaha, S.S., Arora, J.K. (2003). Biotechnological strategies in agro-Processing (Asiatech publishers Inc. New Delhi, India).
2. Stanbury, P.F., Whitaker A. (2011) 2<sup>nd</sup> edition. Principles of fermentation technology.
3. Singh, BD. (2008). Biotechnology: Expanding horizons (Kalyani Publishers, India).
4. Patel A.H. (2007). Industrial microbiology (New Age International Publishers).
5. Loessner, J. M, Jay J.M, D.A. Golden (2005). Modern food microbiology (Golden Springer).
6. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual (Pearson Benjamin Cummings).

#### BIOT-Sem-IV-V-P      Agro & Industrial Biotechnology (Practicals)

Practical : 22 marks  
 Int. assessment : 03marks  
 Total : 25 marks  
 Time : 3 hours

1. Counting of Microbial cells by serial dilution techniques (Spread plate and pour plate).
2. Measurement of bacterial size.
3. Screening of industrial enzymes (cellulase, protease, amylase *etc.*) from different soil samples.
4. Production of enzymes by submerged and solid state fermentation.

## B.Sc. Hons. Biotechnology 3<sup>rd</sup> year (5<sup>th</sup> Semester)

**BIOT-Sem-V-I-T**

**MOLECULAR BIOLOGY**

**Theory : 67 marks**

**Int. asset : 08 marks**

**Total : 75 marks**

**Time : 3 hours**

### **Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**

***Objective:** This course of Molecular Biology will introduce the students with structure of various nucleic acids and detailed molecular mechanisms of gene expression.*

### **UNIT-I**

1. DNA: Chemical composition of DNA DNA structure-single stranded DNA, detailed account of double stranded DNA, BDNA, Z.DNA and other structural forms and their importance.
2. Genome organization in prokaryotes: Molecular nature of the genetic material, Composition and structure of prokaryotic DNA and RNA.
3. Genome organization in eukaryotes: Composition and structure of eukaryotic DNA and RNA. Characteristic features of highly repetitive DNA, Tandem repetitive DNA and Mini and microsatellite DNA and Insertional elements and their role and importance

### **UNIT-II**

4. DNA replication: Prokaryotic DNA replication; replication origin and site and structure and DNA Ter regions and structure. DNA polymerases, composition and features, replication factors and the mechanism of replication, leading strand and lagging strand synthesis, processivity and fidelity. Replication of single stranded DNA, M13 viral DNA.
5. Eukaryotic DNA replication; origins, replication initiation complexes and their assembly, licensing factors, DNA polymerases and their composition, telomerase and mode of action, replication factors, disassembly of chromatin components and reassembly during replication.

### **UNIT-III**

6. Gene Expression: Overview of central dogma
7. RNAs: types, rRNAs; Structural features of rRNAs- prokaryotic and eukaryotic. tRNAs: structural features, their anticodon feature. mRNAs- prokaryotic and eukaryotic mRNAs, structural features,

8. Transcription: regulatory elements and mechanism of transcription regulation in prokaryotes and eukaryotes

#### **UNIT IV**

9. Translation: Overview and mechanism of translation process in prokaryotes, characteristics of the genetic code, structure and charging of tRNA,

10. Gene Regulation: Regulation of gene expression in response to environmental conditions. Operon concept- the Lactose and the Tryptophan operon.

#### **REFERENCE BOOKS:**

Lewin, B., 2004, Genes VIII, Oxford Univ. Press, Noida, India.

Ingraham, John.L.2004, Introduction to Microbiology, 3 Ed., Thomson brocks/Cole Inc.

Malacinski, George M., 2005, Freifelder's. Essentials of Molecular Biology, Narosa Publishing House, ND.

Karp, Gerald, 2005, Cell and Molecular Biology, Wiley International, USA.

Snusted and Simmons, 2006, Principles of genetics, John Wiley and Sons, Inc

Brown, T.A, 2007, Genomes 3, Garland Science.

Weaver R.F., Molecular biology (2005), McGraw

#### **BIOT-Sem-V-I-P: MOLECULAR BIOLOGY (Practical)**

**Practical : 20 marks**

**Int. assessment : 05marks**

**Total : 25 marks**

**Time : 3 hours**

1. Preparation of Reagents for DNA isolation.
2. DNA isolation from plants.
3. Agarose gel electrophoresis of DNA.
4. Plasmid DNA isolation.
5. Isolation of genomic DNA from Bacteria.
6. Restriction digestion of DNA.

#### **Reference Books:**

Molecular cloning: A laboratory manual Vol. I-III Sambrook J. and Russel, David N. 2001 Cold Spring Harbor.



BIOT-Sem-V-II-T

Paper: ENZYMOLOGY

Theory : 67 marks

Int. assessment : 08 marks

Total : 75 marks

Time : 3 hours

**Instructions for paper setters and candidates**

- Set nine questions in all. All questions carry equal marks except compulsory question.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

*Objective: The major emphasis of this course is to introduce the students to the world of enzymes, their structure and mode of action at various cellular metabolism and their applications in Biotechnology.*

**UNIT – I**

Structure and functions of enzymes: Historical background and general properties of enzymes, concept of active centre, binding sites, stereo specificity and ES complex formation, activation energy, Evidences for enzyme-substrate complex; Lock and key, Induced fit and Transition state hypotheses, Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways.

**UNIT – II**

**Factors Affecting the Enzyme Activity:** Concentration, pH and temperature. Kinetics of a single substrate enzyme catalysed reaction, derivation of Michealis-Menten Equation, significance of Km value, Vmax, Turnover number, Kcat. Enzyme activity, international units, specific activity,

Enzymes as thrombolytic agents, Anti-inflammatory agents, streptokinase, Isoenzymes

**UNIT-III**

**Enzyme Regulation:** Feedback inhibition, Allosteric Regulation, Covalent Modification and Proteolytic Activation. Organization of enzymes in the cell, localization, enzymes in membranes. Acid-base catalysis, covalent catalysis, Metal ion catalysis, multienzyme complexes and ribozymes, catalytic antibodies, Allosteric enzymes.

**UNIT – IV**

**Applications of Enzymes:** Immobilized enzymes, industrial applications of immobilized enzymes, Thermophilic enzymes, amylases, lipases, Proteolytic enzymes in meat and leather industry, enzymes used in fermentation processes, cellulose degrading enzymes, Metal degrading enzymes.

**Reference Books:**

1. Fundamentals of Enzymology : Nicholas Price & Lewis Stevens
2. Biochemistry text books by Stryer, Voet and Lehninger
3. Methods in enzymology Vol.185 (1990) Gene Expression technology edited by D.V. Goeddel (Academic Press Inc. San Diego).
4. Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).
5. Fundamentals of enzymology: The cell and molecular biology of catalytic proteins (2003) by Nicholas C. Price, Lewis Stevens, Lewis Stevens published (Oxford University Press, USA).
6. Principles and reactions of protein extraction, purification, and characterization (2004) edited by Hafiz Ahmed PhD (CRC, Taylor Francis Group).

**BIOT-Sem-V-II-P: ENZYMOLOGY (Practicals)**

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

1. Estimation of enzyme activity.
2. To study the Effect of pH on activity of enzyme.
3. To study the Effect of temperature on activity of enzyme.
4. To study the effect of substrate concentration on enzyme activity.
5. To estimate  $K_m$  and  $V_{max}$  of an enzyme and plot Line-Weaver Burk plot.

**Reference Books:**

An introduction to practical biochemistry (2004) by Plummer D.T. (Tata McGraw Hill Publishers Co. Ltd., New Delhi).

1. Practical Enzymology (2004) By Hans Bisswanger (Wiley- VCH, Weinheim)
2. Introductory practical biochemistry (2005) by S.K. Sawhney, Randhir Singh (Alpha Science International).

**BIOT-Sem-V-III-T : ENVIRONMENTAL BIOTECHNOLOGY****Theory : 67 marks****Int. assessment : 08 marks****Total : 75 marks****Time : 3 hours****Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**

***Objective:** The course focuses on an introduction to environment, major threats to environment by various polluting agents and the remedies for the same, incorporating design and monitoring of waste treatment processes. As well as learning environmental technology fundamentals, with special focus on biological treatment processes, environmental management. The course is use of biotechnology to design cleaner manufacturing processes and to solve pollution problems. It is ideal for under graduates just embarking on their career, or scientists and engineers who have been working for a few years and wish to develop their career in this direction.*

**UNIT-I**

Basics of Environment and Environmental pollution, air, water, soil and noise.

Air – Types, Sources & Effects,

Soil - Physicochemical and bacteriological analysis of soil, soil pollutants (fertilizers, insecticides fungicides, pesticides).

Noise pollution, its control and impact on human health.

Renewable and Non Renewable resources. and their Environmental Impacts.

Modern Fuels (gasohol, hydrogen and solar energy) and their Environmental Impacts.

**UNIT-II**

Water pollution and its management: Measurement of water, pollution, sources of water pollution. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors.

Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors.

**UNIT-III**

Bioremediation of contaminated soil and its applications

Degradation of pesticides and other toxic chemicals by microorganism. Integrated Pest management

Biofertilizers for clean environment– Nitrogen fixing microorganism, enrichment of the soil with assimilable nitrogen

#### UNIT IV

Introduction to solid waste and municipal solid waste management: Sources, types, composition.

Bioabsorption of metals:- Role of Microorganisms in biosorption and bioleaching. ,

Enrichment of ores by microorganisms

Bioindicators for detection of pollution

#### References Books:

1. Environmental Biotechnology: Principles and applications Bruce, E. Rittmann and Perry L.Mc. Carty, Mc. Graw Hill Publications, New York, 2000.
2. Environmental Biotechnology 2nd Edition, Alan Scragg, 2005, Oxford University Press.
- 3.Environmental Biotechnology (2007) S.K. Agarwal APH Publishing Corporation.
4. Wastewater engineering–Treatment, disposal and reuse (2009) by Metcalf and Eddy, Inc. (Tata Mc Graw Hill, New Delhi).
5. Comprehensive biotechnology (2004) by Murray Moo Young, Alan T Bull, Howard Dalton, Set 4 Vol (Elsevier India P Ltd).
6. Comprehensive biotechnology: The principles and regulation of biotechnology in industry, agriculture and medicine (1985) by Charles L Cooney, Arthur E Humphrey, Vol.2 (Pergamon Press).
7. Environmental chemistry (2006) by Anil Kumar De (New Age International (P) Ltd).
8. Introduction to biodeterioration (2004) by D. Allsopp, Kenneth J. Seal, Christine C. Gaylarde (Cambridge University Press).

#### **BIOT-Sem-V-III-P ENVIRONMENTAL BIOTECHNOLOGY(Practical)**

**Practical : 20 marks**

**Int. assessment : 05 marks**

**Total : 25 marks**

**Time : 3 hours**

1. Detection of coli forms for determination of the purity of potable water.
2. Determination of chlorine in water
3. Determination of total alkalinity of water
4. Determination of dissolved oxygen concentration of water sample.
5. Determination of biological oxygen demand (BOD) of a sewage sample.
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Isolation of phosphate solubilizing microorganisms from soil.

**Reference Books:**

1. Microbiology: A laboratory manual (2007) by Cappuccino J.G and Sherman N. (Publisher Pearson Benjamin Cummings).
2. Biotechnology Laboratory Manual by Swamy, P.M. Rastogi Publications (2008).
3. Practical Microbiology by Dr R.C. Dubey and D.K. Maheshwari, S.Chand Publications.

**BIOT-Sem-V-IV-T TOOLS IN BIOINFORMATICS**

**Theory : 67 marks**  
**Int. assessment: 08 marks**  
**Total : 75 marks**  
**Time : 3 hours**

**Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**

***Objective:** This course of introduces the students to an advanced field of biotechnology which will give an insight how to handle the enormous data generated in biology in silico and the in silico tools applied to decipher and analyze the data.*

**UNIT – I****Introduction to Bioinformatics, Biological Databases and Sequence analysis**

Introduction, overview and needs of bioinformatics technology.

**Primary Databases:** Primary Sequence database i.e. GenBank & EMBL.

**Secondary Databases:** SwissProt/TrEMBL, Pfam.

**Molecular Structure Databases:** Protein Data Bank (PDB), SCOP, CATH. Understanding the structure of each database and using it on the web.

**UNIT – II****Sequence Alignment:**

Introduction to sequence alignment and its applications.

**Pair wise sequence alignment:** Concept of global and local alignment, Dot Plot, algorithm for pair wise sequence alignment (Needleman Wunsch, Smith-watterman methods), Introduction to BLAST, types of BLAST, algorithm of BLAST and interpretation of its result.

**Substitution matrices:** Introduction to substitution matrices: PAM and BLOSUM matrices, concept of log odd ratio.

**Multiple sequence alignment:** Methods of multiple sequence alignment. Introduction to consensus sequences, motifs and profiles.

### UNIT – III

**Phylogenetic Analysis:** Introduction to phylogenetic analysis and its application, phylogenetic tree topologies, methods of phylogenetic tree construction and tools.

**Genome Annotation:** Concept of genome annotation, methods of gene identification. Tools of gene identification: GenScan and Glimmer.

### UNIT IV

**Protein Structure Prediction:** Concepts and strategies of protein structure prediction, methods of secondary structure prediction, and methods of protein tertiary structure prediction. Structure visualization tool – RasMol.

#### **BIOT-Sem-V-IV-P: TOOLS IN BIOINFORMATICS (Practicals)**

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

1. Searching literatures over PubMed.
2. Performing DOTPLOT on web.
3. Retrieving amino acid and nucleotide sequence from sequence databases using Entrez.
4. Performing BLASTp/n and interpreting its results.
5. Performing PSI-BLAST.
6. Performing multiple sequence alignment using Clustalw.
7. Finding ORF in nucleotide sequence using NCBI ORF FINDER
8. Using GenScan to identify exons in nucleotide sequence.
9. Download protein structure form PDB and visualize it using RasMol.

#### **BIOT-Sem-V-V-T INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN BIOTECHNOLOGY AND ENTERPRENEURSHIP**

**Theory : 90 marks**  
**Int. assessment : 10 marks**  
**Total : 100marks**

**Time : 3 hours**

**Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**

***Objective:** To introduce the students to intellectual rights and how to use the current intellectual property system to protect and commercialize their biotechnological invention. This course also covers the ethical issues, controversies and social-ethical impact of biotechnology on society.*

## **UNIT – I**

**IPR:** Introduction to Intellectual Property Rights. Tangible and intangible property. Patents: Introduction to patent law and brief history (early GATT and TRIPS), conditions for patentability; procedure for obtaining patents, patent filing through PCT, rights of a patentee; patent infringements and litigation.

Indian patent laws and amendments. Patents from an international perspective.

## **UNIT- II**

**Design, copyright and Trademark:**

Copyright: Registration procedure and copyright authorities; assignment and transfer of copyright, copyright infringement and exceptions to infringement; software copyright.

Designs: Introduction to the law on industrial designs; registration and piracy; international perspective; commercial exploitation and infringement.

Trademark: Importance, Registration, Trademark infringement and piracy.

## **UNIT – III**

**Patenting in biotechnology:** Biotechnology patents and its economic, ethical and depository considerations.

Patentable subject matter and legal aspects of transfer of biotechnology in India. Other multilateral treaties & International conventions – Paris convention, CBD, UPOV, PGRFA.

Writing a patent specification.

Information sources in patent literature search.

## **UNIT – IV**

**Entrepreneurship:**

Entrepreneur and its types, Women Entrepreneurship. Selection of a product, Product line design and development processes, economics on material and energy requirement, stock the product and release the same for making

The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential.

### Reference Books:

1. J.E. Smith (2004). Biotechnology (Cambridge Univ. Press).
2. V. Santaniello (2000). Agriculture and intellectual property rights: economic institutional, and implementation issues in biotechnology (Edition illustrated Publisher CABI).
3. Thackeray, A (ed) (1998). Private science: Biotechnology and the rise of the molecular sciences (Univ. of Pennsylvania Press, Phil).
4. Inderpal Singh and Baljinder Kaur (2006) Patent law and Entrepreneurship. Kalyani Publishers, India

### B.Sc. (Hons.)3<sup>rd</sup> year (6<sup>th</sup> Semester)

#### BIOT-Sem-VI-I-T Paper: GENETIC ENGINEERING

**Theory: 67 marks**

**Int. assessment: 08 marks**

**Total : 75marks**

**Time : 3 hours**

***Objectives:** Genetic engineering refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics. The students will learn how the genes can be cut and paste from one organism to another and what are its implications.*

#### **Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**



## UNIT-I

**1. Introduction to genetic engineering.** Why gene cloning and DNA analysis is important. . How to clone a gene - What is clone, Overview of the procedure

**2. Tools in Recombinant DNA Technology:**

Restriction and modifying enzymes, Type I , Type II and Type III enzymes and their characteristic features; restriction sequences, isoschizomers, rare cutting enzymes, enzyme cutting similar sequence in different manner.

DNA Modifying enzymes: Characteristics and applications of Nucleases – DNase and RNase, DNA-Pol I, Klenow fragment, T4DNA polymerase, T7 DNA polymerase, T4 Polynucleotide kinase, Phosphatase, Reverse transcriptase, Taq polymerase and Ligase. Terminal deoxy ribonucleotidyl transferase.

**3. Polymerase Chain Reaction:** Types and applications

## UNIT II

**Basic biology of plasmids and Phage vectors** Basic features of plasmids, plasmid classification, Bacteriophage  $\lambda$ , lytic & lysogeny, Promoter control circuits. linear and circular forms of lambda vector, DNA cloning with single stranded DNA vectors.

**DNA cloning vectors** Cloning vectors for E. coli- Nomenclature, pBR 322, pBR 327, pUC 8, pGEM3Z. insertion and replacement vectors; Vectors based on M13. Methods of identification of recombinants: Insertional inactivation, blue/white selection. Cloning vectors for yeast- YE<sub>p</sub>, YI<sub>p</sub>, YR<sub>p</sub>.

**Advanced Vectors:** cosmid, phagemid, Bacterial Artificial Chromosomes (BACs), shuttle vectors, yeast artificial chromosomes.

## UNIT-III

**Preparation of genomic and cDNA library:** Partial digests, Choice of vectors, Construction and Evaluation of a genomic library. cDNA library: mRNA enrichment, cDNA synthesis, Random, arrayed and Ordered library.

**Finding The Right Clone:** Gene identification, Nucleic acid hybridization, screening Procedure, Probe selection, immuno screening, functional complementation. Southern blotting, northern blotting.

**Preparation of nucleic acid probes:** DNA and RNA labeling techniques, nick translation , random priming, end labelling, radioactive and non- radioactive labels.

## UNIT-IV

**Site directed mutagenesis** (cassette , primer extension, RT, real time, multiplex, inverse),

**DNA sequencing** (Maxam-Gilbert, Sanger, pyro).

**Production of Protein from Cloned Genes:** Special vectors for expression of foreign genes in *E. coli*, General problems with the production of recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells.

**Suggested readings:**

1. Recombinant DNA by Watson, J.D. et.al., 1993, Scientific American Books, New York.
2. Principles of Gene Manipulation by Old., R.W. and Primrose, S.B., 2004, Blackwell Publishing, UK.
3. Methods in Gene Technology by Dale, J.N., 1994, JAI Press Ltd. London, England.
4. Recombinant Principles of gene manipulation and genomics, primrose & Twyman 2006, Blackwell, U.K.
5. Gene cloning and DNA analysis: An introduction by T.A. Brown (5th Ed.) 2006, Blackwell Science Ltd.
6. Molecular cloning: A laboratory manual Vol. I-III Sambrook J. and Russel, David N. 2001 Cold Spring Harbar,

**BIOT-Sem-VI-I-P : GENETIC ENGINEERING (PRACTICAL)****Practical : 20 marks****Int. assessment : 05 marks****Total : 25 marks****Time : 3 hours**

1. Demonstration of PCR.
2. Demonstration of Southern blotting.
3. Preparation of competent cells.
4. Transformation of competent cells and blue/white selection.
5. Spectrophotometer analysis of DNA.

**BIOT-Sem-VI-II-T: BIOPROCESS ENGINEERING AND TECHNOLOGY****Theory : 67 marks****Int. assessment: 08 marks****Total : 75marks****Time : 3 hours*****Objectives:***

*The objective of this course is to make the student conversant with basic concepts of bioprocesses, design of fermenter along with growth and product formation in various types of processes. Important concept of down streaming and waste water will also be discussed as important component of fermentation economics*

**Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
  - **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**

- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

### Unit – I

Fundamental principles of biochemical engineering  
Sterilization of air and media sterilization, design of batch sterilization process.  
Del factor, sterilization cycle, continuous sterilization process

### Unit – II

**Microbial growth kinetics** Simple kinetics of microbial growth (Batch and Continuous) yield coefficient, doubling time, specific growth rate, internal and external feedback systems, metabolic and Biomass productivities, effect of temperature and pH on the product formation

### Unit – III

#### Design of fermenter:

Components of Fermenter, Aseptic operation of the fermenters, control and measurement equipment of fermenters, pH and DO probes, impeller and spargers,

### Unit – IV

#### Downstream processing

Removal of microbial cells and other solid materials, foam separations, filtration, industrial filters, centrifugations and industrial centrifuges, cell Disruption, aqueous two phase extraction system, super critical extraction, whole broth process.  
Waste water treatment for fermentation process

#### Reference Books:

1. Madigan, M.T., Martinko, J.M, P.V. Dunlap, T.D. Brock, D.P. Clark (2008). Brock biology of mMicroorganisms (Pearson Benjamin Cummings).
2. Prescott, L.M. Harley, J.P., Klein, D.A. (2001). Microbiology (McGraw-Hill, Boston).
3. Schaechter, M., Ingraham, J.L., Neidhardt, F.C., (2006). Microbe (ASM Press, Washington, DC).
4. Prescott, L.M. (1999). Microbiology with microbes in motion (McGraw-Hill).
5. Bailey J.E., Ollis, D.F. (1986). Biochemical engineering fundamentals (McGraw-Hill).
6. Schuler, M.L., Kargi F. (2002). Bioprocess engineering: Basic concepts (Prentice hall PTR, Upper Saddle River NY).

**BIOT-Sem-VI-II-P:****BIOPROCESS ENGINEERING AND TECHNOLOGY (Practicals)**

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

1. Demonstration of components and sterilization of fermenters and other accessories.
2. Determination of doubling time, yield coefficient for growth of microorganism.
3. Effect of temperature and pH on growth and product formation.
4. Determination of Specific growth rate and maximum specific growth rate
5. Cell disruption by Sonicator
6. Demonstration of normal flow and cross flow filtration process

**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).

**BIOT-Sem-VI-III-T : FOOD BIOTECHNOLOGY**

**Theory: 67 marks**  
**Int. assessment: 08 marks**  
**Total: 75 marks**  
**Time: 3 hours**

*Objective : To enable the students aware of the various prospects of biotechnology in the development of various food products and to make them conversant with food contamination and preservation techniques*

**Instructions for paper setters and candidates**

- Set nine questions in all. All questions carry equal marks except compulsory question.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

**UNIT – I**

**Food and Microorganisms:** History and scope of Food biotechnology, food as substrates for microbes, factors affecting growth of microorganisms, Detection of microorganisms in food: procedure for microbial analysis; Qualitative methods to isolate pathogenic microorganisms, and quantitative methods for microbial enumeration: direct, indirect and standard methods, test for

bacterial toxins in foods; Rapid and advanced estimation methods (Immunoassays, nucleic acid probe) for detection of pathogens. Applications of enzymes in food technology.

## UNIT – II

**Principles of food preservation:** Physical, chemical, and biological methods of preservations.

**Contamination, preservation and spoilage of different kind of foods:** Milk and milk products (milk, yoghurt and cheese), beverages (beer, wine, tea and coffee), meat and fish products

## UNIT – III

**Food adulterants and food additives:** Major food adulterants, types and their methods of assay, food additives their function and uses, flavoring agents, coloring agents and vitamins as food additives.

**Fermented foods and their production:** Bakers yeast, Bread, cheese, yoghurt, tofu, and alcoholic beverages ( beer and wine)

Production of algal, fungal and other microbial proteins( SCP)

Probiotics, prebiotics,fortified and biofortified foods, functional foods

Genetically modified food (Golden rice, Favr savr tomato, protato, pomato etc)

## UNIT –IV

Food and water borne diseases: Shigellosis, Salmonellosis, Cholera.

Food borne intoxications: *Staphylococcal*, *Bacillus* and *Clostridium botulinum*

Exotoxins and Endotoxins, their mechanism of action

## Reference Books:

1. Frazier W.C., Westhoff, D.C. (Ed). (1988). Food microbiology (McGraw-Hill).
2. Admas, M.R., 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., M.J. Loessner, D.A. Golden. (2005). Modern food microbiology (Edition 7, Illustrated Publisher Springer).
5. B. Sivasankar (2004). Food processing and preservation (PHI Private Ltd, New Delhi).
6. Michael P. Doyle (1989). Food borne bacterial pathogens (Edition illustrated, Publisher Marcel Dekker).

**BIOT-Sem-VI-III-P: FOOD BIOTECHNOLOGY (Practicals)**

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

1. Isolation and identification of microorganisms in spoiled food (fungi and bacteria).
2. Inhibitory effect of low temperature on microbial growth.
3. Production and estimation of ethanol.
4. Estimation of lactose in milk.
5. Methylene blue reductase test (MBRT) for determination of quality of milk.
6. Plating the milk samples for microbial contamination.
7. Demonstration for the identification of mushrooms by spore prints.
8. Checking the effect of pasteurization of milk by alkaline phosphatase.

**Reference Books:**

1. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual (Pearson Benjamin Cummings).

**BIOT-Sem-VI-IV-T: GENOMICS AND PROTEOMICS**

**Theory : 67 marks**  
**Int. assessment : 08 marks**  
**Total : 75 marks**  
**Time : 3 hours**

**Instructions for paper setters and candidates**

- **Set nine questions in all. All questions carry equal marks except compulsory question.**
- **Five questions to be attempted.**
- **Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).**
- **Set two questions from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.**

***Objective:** This course emphasizes on the detail study of genomes, their mapping and sequencing techniques and using various data bases to study their structure and how they can be related to proteome. They will be also introduced to various tools for proteomics and its application.*

## UNIT I

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Tools for sequencing projects: Genome sequence assembly software.

## UNIT II

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

## UNIT III

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

## UNIT IV

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

### **BIOT-Sem-VI-IV-P: GENOMICS AND PROTEOMICS (PRACTICALS)**

**Practical : 20 marks**

**Int. assessment : 05 marks**

**Total : 25 marks**

**Time : 3 hours**

1. Use of SNP databases at NCBI and other sites.
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

**Reference Books:**

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.

**BIOT-Sem-VI-V-P****ON JOB TRAINING****MARKS: 100**

**The students are supposed to undergo four to six weeks practical training in industries/institutes during the summer vacations after 4<sup>th</sup> semester for which the reports will be submitted by the students in 6<sup>th</sup> semester and will be evaluated by three teacher evaluating committee.**

\*\*\*\*\*