FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc. (HONOURS) BIOTECHNOLOGY
1st, 2nd & 3rd YEAR

EXAMINATIONS 2013
SYLLABUS FOR 3-YEARS DEGREE COURSES IN BIOTECHNOLOGY
For the examinations 2013

- Year-wise marks distribution for B.Sc (Hons.) course:
  1st year 1000
  2nd year 1000
  3rd year 1000

  Grand Total 3000

w.e.f. the admission 2012 onward

Outline of courses for B.Sc. 1st Year (Hons.) Biotechnology

<table>
<thead>
<tr>
<th>Papers</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Theory</th>
<th>Practicals</th>
<th>Total</th>
<th>Work load</th>
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<td>Pract</td>
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<tr>
<td>Paper I</td>
<td>BIOT - 101</td>
<td>English</td>
<td>50</td>
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<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Paper II</td>
<td>BIOT - 102</td>
<td>Punjabi or History and Culture of Punjab</td>
<td>50</td>
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<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Paper III</td>
<td>BIOT - 103</td>
<td>Physics (Basic and Applied)</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper IV</td>
<td>BIOT - 104</td>
<td>Chemistry</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper V</td>
<td>BIOT– 105(a)</td>
<td>Life Sciences or Mathematics</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VI</td>
<td>BIOT - 106</td>
<td>Statistics and Computer Fundamentals</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VII</td>
<td>BIOT - 107</td>
<td>General Microbiology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VIII</td>
<td>BIOT - 108</td>
<td>Cell Biology</td>
<td>100</td>
<td>50</td>
<td>150</td>
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</tr>
</tbody>
</table>

Total Marks 1000

*Mathematics for +2 medical students and Life Sciences for +2 non-medical students.

The students of B.A./B.Sc./B.Com. have also to study the subject of “Environment and Road Safety Education”. This is a compulsory qualifying paper which the students are required to qualify this paper either in the first year, second year and third year of the course. The examination will be conducted by the University.
### Outline of courses for B.Sc. 2\textsuperscript{nd} Year (Hons.) Biotechnology

<table>
<thead>
<tr>
<th>Papers</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Theory</th>
<th>Practicals</th>
<th>Total</th>
<th>Work load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>BIOT - 201</td>
<td>Biochemistry</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper II</td>
<td>BIOT - 202</td>
<td>Genetics</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper III</td>
<td>BIOT - 203</td>
<td>Biophysical and Biochemical Techniques</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper IV</td>
<td>BIOT - 204</td>
<td>Immunology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper V</td>
<td>BIOT - 205</td>
<td>Plant Tissue Culture and Biotechnology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VI</td>
<td>BIOT - 206</td>
<td>Agro and Industrial Biotechnology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VII</td>
<td>BIOT - 207</td>
<td>Intellectual Property Right and Ethical Issues in Biotechnology</td>
<td>100</td>
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<td>100</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Marks** 1000

### Outline of courses for B.Sc. 3\textsuperscript{rd} year Hons.) Biotechnology

<table>
<thead>
<tr>
<th>Papers</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Theory</th>
<th>Practicals</th>
<th>Total</th>
<th>Work load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>BIOT - 301</td>
<td>Genetic Engineering and recombinant DNA Technology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper II</td>
<td>BIOT - 302</td>
<td>Tools in Bioinformatics</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper III</td>
<td>BIOT - 303</td>
<td>Animal Tissue Culture and Biotechnology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper IV</td>
<td>BIOT - 304</td>
<td>Genomics and Proteomics</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper V</td>
<td>BIOT - 305</td>
<td>Bioprocess Engineering and Technology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VI</td>
<td>BIOT - 306</td>
<td>Food Biotechnology</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Paper VII</td>
<td>BIOT - 307</td>
<td>On Job Training</td>
<td>100</td>
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<td>100</td>
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</tr>
</tbody>
</table>

**Total Marks** 1000

**BIOT- 307: On Job Training**

The job training will be done after completion of B.Sc.2\textsuperscript{nd} year and same will be evaluated in B.Sc.3\textsuperscript{rd} year (BIOT-307) during the session 2012-13.
UNIT I (ENVIRONMENT)

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:**

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.

**Practicals:**
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.

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

**UNIT II (ROAD SAFETY)**

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
4. Traffic Signs.
5. How to obtain Driving License.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.

**Examination Pattern:**

- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted question).
- The paper shall have two units: **Unit I (Environment) and Unit II (Road Safety).**
- Unit I shall comprise of 50 questions with minimum of 2 questions from each topics 1, and 12 to 15 and minimum of 4 questions from topics 2 to 11.
• Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.

• The entire syllabus of Unit I is to be covered in 25 hours and that of Unit II is to be covered in 10 hours.

• All questions are to be attempted.

• Qualifying Marks 33 per cent i.e. 23 marks out of 70.

• Duration of examination : 90 minutes.

• The paper setters are requested to set the questions strictly according to the syllabus.

**Suggested Readings**


2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

**Websites:**

(a) [www.chandigarhpolie.nic.in](http://www.chandigarhpolie.nic.in)

(b) [www.punjabpolice.gov.in](http://www.punjabpolice.gov.in)

(c) [www.haryanapolicen.in](http://www.haryanapolicen.in)

(d) [www.hpppolice.nic.in](http://www.hpppolice.nic.in)
BIOT- 101: English

Objectives

The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general.

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 learning skills.

(iii) For Unit I, the prescribed text is Varieties of Expression, Ed. A. H. Tak, Foundation Books, which shall replace the existing text Patterns in Prose by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e prose and drama are prescribed. Poetry has been deleted completely. Only four prose and four plays have been recommended for the study. The relevant sections, however, are as follows:

UNIT-I

Prose:
I. The Judgement Seat of Vikramaditya, Sister Nivedita
II. Engine Trouble, R. K. Narayan
III. The Conjurer’s Revenge, Stephen Leacock
IV. J. C. Bose, Aldous Huxley

Drama:
V. The Rising of the Moon, Lady Gregory
VI. Waterloo, Arthur Conan Doyle
VII. The Proposal, Anton Chekhov
VII. Riders to the Sea, J. M. Synge

UNIT-II

(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:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (no exceeding 200 words).

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 and group discussion etc.

**Project 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. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 10 pages) in consultation with teachers of science. 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 units, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Unit I shall be as follows:

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

Q1. It shall consist of five short questions (not exceeding 50-60 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text *Varieties of Expression* and cover a wide range of issues, topics and problems. It shall consist of 6 marks.

Q2. It shall consist of two long questions (not exceeding 100-150 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text *Varieties of Expression*. This shall carry 5 marks.

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

Q3. It shall consist of an Unseen Passage for Comprehension (not more than 400 words), with minimum three questions at the end. These questions should be designed in such a way that we are able to test a student’s comprehension ability, language/presentation skills and vocabulary etc. This question shall be of 6 marks.

Q4. 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 six words in one column and asked to match them with words/meanings in the next column. This shall carry 3 marks.

**Unit II (Based upon Unit II)**
Q5  The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry 5 marks.
Q.6. This question shall test a student’s ability to write letters of various kinds (not more than 200 words). Again, there will be internal choice here and the question will be of **5 marks**.

Q.7. There will test a student’s ability to write a Précis, A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry **5 marks**.

Q.8. Two short questions out of four to be attempted from modern forms of communication **5 marks**.

**Suggested Reading:**


**BIOT- 102: Punjabi**

**Objective:**

Punjabi being the regional language it is necessary for jobs in Punjab Government and therefore it has to be included in the curriculum. The student who are from non-Punjab speaking states i.e. who cannot speak Punjabi, it is necessary to make them aware of the History and Culture of Punjab.
OR

PAPER 2 : HISTORY AND CULTURE OF PUNJAB

Theory : 45 marks
Internal Assessment : 5 marks
Total : 50 marks
Time : 3 hours

One Paper

General Instructions :
1. In all, nine questions will be set. Each question will carry 9 marks.
2. First question shall be Short Answer type containing 15 short questions spread over the whole syllabus. Candidates will attempt nine questions out of the fifteen questions in about 25 to 30 words each. Each short question will carry 1 mark, totalling 9×1=9 marks. The first question is compulsory.
3. Rest of the paper shall contain 4 units. Each unit shall have two essay type questions and the candidate shall attempt one question from each unit – 4 in all.
4. 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 (4) in the question paper.

HISTORY CULTURE OF PUNJAB 1200-1849 A. D.

Objective:
Punjabi being the regional language it is necessary for jobs in Punjab Government and therefore it has to be included in the curriculum. The student who are from non- Punjab speaking states i.e. who cannot speak Punjabi, it is necessary to make them aware of the History and Culture of Punjab.

UNIT-I
1. Society in the Punjab during the Afghan rule.
2. The Punjab under the Great Mughals.
UNIT-II

4. Guru Nanak: His teachings; concept of Langar and Sangat.

UNIT-III

7. Martyrdom of Guru Tegh Bahadur; foundation of the Khalsa by Guru Gobind Singh.
8. Banda Bahadur and his achievements; Sikh Struggle for sovereignty from 1716 to 1765; role of Dal Khalsa, Rakhi, Gurmata and Misls.
9. Ranjit Singh’s rise to power; civil and military administrations; relations with the British.

UNIT-IV

10. Social change with special reference to the position of women.
11. New developments in language, literature, architecture in the Punjab during the Medieval Period.
12. Famous Folk tales of Medieval Punjab.

Suggested Readings:

   N.B. - The required detail and depth would conform to the treatment of the subject in the above survey. (This book will also form the basis of the short answer questions).

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

(a) The students who have not studied Punjabi up to class 10th.
(b) Wards of/and Defence Personnel and Central Government employee/employees who are transferable on all India basis.
(c) Foreigners.

BIOT- 103: Physics (Basic and Applied)
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:

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

( MECHANICS )

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.
Basics of vector algebra, definition of gradient, divergence and curl.
Central forces, equation of motion under central forces, elastic collision (one dimensional), coefficient of restitution, mass - energy equivalence.

UNIT – II

( ELECTRICITY AND MAGNETISM )

Coulomb’s law for point charges; electric field due to point charge and electric dipole (on axial line and equatorial 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, currant density, equation of continuity, Ohm’s law in vector form.

Biot- Savart law and its applications for circular current carrying coil (at centre and on the axis), Ampere - Circuital law and its application for solenoid and straight conductor carrying current, magnetic permeability and magnetic susceptibility, magnetic materials (ferromagnetism paramagnetic and diamagnetism) and their properties.

UNIT - III
( OPTICS )

Interference of waves, phase and path differences, theory of interference fringes, Young’s experiment, coherent sources, Llyod’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).

Polarisation, introduction, polarization by reflection and refraction, Brewester’s law, Maltus law, double refraction, Nicol Prism and its use, optical activity, specific rotation, Half-shade polarimeter.

Brief features of laser and its applications in Biology ; optical fibres and its applications.

UNIT – IV
( MODERN PHYSICS )

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.

Books recommended :

2. Electricity and Magnetism : Berkeley physics course vol. II.
1. 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).

2. Young’s modulus by bending beam method.

3. Resolving power of Telescope/Microscope.

4. Rotation of the plane of polarization of a solution using a Polarimeter.

5. Laser interference & diffraction.

6. Use of C.R.O. as a display & measuring device.

7. Using compound pendulum measure time period as a function of distance of centre of suspension from centre of mass, plot relevant graphs and determine radius of gyration and acceleration due to gravity.

8. To study the magnetic field produced by a current carrying solenoid using a search coil and calculate permeability of air.

9. Capacitance by flashing and quenching of a neon lamp.

10. Use of CRO for Lissajous figures.

Books recommended:
1. Laboratory Manual of Physics for Undergraduate classes by D. P. Khandelwal
2. B.Sc. Physics Practicals by C. L. Arora
BIOT 104: Chemistry

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:
Without chemical reactions, biological systems can not work. So understanding the concepts of basic chemistry inorganic, organic and various laws and their applications in Biotechnology is important.

UNIT – I

Ia) **Quantum Chemistry:** Quantization of radiation energy, wave particle duality and uncertainty principle. Schrodinger wave equation (SWE), physical interpretation of wave function, quantization, solution of SWE for particle in one dimension box, quantum numbers, radial and angular probability distribution of electrons.

b) **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.

c) **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.

d) **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

IIa) **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.

c) **Molecular velocities:** Root mean, average and most probable velocities, qualitative discussion of Maxwell’s distribution of molecular velocities, collision number, mean free path.

d) **Electrochemical Cells:** Electrode potential, electromotive force (EMF). Reversible and irreversible cells, measurement of EMF of a cell. Nernst equation. Reference electrodes and other electrodes, standard electrode potential. Activity and activity coefficient determination from EMF results. Applications.

**UNIT – III**

IIIa) **Chemical equilibrium:** The nature of Chemical Equilibrium, The equilibrium constant, External effect on equilibria- concentration and temperature effects, Equilibria in non-ideal situations, calculation with equilibrium constant.

b) **Catalysis:** Homogeneous Catalysis acid base catalysis, enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.

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

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

**UNIT – IV**

IVA) **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, SN², and SN¹ reaction with energy diagram.

b) **Alcohols and Phenols:** Mechanism of dehydration, acidity, Fries rearrangement, Mechanism of Kolbe’s reaction, Reimer Teimann reaction and mechanism.

c) **Aldehydes and ketones:** Common methods of preparation and reactivity. Ketone-enol tautomerism, aldol condensation, Cannizaro’s reaction. The Wittig’s reaction, Perkin’s reaction.
d) **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:**

**BIOT- 104: Chemistry (Practicals)**

Inorganic qualitative analysis
Four ions including interfering ions.
Iodimetry and Iodometry
Redox titrations using cerisulphate, potassium dichromate and potassium permanganate
Complexometric titration using EDTA of Ca++, Mg++, and Zn++
Analysis of a given organic compound (solid): Elemental Analysis, Detection of Functional groups and melting point. The functional groups are acids, phenols, amines, carbohydrates, thiourea etc.

**Reference Books:**
BIOT- 105(a) : Life Sciences

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 paper includes basic introduction to life especially taking into consideration, cell as basic unit of life its evolution and specialization with respect to higher organisms, their systems and their mechanism of interactions.

UNIT – I
General Biology: The nature of life, definition of life, characteristics of life, differences between animals and plants, principal divisions in biology, importance of biology.
Introduction to various systems in human body: Digestive system, respiratory system, circulatory system, endocrine system, reproductive system.

UNIT – II
Basics of cell biology: Definition of cell- fundamental cell types, difference between prokaryotic and eukaryotic cell types, cell structure cell wall, plasma membrane.
Different organelles and their functions.
Cell division, cell cycle and its regulation.
Basic of genetics and evolution: Mendel’s work and experiments, gene bearer of heredity character, chemical basis of heredity.
Chromosome structure, alterations in structure, human karyotype,

UNIT – III
Varity of living organisms; Systematic; need, history and types of classifications (artificial, natural, phylogenetic); biosystematics; binomial nomenclature; Two kingdom system, Five kingdom system, their merits and demerits; zoological parks and museums.
Salient features of non-chordates up to phylum level and chordates (up to class level).
UNIT – IV

Biology in human welfare
Population, environment and development; Population growth and factor-(fatality, mortality, immigration, emigration, age and sex ratio); impact of population growth; reproductive health; common problems of adolescence (drugs, alcohol and tobacco); social and moral implication; mental and addictive disorder; Risks of indiscriminate use of drugs and antibiotics; population as a resource.
Brief account of some common animal diseases; biopesticides; genetically modified food; bio-war, biopiracy; biopatent; and sustainable agriculture.
AIDS, STD, cancer (types, causes, diagnosis, treatment)
Basic concepts of ECG, EEG, CT scan, MRI and ultrasound.

Reference Books:


BIOT- 105(a) : Life Sciences (Practical Course)

| Practical | : 45 marks |
| Int. assessment | : 05 marks |
| Total | : 50 marks |
| Time | : 3 hours |

1. To study cell structure from onion leaf peels.
2. To study various stages of mitosis and meiosis.
3. To study ultra structure of cell organelles through photographs.
4. To study digestive, Respiratory, Circulatory, Endocrine and Reproductive system of Human body through charts/ model.
5. To study Chromosome structure though charts/slides.
6. Study of the slides/specimens and identification with reasons – Bacteria, oscillatoria, Spirogyra, Rhizopus, Mushroom, yeast, liverwort, moss, fern, lichen, one monocotyledon and one dicotyledon.
8. To study the symptom and pathogen of the following diseases: Malaia, Tetanus, Polio, Taeniasis, Ascariasis, AIDS and STD.
**BIOT- 105: (b) Mathematics**

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**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:**
Basic principles of mathematics are required for data analysis. And statistical verifications of various results in biotechnology so without understanding calculations, differentiation integration are required for this curriculum.

**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.

**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 – II**

**Elementary mathematical logic.**
Elementary trigonometry, addition subtraction, A-B, C-D formulas.
Concept of A.P, G.P., natural numbers, elementary computing binary system

**Binomial Theorem**
Expanding \((x+y)^n\), Bionomial coefficients, Binomial theorem

**UNIT – III**

**Matrices and vectors**
Matrix algebra, determinants, applications vector in space,

**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:

BIOT- 105: (b) Mathematics (Practicals)

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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. Functions (Graph of standard functions, modulus, greatest, integer, exponential, logex, signum, sin, cos, tan, cot, sec, cosec,) (2 to 3 practicals).
5. Increasing and Decreasing (Polynomial functions) – wavy curve method (2 practicals).
6. Plotting of irrational number 2, 3, 5 etc. on number line (1 practical).
7. Curve tracing (using Maxima and minima, symmetry along X-axis, Y-axis, Y=X, Y=X, point of intersection with X-axis and Y-axis, f(x), f (x) (3 to 4 practical).
8. Histogram, frequency polygon, ogives, pie chart, bar diagrams (2 to 3 practical).
9. Aragand plane (Plotting of complex numbers) (1 practical).
10. Binary to Decimal, Decimal to Binary, Binary addition, subtraction, multiplication (2 to 3 practical).
BIOT- 106: Statistics and Computer Fundamentals

Theory : 90 Marks
Int. Assessment : 10 Marks
Total : 100 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.

Statistical Methods (Unit-1 & Unit-II)

Objective:
All the data generated in biological sciences needs statistical verification to prove its significance so computer aided analysis of the same is need of the hour. Therefore knowledge of computer in 1st year is important.

UNIT – I
1. An introduction, types of data, collection, classification and tabulation of the primary data, secondary data, discrete data and continuous data, deagammatic and graphical representation of grouped data, frequency distribution (univariate and bivariate), cumulative frequency distribution and their graphical representation, histogram frequency polygon.

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

3. Moments (single and double variables) and their relationships, Karl Pearson’s, Beta & Gamma coefficients, Charlier’s checks and Sheppard’s correction for moments for grouped data (without derivation), skewness & kurtosis and their measures.

UNIT – II
4. Mathematical expectation (single and bivariate), expectation of sum of random variables, variance and covariance, moment generating and cumulate generating function.

5. Binomial distribution, Poisson distribution as a limiting form of binomial distribution and properties of these distributions, moments, moment generation 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 neighbour search
• Search using stem numbers
• Search using text signature

7. Statistical packages.

Computer Fundamental (Unit-III & IV)

UNIT – III
Computers: General introduction to computers, organization to 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 addressed 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:

BIOT-106: Statistics and Computer Fundamentals (Practicals)

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1. Presentation of data by frequency tables, diagrams and graphs.
2. Calculation of measures of central tendencies.
3. Calculation of measures of skewness and Kurtosis.
5. Fitting of binomial distribution.
6. Fitting of Poisson distribution.
7. Probability.
8. Bivariate frequency table.
10. Basic commands-File creation, copying, moving and deleting in Linux & Windows.
11. Using e-mail, browsers, search engines.
Reference Books:

BIOT- 107: General Microbiology

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- 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:
Microbes are playing 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
Biogenesis vs abiogenesis, Koch postulates, discovery of antibiotics.
Principle of microscopy: Bright field, dark field, phase contrast, fluroscent, electron microscopy.

UNIT – II
Microbial classification: Bacteria, fungi and algae.
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
Microbes in extreme environment like high temperature and high/ low pH values
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 etc. Host defense mechanism against pathogens.
Nitrogen fixing microbes in agriculture.
Photosynthesis
Fermentation and its products
Production of heterologous proteins in microbes.

Reference Books:


BIOT: 107: General Microbiology (Practicals)

| Practical : 45 marks | Int. Assessment : 05 marks | Total : 50 marks | Time : 3 hours |

1. Aseptic techniques.
2. Cleaning of glass wares, preparation of media, cotton plugging and sterilization.
3. Personal hygiene- microbes from hands, tooth-scums and other body parts.
4. Isolation of microorganisms from air, water and soil samples.
5. Dilution and pour plating techniques.
6. Enumeration of microorganisms total vs viable counts.
8. Gram staining, other staining methods, metabolic characterization (e.g. Im VIC) tests.
9. Growth curve of microorganisms.
10. Antibiotics sensitivity of microbes using antibiotic discs.
12. Alcoholic and mixed acid fermentation.

Reference Books:

BIOT- 108: Cell Biology

Theory : 90 marks
Int.Assessment : 10 marks
Total : 100 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:
Cell constitutes basic unit of life and regulates all processes within the unicellular and multicelluler organisms; it’s dependent upon diverse variety of organelle and inclusions along with physical chemical processes that determines the efficiency of organisms. This paper will make students aware with cell in detail and its physiology including various pathways for energy production and utilization in true sense the nature of bioenergetics.

UNIT – I
Cell as a basic unit of life. The cell theory.
Broad classification of cell types: Prokaryotic cells (PPLO & bacteria) and eukaryotic cells (plant and animal).
Structure and function of cell organelles: Ultra structure of cell membrane, cytosol, endoplasmic reticulum, golgi bodies, ribosome's, mitochondria, chloroplast, lysosomes, peroxisomes, cytoskeletal system, (actin and microtubules), cilia, flagella and nucleus.

UNIT – II
Cell division and Cell cycle (amitosis, mitosis, meiosis, stages of cell cycle)
Level of organization (cell, tissue, organ and organisms).
Cell differentiation in multicellular organisms: Totipotent, pleuripotent, multipotent.
Cell senescence and death: Apoptosis and necrosis.

UNIT – III
Water: Physico chemical properties of water, dissociation and association constants. pH and buffers, pI, pka, Hasselberg Handerson equation and its implications.
Carbohydrates: Structure of important mono, di-, oligo- and polysaccharides, glycoproteins, peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides.
Lipids: Classification of lipids and fatty acids, general functions of major lipid subclasses, acyglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpenes, sterols, steroids: Prostaglandins.

UNIT – IV
Vitamins and hormones: Types of vitamins and their chemistry, vitamins as cofactors, steroids and peptide hormones.
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:**

**BIOT- 108: Cell Biology (Practical)**

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Preparation of physiological buffers.

1. Verification of Beer-Lamberts law for p-nitrophenol.
2. Determination pKa value of p-nitrophenol.
3. Estimation of carbohydrates in given solution by Anthrone method.
4. The determination of acid value & saponification value of a fat.
5. Separation of lipids by thin layer chromatography.
7. To study the parts of light compound microscope and their working.
8. To study the prokaryotic cells: *Lactobacillus, E. Coli*, Blue green algae, eukaryotic cells (amoeba, fungi, algae) and various tissues (liver, lung, kidney, testis, ovary and skin) from permanent/temporary slides.
10. Cytochemical techniques to study carbohydrates and lipids.
11. To study mitosis from (root tips of onion/ garlic) and meiosis from grasshopper.

**Reference Books:**
B.Sc. (Biotechnology) Part-II
BIOT- 201: Biochemistry

Instructions for paper setters and candidates
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- 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 of genetics.

Unit- I
Enzymes: Classification, nomenclature, general properties, regulation of enzyme activity, steady state kinetics, first order and second order kinetics, covalent modifications, inhibitors, abzymes, ribozymes, immobilization of enzymes.

Unit – II
Metabolism: Metabolic pathways, biochemical reaction mechanism, energy rich metabolites.
Carbohydrate metabolism: Biosynthesis and degradation of carbohydrates; feed pathways for glycolysis; Kreb’s cycle, enzymes of Kreb’s cycle, amphibolic nature of the Kreb’s cycle; regulation of Kreb’s cycle regulation of carbohydrate metabolism.
Mitochondrial electron transport chain, oxidative phosphorylation; regulation of ATP synthesis.

Unit – III
Lipid Metabolism: Biosynthesis and degradation of fatty acids; metabolism of triacyl glycerols; cholesterol metabolism, complex lipids.
Nitrogen metabolism: Reduction and assimilation of atmospheric nitrogen, biosynthesis and degradation of amino acids; amino acids as precursors of heme; biogenic amines; biosynthesis and degradation of nucleic acids.

Unit – IV
Replication: In prokaryotes and eukaryotes (initiation, elongation and termination).
Transcription: Initiation, elongation and termination during synthesis; transcription signals; processing of RNA.
Translation: Initiation, elongation and termination of protein synthesis (both prokaryotic and eukaryotic), post translation modification in proteins, inhibitors of protein synthesis.
Gene expression in prokaryotes: Lac & Tryp operons.
**Reference Books:**

**BIOT- 201: Biochemistry (Practicals)**

Practical : 45 marks  
Int. assessment : 05 marks  
Total : 50 marks  
Time : 3 hours

1. Estimation of α- amylase activity from saliva.  
3. Effect of temperature on enzyme activity.  
4. Effect of pH on enzyme activity.  
5. Determination of \( K_m \) for enzyme.  

**Reference Books:**

**BIOT- 202: Genetics**

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

Nature of genetic material, structure of nucleic acids, biologically important nucleotides and their functions.
Organization of chromosomes: Genome size and complexity, super coiling of DNA, satellite DNA, centromere and telomere structure.
Mendelian laws of inheritance, gene interactions, sex linked inheritance.

**Unit – III**
Gene linkage and chromosome mapping: Linkage and recombination of genes in chromosomes, crossing over and its molecular mechanism, gene mapping by three point test crosses, mapping by tetrad analysis, somatic cell hybridization for gene linkage studies, recombination within genes.

**Unit – III**
Chromosomal aberrations: Deficiencies, duplications, inversions, translocations, position effects, chromosome changes in man.
Mutation: Spontaneous versus induced mutations, types of mutations, molecular basis of mutations, mechanisms of DNA repair, mutations, frequency, correlation between mutagenicity and carcinogenicity, mutagenic agents: Physical, chemical and radiation.

**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.
Population genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies, introduction of eugenics.
Chi- square test, probability, Poisson’s distribution, pedigree analysis.

**Reference Books:**
BIOT- 202: Genetics (Practicals)

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1. Demonstration of law of segregation and independent assortment (use of dried peas, colored peas, capsules etc.).
2. Numericals for segregation and independent assortment.
3. Segregation demonstration in preserved material (maize).
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. Inheritance of other human characteristics, ability to taste PTC/ Thiourea.
7. Calculation of variance in respect of pod length and number of seeds/pod.
8. Calculation of gene frequencies and random mating (colored beads, capsules).
10. Demonstration of sex chromosome from buccal smear using Giemsa stain.

Reference Books:

BIOT- 203: Biophysical and Biochemical Techniques

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- 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 important tools and techniques based on biophysical and biochemical principles with their application in applied science.

Unit – I
2. Electrophoresis: Principle, types & applications.
3. Chromatography: Principle, types (overview of TLC, affinity, ion-exchange and gel filtration) and applications.
Unit – II
4. Spectrophotometry (UV& visible) and spectrofluorimetry, atomic absorption spectrophotometry.

Unit – III
7. Crystallography and X-ray diffraction, electron diffraction, neutron diffraction.

Unit – IV
8. Radioisotope techniques: Radiotracers GM counter, proportional and scintillation counters, autoradiography.
9. Mass spectrometry- GCMS and LCMS.

Reference Books:

BIOT- 203: Biophysical and Biochemical Techniques (Practicals)

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1. Identification of the provided sample using some of the spectroscopic techniques.
3. Performance of electrophoresis of DNA.
4. Chromatography
   - Paper chromatography
   - TLC chromatography
   - Gel permeation, ion exchange and affinity chromatography
5. Performance of differential centrifugation.

Reference Books:
BIOT- 204: Immunology

Theory : 90 marks
Int. assessment : 10 marks
Total : 100 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 modern Immunology, both at the molecular and cellular levels. Further the course presents the importance of interactions between many of these molecular and cellular entities involved in immunity.

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, B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer cells and lymphocyte activated killer cells, eosinophils, neutrophils & mast cells.

3. Organs of the immune system: Primary and secondary lymphoid organs: Thymus, bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Cutaneous-Associated Lymphoid Tissues, lymphocyte trafficking.

Unit – II

4. Immunoglobulins: Structure of antibody, antibody mediated effects function, antibody classes and biological activities, antigens determinants on immunoglobulins, immunoglobulins superfamilies.


6. Antigen: Immunogenecity vs. antigenecity, factors effecting immunogeneticity, nature of immunogen, epitopes, heptans and antigenecity, pattern recognition receptors.

Unit –III

7. Complement system: Function, activation, regulation and deficiencies of complement.

8. Major histocompatibility complex: General organization and inheritance, MHC molecules and genes, genetic map, cellular distribution, regulation of MHC expression and disease susceptibility.
9. Antigen processing and presentation: Self MHC restriction of T Cells, role of Antigen-processing cells, endogenous antigens, exogenous antigens, presentation of non-peptide antigens.

**Unit – IV**

10. Immune response to infectious diseases: Bacteria, viruses and intracellular parasites.
11. Production and applications of polyclonal and monoclonal antibodies (by hybridoma technology).
12. Antigen-Antibody interactions: Strength of interaction, cross reactivity, precipitate, reaction, agglutination reactions, Enzyme Linked Immunosorbent Assay, western blot, immunofluorescence, flow cytometry and fluorescence, alternative to Antigen–Antibody interaction.

**Reference Books:**

**BIOT: 204 Immunology (Practicals)**

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1. Differential leucocytes count.
2. Total leucocytes.
3. Total RBC count.
6. Separation of T and B cells from PBMC by nylon wool method.
7. Separation of serum from blood.
8. Enumeration of T-Cells by E- resetting method.
10. Separation of peritoneal macrophages from rat.
11. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods.
12. Direct and indirect ELISA.
Reference Books:

BIOT- 205: Plant Tissue Culture and Biotechnology

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 application of plant tissue culture. This course will expose students to the methods of culturing, maintaining and modifying plants species.

Unit – I
Cellular totipotency and differentiation.
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 production: advantages and methods.
Protoplast technology: Isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids, applications of protoplast technology.

Unit – III
DNA Delivery and expression Tools:
Agrobacterium mediated gene transfer, natural pathogen mode of infection, vir gene functions, Ti / Ri plasmids, Binary and conintegrate vectors
DNA delivery in to plant cells.
Direct DNA delivery methods:
Partcile bombardment: Principle, components and basic protocol, Advantages and disadvantages.

**Unit – IV**


**Reference Books:**

**BIOT- 205: Plant Tissue Culture and Biotechnology (Practicals)**

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1. Sources of contamination and decontamination measures.
2. How to clean glass/plastic ware.
3. Preparation of simple growth nutrient (Knop’s medium). Full strength, half strength, solid and liquid.
4. Preparation of complex nutrient medium (Murashige and Skoog’s medium).
5. Laboratory design set up for a plant tissue culture laboratory.
6. To selection, prune, sterilize and prepare an explant for culture.
7. Significance of growth hormones in culture medium.
8. To culture different explants for raising callus cultures.
9. To demonstrate various steps of micropropagation.

**Reference Books:**
BIOT- 206: Agro and Industrial Biotechnology

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 producing microbes, revertant back of higher yielding microbes into lower production, 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 B_{12}, alcohol, wine, beer, cheese, bread, citric acid, gluconic acid, antibiotics (penicillin), enzymes (amylases, cellulases, lipases and proteases) and their industrial applications.

Unit IV

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

BIOT- 206: Agro and Industrial Biotechnology (Practicals)

| Practical | : | 45 marks |
| Int. assessment | : | 05 marks |
| Total | : | 50 marks |
| Time | : | 3 hours |

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

Reference Books:

BIOT- 207: Intellectual property rights and Ethical Issues in Biotechnology and Entrepreneurship

| Theory | : | 90 marks |
| Int. assessment | : | 10 marks |
| Total | : | 100 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 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
Introduction to Indian patent laws – TRIPS and other multilateral treaties & International conventions – Paris convention, PCT, CBD, UPOV, PGRFA.

Unit- II
Forms of IPR like patent, design and copyright:
Patents: Introduction to patent law and conditions for patentability; procedure for obtaining patents; rights of a patentee; patent infringements; biotechnology patents and patents on computer programs; patents from an international perspective.
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; registration, commercial exploitation and infringement.

Unit – III
Patenting in biotechnology, economic, ethical and depository considerations. Patentable subject matte and legal aspects of transfer of biotechnology in India. Writing a patent specification.
Information sources in patent literature search.

Unit – IV
Entrepreneurship
Selection of a product, line design and development processes, economics on material and energy requirement, stock the product and release the same for making etc.
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 etc.

Reference Books:
B.Sc. (Biotechnology) Part-III

BIOT- 301: Genetic Engineering and Recombinant DNA Technology

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.

Unit –I
Introduction to gene cloning, DNA manipulative enzymes-Nucleases, ligases, polymerases, modifying enzymes, restriction enzymes and its nomenclature, reverse transcriptase, topoisomerases, plasmids- Basic features of plasmids, plasmid classification, blunt and sticky ends, linkers adapters, homopolymer tailing.

Unit – II
Vectors: Cloning vectors for E. coli- Nomenclature, pBR 322, pBR 327, pUC 8, pGEM3Z.

Unit – III
Cloning vectors for yeast and fungi, YEp, YIp, YRp, artificial chromosomes, YAC, application of YAC, identification of a recombinants from a gene library, methods of clone identification, radioactive and non- radioactive DNA and RNA labeling techniques, nick translation, random priming, Site directed mutagenesis (cassette, primer extension, RT, real time, multiplex, inverse), DNA sequencing (Maxam-Gilbert, Sanger, pyro).

Unit- IV
Southern, Northern and western blotting, colony hybridization, in situ hybridization, dot- blot technique, genomic cloning, transformation of E. coli, yeast and plant cells.
PCR: Types, applications and limitations.
Applications of rDNA technology to medicine, agriculture & environment.
**Reference Books:**

**BIOT- 301: Genetic Engineering and recombinant DNA Technology (Practicals)**

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1. DNA isolation from plants.
2. DNA isolation from *E. coli*.
3. Spectrophotometer analysis of DNA.
4. Agarose gel electrophoresis of DNA.
5. Plasmid DNA isolation.
6. Restriction digestion of DNA.
7. Demonstration of Southern blotting.
8. Preparation of competent cells.
10. Demonstration of PCR.

**Reference Books:**
BIO- 302: Tools in Bioinformatics

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.

Unit – I
Introduction to bioinformatics
Introduction, overview and needs of bioinformatics technology.

Biological databases
Primary Databases: Nucleotide sequence database (GenBank, EMBL), protein sequence database.
Secondary Databases: SwissProt/TrEMBL, conserved domain database, Pfam.
Molecular Structure Databases: Protein Data Bank (PDB), SCOP, CATH.
Understanding the structure of each database and using it on the web, searching database using SRS, Entrez.

Unit – II
Sequence analysis
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 and Wunsch, Smith watterman methods), Introduction to BLAST, types of BLAST, algorithm of BLAST and interpretation of its result.
Multiple sequence alignment: Methods of multiple sequence alignment, Tools of MSA– Clustalw, TCoffee; Position specific scoring matrices, 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, Grail, GeneID and Glimmer.
Unit – IV

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

Reference Books:


BIOT- 302: Tools in Bioinformatics (Practicals)

| Practical | : 45 marks |
| Int. assessment | : 05 marks |
| Total | : 50 marks |
| Time | : 3 hours |

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.
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.

Reference Books:

BIOT-303: Animal Cell Culture and Biotechnology

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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.

Unit – I

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

Animal cell culture Techniques: Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary culture, transformed animal cells, established/continuous cell lines measurement of growth and viability of cells in culture, tissue culture media: Components their importance, serum free media.

Unit – III

Cell lines availability, commonly used animal cell lines, their origin and characteristic, growth kinetics of cells in culture, differentiation of cells, organ culture, expressing cloned protein genes in animal cell cultures. Cytotoxicity assays & their applications.

Unit – IV

Applications of animal cell culture:
Cell fusion and production of monoclonal antibodies
Scale up methods for propagation of anchorage dependent and suspension cell culture Bioreactors for large scale culture of cells
Micro carrier culture
Transplanting cultured cells.

Unit – IV

Genetic engineering in production or regulatory proteins, blood products, vaccines and hormones, transgenic animals and production of useful products in transgenic animals. In vitro fertilization, embryo transfer. Cloning: Methodology and its applications, ethics in cloning.
Reference Books:


BIOT- 303: Animal Tissue Culture and Biotechnology (Practicals)

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Sterilization techniques: Theory and practical
a). Glass ware sterilization
b). Media sterilization
c). Fumigation of laboratories.
1. Sources of contamination and decontamination measures.
2. Preparation of Hanks balanced salt solution.
4. Isolation of lymphocytes for culturing.
5. Primary lymphoid culture.
6. DNA isolation and its quantification from animal tissue.
7. Resolving DNA on agarose Gel.

Reference Books:

BIOT- 304: Genomics and Proteomics

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.

Unit – I

Organization and structure of genome
Model organisms and genome size.
Unicellular and multicultural genome: Lessons learned sequencing of genomes, evolution of genome.
Genome identification.
Mapping of genome
Construction of genomic libraries, vector, mapping strategies (genetic maps, physical maps, cytological maps, comparative maps) and techniques (FISH, radiation hybrid mapping, finger printing)

Unit – II

cDNA library construction and screening
Methods development, justification for subtraction, normalization and fingerprinting; identification of cDNA’s encoding rare messages, EST projects and their utility in research
Next generation sequencing techniques
Sequencing by synthesis: Solexa & 454.
Sequencing strategies for human genome.

Unit – III

Genome annotation and bioinformatics
How to identify genes, inferring gene function, database construction and searching.
Comparative genomics
Protein evolution from exon shuffling, protein structural genomics, gene function by sequencing comparison.
Global expression profiling
Whole genome analysis of mRNA and protein expression, types of microarray and applications.
Unit –IV

**Comprehensive mutant libraries**
High throughput gene knockout, gene targeting, gene trapping, genome wide mutagenesis.

**Mapping protein interactions**
Methods- Two hybrid, phage display, mass spectrometry.

**The Rise of OMIC**
Impact on other fields (toxicogenomics, chemical genomics, pharmagenomics).

Reference Books:

**BIOT-304: Genomics and Proteomics (Practicals)**

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1. Generate transpositions using plasmid vectors.
3. Deleting a DNA sequence from a plasmid and introduction into *E. coli*.
4. Quantitation of recombination rates near short and normal length telomeres.
5. Generating mutant.
6. Analysis of mutants using Southern blot and PCR analysis.

Reference Books:

**BIOT-305: Bioprocess Engineering and Technology**

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

**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, sterilization of fermenters.

**Unit – II**
**Microbial growth kinetics**  
Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, internal and external feed back systems, metabolic and Biomass productivities, effect of temperature and pH on the product formation.

**Unit – III**
**Design of fermenter**  
Introduction  
Types of fermenters: Batch, fed batch, CSTBR, plug flow and air lift.  
Aseptic operation of the fermenters, control and measurement equipments of fermenters, pH and DO probes, impeller and spargers, agitation and its kinetics.
Unit – IV

Down stream 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.
Effluent treatment: Aerobic and anaerobic slug treatment process.
Fermentation economics

Reference Books:

BIOT- 305: Bioprocess Engineering and Technology (Practicals)

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1. Demonstration of sterilization of fermenters and other accessories.
2. Determination of doubling time, yield coefficient for growth of microorganism.
4. Determination of $K_L a$ for given process.
5. Determination and BOD and COD value of given waste sample.

Reference Books:
BIOT- 306: Food Biotechnology

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.

Unit – I

Food and Microorganisms: Composition of food, food as substrates for microbes (intrinsic and extrinsic factors), factors affecting growth of microorganisms, role of microbes in the production of new proteins, food SCP-mushroom, food yeast’s, algal proteins, applications of enzymes in food processing.
Fermented foods: Bread, cocoa, coffee, tea, cheese, yoghurt, meat and alcoholic beverages.

Unit – II

Principles of food preservation: Physical, chemical, and biological methods of preservation.
Contamination, preservation and spoilage of different kind of foods: Milk and milk products (milk, butter, yoghurt and cheese), beverages (alcohols, tea and coffee), meat and fish products (flesh foods), vegetables and fruits.

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.
Probiotics, biofortified foods, fortified foods, functional foods, nutraceuticals, organic foods.
Biotechnology and future foods (Golden rice, protato).

Unit – IV

Food and water borne diseases: Shigellosis, salmonellosis, cholera.
Food borne intoxications: Staphylococcal, Bacillus and Clostridium.
Detection of microorganisms in food: Sampling plan & procedure for microbial analysis; Qualitative methods to isolate pathogenic microorganisms, test for bacterial toxins in foods;
Quantitative methods for microbial enumeration: Direct enumeration, indirect estimations and standard and recommended methods; Rapid methods and automation: Immunoassays, nucleic acid probe for detection of pathogens.
BIOT- 306: Food Biotechnology (Practicals)

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

Reference Books:


BIOT- 307: On Job Training

Job training for 4-6 weeks during the summer vacations at the end of the B.Sc. 2nd year and should be evaluated in the B.Sc. 3rd year. The report to be presented before the three members committee to be appointed by Principal.

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