Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science and Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Biological Sciences

Name of the Course: B. Sc. Part- I

(Syllabus to be implemented from June 2022)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Choice Based Credit System (CBCS)

BACHELOR OF SCIENCE

B.Sc. Biological Sciences

FOUR YEAR FULL-TIME PROGRAMME

Choice Based Credit System: With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate degree, Solapur University has implemented Choice Based Credit System (CBCS) at Undergraduate level. The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

· **Outline of Choice Based Credit System:**

1. ***Core Course:*** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. ***Elective Course:*** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

3. ***Ability Enhancement Courses (AEC):*** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; (i) Environmental Science and (ii) English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill based and are aimed at providing hands-on-training, competencies, skills, etc.

• **Credit:** Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. The contact hours are transformed into credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 20 marks and University Evaluation for 80 marks. It is 80+20 pattern of evaluation. It is applicable for theory and practical as well. The details regarding this evaluation system are as under.

- **Conversion of marks into Grades:**

A table for the conversion of the marks obtained by a student in each paper (out of 100) to grade and grade point is as given below:

Sr. No.	Range of Marks	Grade	Grade Point
1	80 – 100	O	10
2	70 – 79	A+	9
3	60 – 69	A	8
4	55 – 59	B+	7
5	50 – 54	B	6
6	45 – 49	C+	5
7	40 – 44	C	4
8	<39	FC	0 (Failed in Term Exam)
9	<39	FR	0 (Failed in Internal Assessment)

1. **Grade Point Average at the end of the Semester (SGPA)**

$$SGPA = \frac{(G_1 \times C_1) + (G_2 + C_2) + \text{KKK}}{\sum C_i}$$

(ΣC_i = the total number of credits offered by the student during a semester)

2. **Cumulative Grade Point Average (CGPA)**

$$CGPA = \frac{(G_1 \times C_1) + (G_2 + C_2) + \text{KKK}}{\sum C_i}$$

(ΣC_i = the total number of credits offered by the student upto and including the semester for which CGPA is calculated.)

3. **Final Grade Point Average (FGPA)**

It will be calculated in the similar manner for the total number of credits offered for the completion of the said course.

Where: C_i = Credits allocated for the i^{th} course.

G_i = Grade point scored in the i^{th} paper (subject)

4. Conversion of average grade points into grades:

SGPA/CGPA/FGPA	Letter Grade
9.5 – 10	O
8.5 – 9.49	A+
7.5 – 8.49	A
6.5 – 7.49	B+
5.5 – 6.49	B
4.5 – 5.49	C+
4.0 – 4.49	C
<3.99	FC / F
	FR

General guidelines for syllabus Structure:

- The University follows semester system.
- An academic year shall consist of two semesters.
- Each B.Sc. course shall consist of four years i.e., eight semesters.
- B.Sc. I Biological sciences shall consist of two semesters. Each paper is having of 100 marks. Similarly in Semester II there will be two core papers. Each paper has 100 marks weightage with 20 marks internal and 80 marks Theory papers for University exam. English will be as Ability Enhancement Course (AECC) in both Semester II. English paper carries 100 marks. The scheme of evaluation of performance of candidates shall be based on university assessment as well as College internal assessment as given below. For B.Sc. Biological sciences the internal assessment will be based on Internal tests, home assignment, Tutorials, Seminars, Group discussion, Brain storming sessions etc. as given below. Practical course examination is of 200 marks shall be conducted at the end of semester. The practical examination of 100 marks shall also consist of 80 marks for university practical assessment and 20 marks for college internal assessment. For University practical examination out of two examiners, both examiners will be internal. Both examiners will be appointed by the College. The internal practical assessment shall be done as per scheme given below.

- **Scheme of Evaluation**

As per the norms of the grading system of evaluation, out of 100 marks, the candidate has to appear for college internal assessment of 20 marks and external evaluation (University assessment) of 80 marks.

Each semester examination pattern -
Each Theory paper: (100 marks)
University Examination (80 marks): No. of theory papers: 4
Internal Continuous Assessment: (20 marks)
Scheme of marking: 10 marks – Internal test
10 marks – Home assignment / tutorials / seminars / viva/
Each Practical Examination: (50 marks) No. of theory practical papers: 4
Total marks for each semester examination - 600 Marks
The Research project in the 7th and 8th semester – 100 Marks will be given in 8th semester

Passing Standard

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in internal assessment and passed in university examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same 70 marks of external examination and his performance shall be scaled to 100 marks.

- **ATKT**

Candidate passed in all papers, except 5 (five) papers combined together of semester I and II of B.Sc. Part-I Biology examination shall be permitted to enter upon the course of Semester III of B.Sc. Part-II Biology.

Solapur University, Solapur: **Faculty of Science and Technology**
Choice Based Credit System (CBCS), (w.e.f. 2022-23)

Structure for B. Sc. Biological Sciences

The B.Sc. Biological Sciences is divided into four parts as under, each part willconsist of two semesters as given below:

Part I	First Year	Semester-1	Semester -2
Part II	Second Year	Semester-3	Semester-4
Part-III	Third Year	Semester-5	Semester-6
Part-IV	Fourth Year	Semester-7	Semester-8

There shall be 4 papers in each semester. Student have to carry out one research project in Semester 7 and 8 of the 4th year of the B.Sc. Biological Sciences course. The schedule of papers prescribed for various semesters shall be as follows -

B.Sc. Biological Sciences 1st year: Semester – 1

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 1	HCTB - 1.1	Light and Life	5	100
Paper 2	HCTB – 1.2	Chemistry	5	100
Paper 3	OETB- 1.3	Physics and Applications to Biology	5	100
Paper 4	OETB- 1.4	Mathematics & Statistics	5	100
Paper 5	OETB- 1.5	Fungi and Archegoniate classification	5	100
Paper 6	SCPB-1.6	Light and Life Practical	5	50
Paper 7	SCPB-1.7	Chemistry Practical	5	50
Paper 8	OEPB-1.8	Physics and Applications to Biology Practical	5	50
Paper 9	OEPB-1.9	Mathematics & Statistics Practical	5	50
Paper 10	OEPB-1.10	Fungi and Archegoniate classification Practical	5	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 1st year: Semester – 2

PaperNo.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 11	HCTB-2.11	Biodiversity & Bio-prospecting	5	100
Paper 12	HCTB-2.12	Bioinstrumentation	5	100
Paper 13	OETB-2.13	Ecology:Concepts and Management	5	100
Paper 14	OETB-2.14	English Communications	5	100
Paper 15	OETB-2.15	Animal Classification	5	100
Paper 16	SCPB-2.16	Biodiversity & Bio-prospecting Practical	4	50
Paper 17	SCPB-2.17	Bioinstrumentation Practical	4	50
Paper 18	OEPB-2.18	Ecology: Concepts and Management Practical	4	50
Paper 19	OEPB-2.19	English Communications Assignments	4	50
Paper 20	OEPB-2.20	Animal Classification Practical	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 2nd year: Semester – 3

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 21	HCTB-3.21	Biochemistry	5	100
Paper 22	HCTB-3.22	Metabolism, Integration andAdaptation	5	100
Paper 23	OETB-3.23	Cell Biology	5	100
Paper 24	OETB-3.24	Genetics	5	100
Paper 25	OETB-3.25	Plant Anatomy	5	100
Paper 26	SCPB-3.26	BiochemistryPractical	4	50
Paper 27	SCPB-3.27	Metabolism, Integration andAdaptation Practical	4	50
Paper 28	OEPB-3.28	Cell Biology Practical	4	50
Paper 29	OEPB-3.29	Genetics Practical	4	50
Paper 30	OEPB-3.30	Plant Anatomy Practical	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 2nd year: Semester – 4

Paper No.	Course Code	Course Title	No. of Hour sper week	Maximum Marks
Paper 31	HCTB-4.31	Growth & Reproduction	5	100
Paper 32	HCTB-4.31	System Physiology & Behavior	5	100
Paper 33	OETB-4.33	Plant tissue culture and Animal cell culture	5	100
Paper 34	OETB-4.34	Molecular Biology	5	100
Paper 35	OETB-4.35	Biomedical Instrumentation	5	100
Paper 36	SCPB-4.36	Growth & Reproduction Practical	4	50
Paper 37	SCPB-4.37	System Physiology & Behavior Practical	4	50
Paper 38	OEPB-4.38	Plant tissue culture and Animal cell culture Practical	4	50
Paper 39	OEPB-4.39	Molecular Biology Practical	4	50
Paper 40	OEPB-4.40	Biomedical Instrumentation Practical	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 3rd year: Semester – 5

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 41	HCTB-4.41	Immunology	5	100
Paper 42	HCTB-4.42	Evolution & Adaptation	5	100
Paper 43	OETB-4.43	Bioinformatics	5	100
Paper 44	OETB-4.43	Applied Biology	5	100
Paper 45	OETB-4.45	Nursery, gardening & horticulture	5	100
Paper 46	SCPB-4.46	Immunology Practical	4	50
Paper 47	SCPB-4.47	Evolution & Adaptation Practical	4	50
Paper 48	OEPB-4.48	Bioinformatics Practical	4	50
Paper 49	OEPB-4.49	Applied Biology Practical	4	50
Paper 50	OEPB-4.50	Nursery, gardening & horticulture Practical	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 3rd year: Semester – 6

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 51	HCTB-6.51	Differentiation & Morphogenesis	5	100
Paper 52	HCTB-6.52	Microbiology: Principles and applications	5	100
Paper 53	OETB-6.53	Clinical Microbiology	5	100
Paper 54	OETB-6.54	Bio-resources and Management	5	100
Paper 55	OETB-6.55	Plant systematics	5	100
Paper 56	SCPB-6.56	Differentiation & Morphogenesis Practical	4	50
Paper 57	SCPB-6.57	Microbiology: Principles and applications Practical	4	50
Paper 58	OEPB-6.58	Clinical Microbiology Practical	4	50
Paper 59	OEPB-6.59	Bio-resources and Management Practical	4	50
Paper 60	OEPB- 6.60	Plant systematics	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 4th year: Semester – 7

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 61	HCTB-7.61	Endocrinology	5	100
Paper 62	HCTB-7.62	Wildlife Conservation & Management	5	100
Paper 63	OETB-7.63	Plant Breeding	5	100
Paper 64	OETB-7.64	Plant Pathology	5	100
Paper 65	OETB-7.65	Environmental Microbiology	5	100
Paper 66	SCPB-7.66	Endocrinology Practical	4	50
Paper 67	SCPB-7.66	Wildlife Conservation & Management Practical	4	50
Paper 68	OEPB-7.67	Plant Breeding Practical	4	50
Paper 69	OEPB-7.69	Plant Pathology Practical	4	50
Paper 70	OEPB-7.70	Environmental Microbiology Practical	4	50

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

B.Sc. Biological Sciences 4th year: Semester – 8

Paper No.	Course Code	Course Title	No. of Hours per week	Maximum Marks
Paper 71	HCTB-8.71	Virology	5	100
Paper 72	HCTB-8.72	Cancer Biology	5	100
Paper 73	OETB-8.73	Bionanotechnology	5	100
Paper 74	OETB-8.74	Food and Industrial Microbiology	5	100
Paper 75	OETB-8.75	Agricultural Microbiology	5	100
Paper 76	SCPB-8.76	Virology Practical	4	50
Paper 77	SCPB-8.77	Cancer Biology Practical	4	50
Paper 78	OEPB-8.78	Bionanotechnology Practical	4	50
Paper 79	OEPB-8.79	Food and Industrial Microbiology Practical	4	50
Paper 80	OEPB-8.80	Agricultural Microbiology Practical	4	50
Paper 81	RPB-8.81	Research Project	6	100

HCTB – Hard Core Theory Paper Biological Sciences – Mandatory

OETB – Open Elective theory paper Biological Sciences - Students should select 2 OETB papers from 3 OET papers

SCPB – Soft Core practical paper Biological Sciences – Mandatory

OEPB – Open Elective practical paper Biological Sciences - Students should select 2 OEPB papers from 3 OEPB Paper with respective OETB papers

RPB - Research Project Biology -Mandatory – Students have to carry out research project in 4th year

TEACHING HOURS

1. Each paper will have 5 Hours of lectures per week. Each lecture shall be of 45 min. duration

2. Each paper will have practical of 4 Hours per week

3. There will be one additional tutorial period per week per paper for students who require extra help.

SCHEME OF EXAMINATIONS

1. English shall be the medium of instruction and examination

2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the Punyashlok Ahilyadevi Holkar Solapur University, Solapur.

3. Each paper will carry 100 marks and will have following components

i) Theory Paper

a) Internal Assessment - 20 marks

- Assignments/Seminars - 10 marks
- Class Test - 10 marks

b) End Semester Examination - 80 marks

ii) Practical

End Semester Examination each paper - 40 marks

Internal Assessment each paper – 10 marks

CREDIT SCHEME

Each course in a semester shall have a certain number of credits assigned to it depending upon the number of lectures, tutorial and practical Hours per week.

Lecturers/Tutorials: One lecture/tutorial period per week shall be assigned one credit.

Practical: One Practical period per week shall be assigned half credit.

Computational Practical: One computational Practical period per week shall be assigned half credit.

PASS PERCENTAGE & PROMOTION CRITERIA

1. The minimum marks required to pass any paper in a semester shall be 40% in theory and 40% in Practical, wherever applicable. The student must secure 40% in the End Semester Examination and 40% in the total of End Semester Examination & Internal Assessment of the paper for both theory & practical separately.

2. A student shall be eligible for promotion from 1st year to 2nd year of the course provided she/he has passed 50% papers of I and II Semester taken together.

3. Similarly, a student shall be eligible for promotion from 2nd year to 3rd year of the course provided she/he has passed 50% papers of III and IV Semester taken together.

5. Similarly, a student shall be eligible for promotion from 3rd year to 4th year of the course provided she/he has passed 50% papers of V and VI Semester taken together.

6. Students who do not fulfill the promotion criteria as given above shall be declared failed in the part concerned. However, they shall have the option to retain the marks in the papers in which they have secured Pass marks as above.

7. A student who has to reappear in a paper prescribed for Semester I/III/V may do so only in the Semester examinations to be held in November/December. A student who has to reappear in a paper prescribed for Semester II/IV/VI may do so only in the examination to be held in April/May

SPAN PERIOD

The span period to complete the course shall be four years from the year of admission.

FAILED STUDENTS

Failed students shall appear in the examination as per rules prescribed for ex-students.

ATTENDANCE REQUIREMENTS

No student shall be considered to have pursued a regular course of study unless he/she is certified by the Principal of the College, Punyashlok Ahilyadevi Holkar Solapur University, Solapur to have attended 66% of the total number of lectures and seminars conducted in each semester, during his/her course of study. Provided that he/she fulfils other conditions, the principal, may permit a student to the next Semester who falls short of the required percentage of attendance by not more than 10%of the lectures and seminars conducted during the Semester.

B.Sc. I Semester 1

Paper 1 HCTB 1.1- 1: Light and life

UNIT 1 **15 Hours**

Nature of light, spectrum of light useful for various biological processes in the life of plants and animals, spectrum of light which is harmful to life, unit of light energy (Photon, quantum), Photo Biological reactions. Measurement of light (Lux, Foot Candle). Pigments associated with harvesting light energy: pigments/receptors of light, chlorophylls, caroteniods, phycobilinoproteins, bacteriochlorophylls, phytochromes, Rhodopsin etc. chemistry and functional roles.

UNIT 2 **15 Hours**

Photosynthesis: History, Photosynthetic equations, Light and dark reactions, mechanism of photolysis of water and oxygen evolution; C_3, C_4, CAM plants, spectrum of photoautotrophs, photoautotroph vs photoheterotrophs; Photoautotroph vs. chemoautotroph, structure of chloroplast and quantasome, Anoxygenic and oxygenic photosynthesis, reaction centers.

UNIT 3 **15 Hours**

Bioluminescence: definition, discovery, examples of organisms, photoreceptors – distribution, mechanism; Phytochrome mediated photomorphogenesis phenomena – seed germination etc. Photoperiodism: LDP, SDP, DNP plants, vernalization, vernalin, etiolationand de-etiolation. Light as an ecological factor affecting distribution of plants and animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems: Morphological, Anatomical, Physiological and Behavioural adaptations to extreme light conditions byorganisms.

UNIT 4 **05 Hours**

Behavioral aspects: circadian rhythms, jetlag, rhythm of heart beat and other examples.
Light as an inducer for biosynthesis of enzymes, hormones and other biomolecules.

Suggested Reading Materials

1. Hawes C & Satiat-Jeunemaitre – 2001 Plant Cell Biology: Practical approach
2. Buchanan B, Gruissem G & Jones R – 2000 – Biochemistry and Molecular Biology of Plants.

B.Sc. I Semester 1

Paper 2 HCTB-1.2: Chemistry

UNIT 1 Chemical Bonding and Molecular Structure **15 Hours**

Ionic Bonding: Lattice energy and solvation energy Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, *Covalent Bonding*: VB Approach, Lewis theory, VSEPR theory to explain the shapes of molecules, salient features of the Valence bond (VB) theory and the concept of hybridization, Concept of resonance, *MO Approach:* limitations of the VB approach, salient features of the MO theory. Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, nonbonding combinations of orbitals MO treatment of homonuclear diatomic molecules of 1st period andheteronuclear diatomic molecules such as CO, HF. pH and Buffers

UNIT 2 Chemical Thermodynamics **15 Hours**

Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of Thermodynamics: Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH forprocesses involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics, concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change andfree energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation. Maxwell's relations. Statements of Third Law of thermodynamics*:* calculation of absolute entropies of substances.

UNIT 3 Fundamentals of Organic Chemistry **10 Hours**

Hybridization in organic compounds, cleavage of covalent bond, homolysis and heterolysis, electronic effects: Electronic effects and their applications – inductive, resonance and hyperconjugation effects. Structure and relative stability of reactive carbon species – carbocations, carbanions, free radicals and carbenes, Molecular Forces: types of intermolecular and intra-molecular forces and their characteristics: dipole-dipole, dipole- induced dipole and dispersion (London) forces. Hydrogen bond (both intramolecular and intermolecular), Effect of inter/intramolecular forces on physical properties such as solubility, vapour pressure, melting and boiling points of different compounds, Aromaticity: Huckel's rule and its applications to aromatic species.

UNIT 4 Stereochemistry **10 Hours**

Stereochemistry and its importance. Geometrical isomerism, cis-trans and E/Z nomenclature Optical isomerism – optical activity, plane polarized light, enantiomerism, chirality, specific molar rotation, Stereoisomerism with two chiral centers : Diastereomers, mesoisomers, Resolution of racemic modification. Projection diagrams of stereoisomers: Fischer, Newman and Sawhorse projections. Relative Configuration: D/L designation. Absolute Configuration R/S designation of chiral centres, Conformational isomerism – ethane, butane, energy diagrams and relative stability of conformers. Ring strain in cyclopropane, cyclobutane.aeyer strain theory and its limitations, cyclohexane and its conformers.

Suggested Reading Materials:

1. J.D. Lee : A New Concise Inorganic Chemistry, E.L.B.S.
2. P.W. Atkins : Physical Chemistry, Oxford University Press
3. R.T. Morrison & R.N.Boyd : Organic Chemistry, Prentice Hall
4. James E.Huheey etl. : Inorganic Chemistry : Principles of Structure and reactivity
5. A.I. Vogel, Vogel's Qualitative Inorganic Analysis, Prentice Hall, 7th Edition
6. A.I. Vogel, Vogel's Quantitative Chemical Analysis, Prentice Hall, 6th Edition
7. B.D. Khosla, Senior Practical Physical Chemistry, R.Chand & Co.

B.Sc. I Semester 1

Paper 3 OETB- 1.3: Physics and applications to biology

UNIT 1 Mechanics and Special Theory of Relativity **10 Hours**

Mechanics: Galilean invariance and Newton's Laws of motion. Dynamics of a system of particles, Conservation of momentum and energy, work energy theorem. Conservation of angular momentum, torque, Motion of a particle in central force field. Kepler's Laws, Satellite in circular orbit and applications (Synchronous satellite, GPS, Artificial gravity, apparent weightlessness), Physiological effects of acceleration and angular motion.**Special Theory of Relativity**: Constancy of speed of light, postulate of Special theory of relativity, length contraction, time dilation, relativistic velocity addition, Mass-energy momentum relations

UNIT 2 Waves and Oscillations and Modern optics **15 Hours**

Waves and Oscillations: Simple harmonic motion, damped and driven harmonic oscillator, coupled oscillator, energy relation and energy transfer, normal modes, Wave equation, Travelling waves, superposition principle, pulses, Doppler effect, effects of vibrations in humans, physics of hearing, heartbeat**Modern optics:** Two slit Interference, Diffraction, Resolving power, Resolution of the eye, Laser characteristics, Principle, Population inversion, Application of laser in medical science, Polarization of EM wave, Malus Law, Polarizing materials, Polarizer, Analyzer

UNIT 3 Membrane Systems and Membrane Physics **10 Hours**

:Micelle and Bilayer formation, structure andfunction. Physicochemical characterization and analysis of micelles and bilayers. Membrane equlibria and Transport. Thermodynamics of transport process. Ficks', law, Nernst Planck Equations, Diffusion, Osmosis, Donnan effect, permeabilily coefficient. Excitable Membranes, Resting potentials, Measurement membrane conductance. Neural signals and action potentials.

UNIT 4 Overview of Neural networks **05 Hours**

Integrate-and-fire model, Leaky integrate-and-fire model, Hodgkin-Huxley model, Fitzhugh-Nagumo model; Artificial neural network: Binary neuron,Associative memory, Hopfield model

Suggested Reading Materials:

1. Rodney Cotterill; Biophysics : An Introduction, John Wiley & Sons
2. D.S. Mathur , Mechanics, S.Chand & Company Ltd. 2000
3. N.K.Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill 1988

B.Sc. I Semester 1

Paper 4 OETB-1.4: Mathematics & Statistics

UNIT 1 Matrices and Linear Equations **10 Hours**

Matrices: Symmetric and Skew symmetric, Elementary transformations, Rank of a Matrix (Echelon and Normal form), Characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix. **Linear Equations:** Application of matrices to a system of linear (both Homogeneous and non-homogeneous) equations, Eigen values and Eigen vectors

UNIT 2 Complex Number and Transcendental Functions **10 Hours**

Complex Number: Modulus and Argument of a Complex Number, DeMoivre's Theorem and its applications, Roots of Unity, Roots of Complex Numbers. **Transcendental Functions:** Circular Functions and their inverses and Hyperbolic Function of a complex variable with their inverses.

UNIT 3 Basics concepts of biostatistics and data representation **15 Hours**

Biostatistics -Basic concepts, definitions, statistics and biostatistics, sampling methods, merits and demerits of Random, non-random sampling method. Measures of central tendency; Mean, Median, Mode, Measures of dispersion; Standard deviation and Standard error. Data organization, Tabulation of data, Graphical representation of data; Bar graph, Line graph, Pie chart. Descriptive statistics: measures of central tendency, dispersion, skewness and kurtosis, Normal, Binomial and Poisson distribution and their applications, test for goodness of fit. Standard error, Confidence interval

UNIT **4 Advanced biostatistics** **15 Hours**

1) Probability - definition, elementary properties, types, rules, applications to biological problems, chi-square ($\chi 2$) distribution and test. 2) Hypothesis testing: definition of hypothesis, hypotheses - null and alternate hypotheses, general procedure, decision about H0 – one-tailed and two- tailed tests, type I and type II errors 3) Analysis of Variance (ANOVA): basic concepts, experimental designs – CRD, RBD, factorial experiment, repeated measures, other designs, general method, F – test, multiple comparison tests. 4) Correlation and Regression

Suggested Reading Materials

1. ALGEBRA, Prof. S. J. Alandkar, Prof. N. I. Dhanshetti, Prof. Dhone A. S. Prof. R. D. Mahimkar, Nirali Prakashan (Edition- July 2014) ISBN 978-93- 5164-169-8.
2. Statistical Methods for the Analysis of Repeated Measurements C. S. Davis, Springer, 2002.
3. Fundamentals of Biostatistics, I. A. Khan and A. Khanum, Ukaaz Publications, 2nd Edition.
4. Algebra and Geometry by R. B. Kulkarni, J. D. Yadav, S. J. Alandkar, N. I. Dhanshetti. (SUMS Publication B.Sc.-I Paper-I 2004.
5. Algebra and Geometry by Dr. B. P. Jadhav, Prof.A.M.Mahajan ,Prof.S.P.Gade, Prof. Kokare B.D . [Phadke Prakashan]

B.Sc. I Semester 1

Paper 5 OETB- 1.5: Plant Classification

UNIT 1: Fungi **10 Hours**

General introduction of true fungi classification of Zygomycotina and Ascomycotena

UNIT 2: Archegoniate **05 Hours**

Introduction & general characters of Archegoniate

UNIT 3: Bryophytes

Bryophytes and life cycle of *Riccia* with its economic importance. **05 Hours**

UNIT 4 Pteridophytes **10 Hours**

Pteridophytes and life cycle of ***Selaginella*** with its economic importance.

UNIT: 5 Gymnosperms **10 Hours**

Gymnosperms and life cycle of ***Cycas*** with its economic importance

UNIT: 6 Angiosperms **10 Hours**

Gymnosperms and life cycle of ***Hibiscus*** with its economic importance

B.Sc. I Semester 1

Paper 6 SCPB-1.6: Light and Life Practical

1. Demonstration of
   (a) Etiolation and de etiolation;
   (b) Light and CO_2 are essential for photosynthesis (Moll's half leaf experiment) and measure oxygen evolution during photosynthesis
   (c) Oxygen liberation during photosynthesis;
   (d) Measurement of light using Luxmeter, Secchi disc
2. Chemical separation of chloroplast pigments/Chromatographic separation of chloroplast pigments.
3. Demonstration of Hill's reaction and study of the effect of light intensity.
4. Demonstration of Blackman's law of limiting factors.
5. Study of the effect of red and blue light on seed germination and development of pigments during fruit ripening.
6. Photographs/slides/specimens of photoautotrophic and photosynthetic bacteria, chloroplast, quantasome, bioluminescent organisms.
7. To study the effect of light and darkness on the chromatophores of fish
8. To study the phototactic behavior of earthworm/ to determine whether insect larvaeare equally attracted to different colored lights.
9. Effect of UV light on insects/Effect of photoperiod on the emergence of adult butterfly/moth/Effect of light on development of insect (*Spodoptera*)
10. To study the estrous cycle of rat.

B.Sc. I Semester 1

Paper 7 SCPB 1.7: Chemistry Practical

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture
2. Estimation of oxlic acid by titrating it with $KMnO_4$.
3. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator
4. Surface tension measurement (use of organic solvents excluded) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
5. Determination of the relative and absolute viscosity of a liquid or dilute solution usingan Ostwald's viscometer
6. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
7. pHmetric titration of HCl with NaOH
8. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
9. Determination of melting and boiling points of organic compounds
10. Separation of mixures by Chromatography; Measure the R_f value in each case (Combination of two compounds to be given)
    a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
    b) Identify and separate the sugars present in the given mixture by paper chromatography.

B.Sc. I Semester 1

Paper 8 OEPB-1.8: Physics and applications to biology Practical

1. Determination of acceleration due to gravity using Kater's Pendulum
2. Determination of the acceleration due to gravity using bar pendulum
3. Determination of moment of inertia of a Fly wheel
4. Determination of the frequency of an electrically maintained tuning fork by Melde's experiment
5. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method)
6. Verification of Beer Lamberts Law
7. Determination of Molar Exctinction coefficient
8. Determination of CMC for a detergent
9. Thermal Conductivity of a membrane and effect of temperature

Paper 9 OEPB-1.9: Mathematics and biostatistics Practical

Assignment –1: Inverse of Matrix by Cayley-Hamilton Method.

Assignment –2: Solution of system of Linear Homogeneous Equation

Assignment –3: Solution of system of linear non-homogeneous Equation.

Assignment –4: Calculating measures of central tendency of sample data.

Assignment –5: Student's t-test and chi-square test on sample data.

Assignment –6: Graphical representation of sample data by Pie chart.

Assignment –7: Graphical representation of sample data by Line graph and Bar graph.

B.Sc. I Semester 1

Paper 10 OEPB-1.10: Plant classification Practical

1. Identification of Fungi (*Albugo, Penicilium, Agaricus,*)
2. Study of *Mucor and Aspergillus*
3. Study of Yeast a
4. Identification of Archegoniates (*Marchantia, Adantium, Pinus*)
5. Study of *Riccia.*
6. Study of *Selaginella*- Morphology of sporophyte and anatomy of stem, Strobilus.
7. Study of *Cycas*- Morphology of sporophyte and anatomy of leaflet.
8. Study of *Cycas*- Reproductive structure: male cone, microsporophyll, microspore
9. Study of *Hibiscus*- Reproductive structure, pollen grain, Stigma, Anthers

B.Sc. I Semester 2

Paper 11 HCTB-2.11: Biodiversity & Bio-prospecting

Unit I: Introduction to Biodiversity **15 Hours**

Defining Biodiversity - Components of biodiversity. Biodiversity crisis and biodiversity loss. Importance of biodiversity in daily life. Biodiversity and climate change.**Types of Ecosystems:** India as mega biodiversity Nation. Hot spots and biodiversity in India. Biodiversity and Ecosystem functioning. Plant and Animal systematic. Species concept in biodiversity studies.

Unit II: Modern Tools in the study of Biodiversity **10 Hours**

Endemism, endemic plants and animals; Assessment of mapping of biodiversity; GIS/Remote sensing; Biotechnology and Conservation, IUCN; Germplasm banks, National Parks, Botanical Gardens; Wildlife Sanctuaries, Bioresources

Unit III: **Crop Diversity** **10 Hours**

Wild relatives of cultivated plant; Domesticated diversity; Spice diversity; Forest diversity and wild life. **Representative type (one each) studies from** Cryptogams, Phanerogams, Non-chordates and Chordates**;** Sacred flora and fauna

Unit IV: Bio-prospecting **15 Hours**

Microorganisms as a source of novel enzymes, antibiotics, antiviral agents; Immunosuppressive agents and other therapeutic agents. Botanicals for Biocontrol, Health and biodiversity. Medicinal plants, Venom and Antivenom.

Suggested Reading Materials

1. Aber, J.D.and Melillo J.M., Terrestrial Ecosystems: 1991, W.B. Saunders
2. Ingrowille, M Diversity and Evolution of land plants 1992 chapman and Hall

B.Sc. I Semester 2

Paper 12 HCTB 2.12- 10: Bioinstrumentation

UNIT I Microscopy **10 Hours**

Microscopy- Types of light microscopes: Bright field, dark field, fluorescence and phase contrast Micrometry. Basic components of electron microscopes. Thermionic and field emission electron guns. Types of electron microscopes: TEM, SEM,

UNIT II Chromatography **15 Hours**

Paper Chromatography and Thin layer chromatography, Protein purification by Ammonium sulphate precipitation, Ion exchange chromatography, Gel filtration chromatography, and Affinity chromatography, and High-performance liquid chromatography (HPLC).

UNIT III Spectroscopy **10 Hours**

Colorimetry, UV Visible spectroscopy, FT-IR, NMR, ESR , XRD, AAS. GCMS, LCMS-MS, MALDI-TOF

UNIT IV Centrifugation and Electrophoresis **10 Hours**

Centrifugation: Basic principle and application, differential – density gradient and ultra-centrifugation. **Electrophoresis**, Principle and application of Native, SDS Agarose gel electrophoresis, and 2D gel,

Suggested readings

1. Shrama BK, Instrumental method of chemical analysis
2. DA Skoog. Instrumental methods of analysis
3. Plummer, An introduction to practical Biochemistry
4. Chatwal and Anand, Instrumentation Boyer, Modern experimental Biology
5. Biochemistry by Lubert Stryer
6. Plummer, An introduction to practical Biochemistry
7. Boyer, Modren experimental Biology
8. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker. Cambridge University Press India Pvt. Ltd.

B.Sc. I Semester 2

Paper 13 OETB: Ecology: Concepts & Management

UNIT I Introduction to Ecology **10 Hours**

Ecology: History, definition, ecological factors (abiotic and biotic factor), ecological range (Eury , Steno)Stress and adaptation (Morphological, physiological, anatomical and biochemical), Biotic interaction, phenotypic and genotypic plasticity, canalization.

UNIT II Ecosystem **15 Hours**

Ecosystem: Concept, components, (e.g., aquatic, marine, forest, grassland, desert, fish tank, euxenic cultures, complete and incomplete ecosystem), energy flow(GFC, DFC), food web, niche , Gause's exclusion principle, Leibig's law, ecological pyramids, Autecology and Synecology, r- & k-selections, carrying capacity, population dynamics,(exponential & logistic growth curves),keystone species. Ecological succession , Ecology restoration.

UNIT III Pollution and disaster management **15 Hours**

Pollution of Soil, water, air (types of pollutants and sources), noise pollution, radiationpollution, remedial measures, bio amplification, , Bioremediation and Bioaugmentation, **Disaster management:** Types of disasters & Management strategy

UNIT IV Behavioral ecology **10 Hours**

Behavioral ecology: social, reproductive & territorial behavior, evolution of optimal lifehistory, reproductive structure and mating system, microbial ecology.

Suggested Reading Materials

1. Wilkenson DM – 2007 – Fundamental Processes in Ecology
2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystem

B.Sc. I Semester 2

Paper 14 OETB 2.14: English literature and communication

UNIT I Grammar and Vocabulary Parts of Speech **10 Hours**

1. Nouns
2. Pronouns
3. Articles
4. Verbs
5. Tenses

UNIT II Communication **10 Hours**

1. What is Communication?
2. Words and Thoughts
3. Process of Communication: The Communication Cycle, the Sender of the Message, Channel, Feedback
4. Communication Environment, Essentials of Effective Communication

Interviewing

5. Group Discussion
8. Email
9. Blog and Social Media

UNIT III Scientific documents **15 Hours**

Different types of scientific documents, review paper, book reviews, research paper, thesis, project reports and conference report. Presentation of research: Oral and poster presentation, presentation in conferences and symposia. Preparation and submission of proposals to the funding agencies

UNIT III Scientific documents **15 Hours**

Components of research paper, IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations, Preparation for publications-Submission of manuscript

B.Sc. I Semester 2

Paper 15 OETB 2.15- 12: Animal Classification

UNIT I Kingdom Protista, Porifera and Cnidaria **15 Hours**

General characters and classification up to classes; locomotory organelle and locomotion inprotozoa , nutrition in protozoa. **Phylum Porifera** General characters and classification up to classes; canal system in **Sycon . Phylum Cnidaria** General characters and classification up to classes; polymorphism in hydrozoan,

UNIT II Phylum Nematoda, Phylum Platyhelminthes Phylum Annelida **15 Hours**

Phylum Nematoda , Phylum Platyhelminthes General characters and classification up to classes; life history of *Ascaris lumbricoides* andits parasitic adaptations, **Phylum Annelida** General characters and classification up to classes; metamerism in annelid, economic importance of annelids with reference to earthworm and leech,

UNIT III Phylum Arthropoda and Phylum Mollusca **15 Hours**

Phylum Arthropoda General characters and classification up to classes; vision in arthropoda, metamorphosis ininsects, economic importance of insects, **Phylum Mollusca** General characters and classification up to classes; torsion in gastropodseconomic importance of molluscs

UNIT IV: Phylum Echinodermata and Hemichordata and Chordata **15 Hours**

General characters and classification up to classes; water-vascular system in Asteroidea,

General characters and classification up to classes **Hemichordata**

General characters and classification up to classes **Chordata**

B.Sc. I Semester 2

Paper 16 SCPB 2.16: Biodiversity and Bio-prospecting Practical

FAUNA

1. **Study of following specimens**: *Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus,* Hermitcrab, *Daphnia,* Millipede, Centipede, Beetle, Pila, *Chiton, Dentalium, Octopus, Asterias, and Antedon.*

2. **Dissections**: Digestive and nervous system of Cockroach; Mouth parts , salivary apparatus and ovary of cockroach; Unstained mount of Placoid scales.

3. **Study of following specimens** : *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus ,Draco,Uromastix, Naja, Viper,* any three common birds, Squirrel and Bat.

4. Study of a few endangered species of amphibians, reptiles, birds and mammals ofIndia

5. To study the faunal composition (insects and mites) of soil samples. (Berley's funnel)

6. To study faunal composition of water samples (Lucky drop method)

7. Report on visit to National Park/Wild life sanctuary/Botanical garden.

FLORA

8. Study through specimens/photographs/slides of

(a) Key stones species (b) Ecads, Ecotypes, Ecophenes (c) Source of Immunosuppresive and other therapeutic agents (d) Botanicals for biocontrol (e) Sacred flora (havan materials etc.)

9. Study through permanent slides and specimens (vegetative and reproductive structures) of *Coleacheate, Vaucheria, Polysiphonia, Fucus* (*Fucus* permanent slides only); *Rhizopus, Penicillium* and *Agaricus*; *Riccia, Anthoceros, Funaria; Psilotum, Selaginella, Pteris; Cycas, Pinus, Gnetum*

10) Study of the characteristic features of any two flowers for each family

(a) Malvaceae/ Fabaceae/Cruciferae/Ranunculaceae (any one family), (b) Compositae

(b) Euphorbiaceae, (d) Poaceae/Liliaceae (any one family)

B.Sc. I Semester 2

Paper 17 SCPB 2.17: Bioinstrumentation Practical

1. Chromatographic Separation of amino acids using paper Chromatographic techniques
2. Chromatographic Separation of amino acids using thin layer Chromatographic techniques.
3. Purification of proteins by ion exchange chromatography
4. Purification of proteins by gel filtration chromatography
5. Electrophoretic separation of nucleic acids by agarose gel electrophoresis
5. Electrophoretic separation of proteins by polyacrylamide gel electrophoresis
6. Beer and Lambert`s laws, extinction coefficient and molar extinction coefficient by using UV- Visible spectrophotometry
7. Centrifugation

B.Sc. I Semester II

Paper 18 OEPB 2.18: Ecology: Concepts & Management Practical

1. Study through specimens/photographs/slides

Parasitic angiosperms, Saprophytic angiosperms, VAM fungi, Root nodules, Corolloid roots, Mycorrhizal roots, Velamen roots, Lichen as pollution indicators,

2. Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hairhygrometer, Luxmeter, Rain guage, Soil thermometer, Min-Max thermometer

3. Minimal quadrat

4. To determine density/frequency/abundance of the vegetation by quadrat method.

5. To determine soil texture

6. To determine soil density, bulk density, particle density and pore space.

7. To determine water holding capacity and percolation rate of soil.

8. To determine pH, Cl, SO_4 , NO_3, base deficiency, organic matter, cation exchange capacity in the soil.

9. Plotting of survivorship curves from hypothetical life table data.

10. Study of community ecology like pond ecosystem, Garden ecosystem

B.Sc. I Semester 2

Paper 19 OEPB 2.19: English communication assignments

1. Writing suitable title (Analysis) of research papers.
2. Search of authors instructions from website of a scientific journal and its analysis/ comparison
3. Assignment on analysis of data/ Results/ Conclusion.
4. Assignment on Google search for scientific purpose.
5. Writing abstract for research paper
6. Preparation of a research article for publication in a journal
7. Preparation of an application to file a patent
8. To enlist Indian journals in Microbiology field with their impact factors
9. Write an assay on current climate change and greenhouse effect
10. Arrange a group discussion on use of pollution
11. English communication Linguistic lab practical for TOFFEL

B.Sc. I Semester 2

Paper 20 OEPB 2.20: Animal Classification Practical

Study of the following specimens (General characters and classification) by using CD/Model/Chart/Slides/Virtual

1. *Amoeba, Euglena, Plasmodium, Paramecium*
2. *Sycon, Hyalonema, and Euplectella*
3. *Obelia, Physalia, Aurelia, Metridium*
4. *Taenia,, Ascaris, Fasciola*
5. *Aphrodite, Nereis, Pheretima, Hirudinaria*
6. *Peripatus, Palaemon, Crab, Limulus, Scolopendra, Julus, Periplaneta*
7. *Chiton, Dentalium, Pila, Unio, Sepia, Octopus*
8. *Pentaceros, Ophiura, Echinus, Cucumaria and Antedon,*
9. *Balanoglossus, Herdmania, Branchiostoma*
10. *Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla*
11. *Ichthyophis, Salamandra, Bufo, Hyla*
12. *Chelone,Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis*

B.Sc. II Semester 3

Paper 21 HCTB 3.21: Biochemistry

UNIT I Biomolecules: Diversity and distribution **15 Hours**

Lipids: Role of lipids in cellular architecture and functions. Definition and classification of lipids. Structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Carbohydrates: Biological roles of carbohydrates. Structure of monosaccharides- Hexoses and pentoses. Disaccharides-Sucrose, lactose, maltose. Storage and structural polysaccharides- Glycogen, starch and cellulose. Nucleic acids: Role of nucleic acids in living system. Composition of nucleic acids-the purine and pyrimidine bases. Structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and Crick model for DNA. Different classes of RNA.

UNIT II Proteins **10 Hours**

Classification of proteins on the basis of composition, conformation and function-functionaldiversity of proteins. The amino acid building blocks-classification, structure and physical properties of the standard amino acids. Proteinaceous and non-proteinaceous, essential and non-essential amino acids. Primary, secondary, tertiary and qua ternary structure of proteins. Structure of myoglobin and hemoglobin. Molecular physiology of myoglobin and hemoglobin, Bohr effect, Hill's coefficient. Concerted and sequential models for allosteric proteins,
Protein quality control, Chaperonins

UNIT III Enzymes **10 Hours**

Enzymes as biological catalysts. Enzyme classification and nomenclature. Chemical nature of enzymes, ribozymes. Concept of active site, specificity. Coenzymes, cofactors and prostheticgroups. Kinetics of enzyme catalyzed reactions - Michaelis Menten equation. Determination of K_m and V_{max}. Factors influencing the rate of enzyme catalyzed reactions. Enzyme inhibitions- competitive, non-competitive and uncompetitive inhibitions. Catalytic mechanism of lysozyme, chymotrypsin and Hexokinase. Regulation of enzyme activity- allosteric enzymes, feedback inhibition with ATcase as an example.

UNIT IV Medicinal Chemistry and Role of Metal ions in Biology **15 Hours**

Structure based drug design, combinatorial chemistry and high throughput screening. Combinatorial synthesis in medicinal chemistry-solid phase synthesis, Houghton's teabag method, mix split method. Introduction to pharmacology, pharmacokinetics, safety and efficacy of the candidate drugs, toxicity and adverse reactions, clinical trials; Metalloprotein, Metaloenzymes, metal base drug interaction and inhibition; metallo porphyrins, Redox carriers in mitochondrial electron transport chain.

Suggested Reading Materials:

1. Nelson, D. L. and Cox, M.M. (2008**).**Lehninger, Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA.
2. Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc.USA.
3. Patrick Medicinal chemistry

B.Sc. II Semester 3

Paper 22 HCTB 3.22: Metabolism, integration and adaptation

UNIT I Concept of Metabolism **05 Hours**

Experimental approaches to study metabolism; Primary and secondary metabolism

UNIT II Major metabolic pathways & Regulation **15 Hours**

Glycolysis, the TCA cycle, Oxidative degradation of fatty acids and amino acids in animal tissues; correlation between carbohydrate, amino acids and fatty acid degradation Selected metabolic pathways (for example biosynthesis of rubber, antibiotics etc.); Regulation of metabolism and environmental cues. Metabolic inter relationships – starve feed cycle. Mechanisms involved in switching liver metabolism between the well feed and starved states. Inter relationship of tissue in nutritional and hormonal states.

UNIT III Special aspects of metabolic regulation, Tissue specialization **10 Hours**

Function. Intracellular communications and signal transduction mechanisms; developmental adaptations – eg: rat, C_3, C_4 plants; Metabolic basis of health and disorders – Jaundice – diabetes mellitus, exercise, alcohol abuse

UNIT IV Use of microbes for specific metabolic tasks **15 Hours**

Alternate metabolic cycles, Carbon metabolism of intracellular bacterial pathogens**;** Environmental cleaning, biotransformationof metals; Metabolic handling of xenobiotics and drug resistance; Photo and lithotrophic metabolic capabilities; myporia

Suggested Reading Materials

1. H.G. Sehlegal, General Microbiology 2003, Cambridge University Press Cambridge
2. Sterier, R.Y.et AL, General Microbiology 1986, Macmillan London
3. Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss
4. Peter W. Hochachka, George. N. Somero, Biochemical adaptation, Amazon Publishers
5. Nelson, D. L. and Cox, M.M. (2008**).**Lehninger, Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA

B.Sc. II Semester 3

Paper 23 OETB 3.23: Cell Biology

UNIT I An overview of cell and cell organelles **15 Hours**

Prokaryotic and eukaryotic cells, Plant and Animal cell, cell size and shape, molecules of cell, Structure and functions of cell organelles - Endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, chloroplast, peroxisomes. Nucleus - Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, nucleolus

UNIT II Cytoskeleton and cell movement **15 Hours**

Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules. Mechanism of vesicular transport. Endocytosis. Bacterial and Eukaryotic Cell wall; The plasma membrane structure; Transport of small molecule, the extracellular matrix and cell matrix interactions; cell-cell interactions. cell membranes and cell proteins., transport across nuclear envelope

UNIT III DNA and RNA **10 Hours**

Structure of DNA and RNA, Eukaryotic Chromosome: Molecular organization, Procaryotic Chromosome organization

UNIT IV Eukaryotic Cell Cycle **10 Hours**

Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization. Programmed Cell Death

Suggested reading material

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.
3. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V
5. Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

B.Sc. II Semester 3

Paper 24 OETB 3.24 Genetics

UNIT I Basic Concepts of genome **15 Hours**

Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Importance of Molecular Biology, Central Dogma of Molecular Biology, Model organisms for studying Molecular Biology.

UNIT II Replication of DNA in prokaryotes **10 Hours**

Features of DNA Replication, Proof of semiconservative nature of DNA replication, Features of bidirectional DNA replication. Mechanism of bidirectional DNA replication

UNIT III RNA synthesis **15 Hours**

RNA structure and types of RNA, Transcription in prokaryotes with E. Coli as model system: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, Genetic code, properties of genetic code, Wobble hypothesis Components of Protein synthesis machinery Messenger RNA, tRNA structure and function, Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly

UNIT IV Protein synthesis in prokaryotes **10 Hours**

Initiation, elongation and termination. Principles of gene regulation, negative and positive regulation, concept of operons, Regulation of gene expression in bacteria: lac operon concept

Suggested reading material

1.Concepts of Genetics- Klug W. S. And Cummings M. R Prentice-Hall
2. Genetics-a Conceptual Approach Pierce B. A. Freeman
3. An Introduction to Genetic Analysis- Griffith A. F. et al Freeman
4. Principles of Genetics -Snustad D. P. And Simmons M. J. John Wiley & Sons.
5. Genetics - B.D.Singh
6. Genetics – Verma and Agrawal
7. Genetics - P.K.Gupta

B.Sc. II Semester 3

Paper 25 SCTB 3.25 Plant Anatomy

UNIT I Meristematic tissue **15 Hours**

Introduction, Characteristics and Classification of meristems based on position, Classification of meristem based on origin, position and plain of division, Theories of structural development, Apical cell theory Histogen theory, Tunica Corpus theory. Leaf anatomy

UNIT II Permanent tissue **10 Hours**

Simple and complex tissue structure and function of simple tissues a) Parenchyma b) Collenchyma c) Sclerenchyma structure and function of Complex tissue a) Xylem b) Phloem Types of Vascular bundles

UNIT IV Primary structure of plant body **10 Hours**

Primary structure of Monocotyledon and Dicotyledon root. Primary structure of Monocotyledon and Dicotyledon stem.

UNIT IV Secondary structure of plant body **15 Hours**

Normal secondary growth in Dicotyledon root and stem, Anomalous l secondary growth in Bignonia (Dicot.) and Dracaena stem. Vascular cambium – structure and function Periderm and Lenticel, Tylosis, Wood types. Tissue system Epidermal tissue system**,** Secretary tissue system**,** Mechanical tissue system

B.Sc. II Semester 3

Paper 26 SCPB 3.26: Biochemistry Practical

1. Preparation of buffers
2. Determination of PK_a value for acetic acid
3. Estimation of proteins by Biuret method
4. Estimation of proteins by Lowry's method
6. Separation of amino acids by Thin Layer chromatography
7. Assay of the enzyme acid phosphatase from germinated mungdal or β-amylase from sweet potato beams
8. Effect of pH on the activity of an enzyme
9. Progress curve of an enzyme
10. Estimation sugar by DNSA method.
11. Estimation of Fatty acids and lipids

B.Sc. II Semester III

Paper 27 OEPB 3.27: Metabolism: Integration and adaptation Practical

1. Estimation of blood glucose – Glucose Oxidase method
2. Estimation of Cholesterol – Hyper Cholesteremia samples
3. Estimation of SGPT and SGOT
4. Estimation of Bilirubin
5. Estimation of creatinine
6. Identification of organelles by marker enzymes – SDH, LDH and acid phosphatase

B.Sc. II Semester 3

Paper 28 OEPB 3.28: Cell Biology Practical

1. Plant cell staining observation of cell organelles
2. Animal cell staining and observation of cell organelles
3. Chromosome staining of plant cell
4. Chromosome staining of animal cell
5. Chromosome staining of bacterial cell
6. Bacterial cell wall staining
7. Bacterial cell staining
8. Study of Chromosome karyotyping,
9. Study of Mitosis and Meiosis,
10. Study of Polytene chromosome,
11. Study of WBC and RBC.

B.Sc. II Semester 3

Paper 29 OEPB 3.29 Genetics Practical

1. Isolation of DNA from bacteria by phenol Chloroform method
2. Isolation of DNA from yeast by spin column method
3. Colorimetric estimation of DNA
4. Spectrophotometric estimation of DNA
5. Agarose gel electrophoresis of DNA
6. Isolation of DNA from Plant
7. Isolation of DNA from human cheek cell
8. Isolation of DNA from Drosophila
9. Mutation in Drosophila.

B.Sc. II Semester 3

Paper 30 OEPB 3.30 Plant Anatomy

1) Study of shoot and root apex by permanent slides.
2) Study of simple tissues.
3) Study of complex tissues.
4) Study of primary structure of dicot and monocot root
5) Study of primary structure of dicot and monocot stem
6) Study of anomalous secondary growth in *Bignonia*.
7) Study of anomalous secondary growth in *Dracaena*.
8) Study of double stained micro preparation in Bignonia *and Dracaena* stem.
9) Study of double stained preparation of anomalous secondary growth in *Dracaena*.
10) Study of anatomy of porous (ring porous & diffused porous) and non-porous wood.
11) Maceration technique.
12) Study of Epidermal tissue system.
13) Study of Secretary Tissue system.
14) Study of Mechanical tissue system.
15) Study of Leaf anatomy

B.Sc. II Semester 4

Paper 31 HCTB 4.31: Growth & Reproduction

UNIT I General growth patterns in animals and plants **15 Hours**

General growth patterns in animals and plants; hyperplasia and hypertrophy ; measurements (fresh weight, dry weight, dimension, number etc.); kinetics and kinematics; meristem(a general account) ; senescence and ageing; programmed cell death (Apoptosis); quiescence and dormancy. Flower, Fruit, Root and Shoot development, Plant growth regulation by hormones.

UNIT II Asexual and sexual reproduction **10 Hours**

Alternation of generations and reproductive patterns in animals and plants- asexual and sexual reproduction -an overview (regeneration, apogamy, apospory, apomixis etc); Pre- fertilization events-gametogenesis – spermatogenesis and oogenesis, types of eggs in animals; isogamy, anisogamy and oogamy, relative sexuality in plants

UNIT III Fertilization in animals **15 Hours**

Fertilization in animals, and in plants-mode of transport of gametes leading to fertilization/double fertilization; Post fertilization events: animals-general cleavage types; cleavage in frog, chick and mammal; fate maps, morphogenetic movements during gastrulation; gastrulation in frog and chick; fate of germ layers; an overview of neural tube formation, types of mesoderm, somite formation, endoderm and its derivatives; extra embryonic membranes; placenta; role of hormones during pregnancy, parturition and lactation; Post fertilization events in plants: endosperm, embryo, seed and fruit formation, dispersal of seeds

UNIT IV Organogenesis **10 Hours**

Organogenesis- Formation of Brain, (CNS), Heart and other organs, Stem cells and application of stem cells.

Suggested Reading Materials:

1. Gilbert, S: Developmental Biology. 9th ed.,Sinauer Associates Inc.2010
2. Carlson, B.M. Patten;s foundations of embryology.McGraw Hill, 1996

B.Sc. II Semester 4

Paper 32 HCTB 4.32: System physiology and behavior

UNIT I Movements and Bulk Transport **15 Hours**

Cellular movements, ciliary and flagellar structure and function**;** Introduction to musculo skeletal system; Terrestrial, aquatic and aerial locomotion**;** Locomotory cost**;** Bulk transport of water and nutrients in plants**;** General plan of circulatory system in vertebrates and invertebrates**;** Cardiovascular system; structure and function

UNIT II Gas exchange in organism; Generation and utilization of energy **10 Hours**

Exchange in unicellular organisms and plants; Respiratory organs in aquatic and terrestrial systems; Physiology of aquatic breathing and aerial breathing; Feeding patterns, digestive tract systems; Digestion of food

UNIT III Regulatory Physiology **10 Hours**

Regulation of water in aquatic and terrestrial animals; Water and solute excretion in organisms, osmoregulatory organs; Transpiration in plants; Excretion of nitrogenous wastes in animals; Patterns of Thermoregulation: Ectotherms and Endotherms; Structural and functional adaptation to stress

UNIT IV Integrative Physiology **15 Hours**

An overview of neuronal structure and function; Sensory physiology –mechano, chemo, thermo, photo and electro receptors; Endocrine systems in animals and their physiological effects; Plant hormones and their physiological effects; Regulation of metabolism and response to environmental cues; Neuronal basis of behavior; Behavior concepts and measurements

Suggested Reading Materials:

1. David Randall, Eckert's Animal Physiology, W.H. Freeman and Co.
2. Philips Withers; Comparative Animal Physiology. Books Cole Publishers

B.Sc. II Semester 4

Paper 33 OETB 4.33: Plant tissue culture and Animal cell culture

UNIT I Plant Tissue culture technique **15 Hours**

Introduction to Plant Tissue culture, Terms and definitions, Historical background, Practical organization, Tools and techniques, methods of sterilization. Role of Micro and macro nutrients, Vitamins and carbon source in tissue culture, Media preparation- pH, Temprature, Solidifying agents, Slant Preparations etc.

UNIT II Explants selection and Callus culture **10 Hours**

Explants selection, sterilization and inoculation; Callus and cell suspension culture. Induction and growth parameters; Culture initiation, Callus culture., Micropropagation through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills).

UNIT III Animal cell culture techniques **15 Hours**

History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture.

UNIT IV Behavior of cells in culture conditions **10 Hours**

Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development, Characterization and maintenance of cell lines, Cryopreservation; Embryonic Stem Cell culture IVF, Cell culture bioreactors

Suggested reading material

1. Plant Tissue Culture by Satyanarayana B. N, IK Intl. Publishers
2. Plant Molecular biology by D. Grierson & S.N. Covey Blackie, London.
3. Animal Cell biotechnology by R.E. Spier and J.B. Griffiths, Academic press.
4. Living resources for Biotechnology, Animal cells by A. Doyle, R. Hay and B.E. Kirsop, Cambridge University Press.
5. Fermentation & Enzyme Technology by D.I.C. Wang et.al., Wiley Eastern.
6. Principle of Microbe & Cell Cultivation by SJ Prit, Blackwell Scientific co.
7. Animal cell culture Techniques by Ian Freshney, Wiley-Liss.
8. Animal Cell Culture – Practical Approach BY Ed. John R.W. Masters, 3rd Edition, Oxford University Press.
9. Animal Cell Culture Techniques BY Ed. Martin Clynes,. Springer

B.Sc. II Semester 4

Paper 34 OETB 4.34: Molecular biology I

UNIT I Overview of gene Cloning **10 Hours**

Overview of gene Cloning: Cloning vectors - pBR322, pUC18, Bacteriophage lambda and M13 based vectors. Cosmids, Phagmids, Ti plasmid, YAC, BAC, HAC.

UNIT II Restriction and Modification systems in bacteria **15 Hours**

Restriction and Modification systems in bacteria: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering, Restriction Mapping, Finding of restriction sites in desired gene by online software.

UNIT III Enzymes used in Recombinant DNA techniques **10 Hours**

Enzymes used in Recombinant DNA techniques: DNA ligase, Polynucleotide Kinase, DNA Polymerase, Reverse Transcriptase, Terminal deoxynucleotidyl transferase, Phosphatases. Use of linkers and adaptors, Homopolymer tailing for ligation.

UNIT IV Insertion of recombinant DNA **15 Hours**

Insertion of recombinant DNA-Host selection, Transformation, Transfection Electroporation, Lipofection, Microinjection, Protoplast fusion, Biolistic transformation, Calcium phosphate method, Polyethene glycol and Gene gun. Screening of recombinants.

Suggested reading material

1.Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.
2.Sandy Primrose, Richard Twyman, Bob Old (2001) Principles of Gene Manipulation, 6th Edition, Blackwell Science Ltd.
3.Brown T., (2007) Genome 3, 3rd Edition, Garland Science
4.Strachan T. and Read A., (2004) Human Molecular Genetics, 3rd Edition, Garland Science.
5.Wink Michael, Ed., An introduction to molecular biotechnology, Wiley-VCH Publications.

B.Sc. II Semester 4

Paper 35 OETB 4.35: Biomedical Instrumentation

UNIT I Measurement of blood pressure

Measurement of blood pressure, Cardiac output , Heart rate, Heart sound , Pulmonary function measurements, spirometer, Blood Gas analysers, pH of blood – measurement of blood pCO2, pO2, finger-tip oxymeter, ESR, GSR measurements. **10 Hours**

UNIT II Electrodes

Electrodes, Limb electrodes, floating electrodes, pregelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier, ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms, Electrical safety in medical environment, shock hazards, leakage current-Instruments for checking safety parameters of biomedical equipments. **20 Hours**

UNIT III Radiographic and fluoroscopic techniques

Radiographic and fluoroscopic techniques, Computer tomography, MRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems, Retinal Imaging, Imaging application in Biometric systems, Analysis of digital images. **10 Hours**

UNIT IV Advanced instruments

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart – Lung machine, Audio meters, Dialysers, Lithotripsy. **10 Hours**

Suggested Reading

Singh, M. (2010) Introduction to Biomedical Instrumentation. Prentice Hall

B.Sc. II Semester 4

Paper 36 SCPB 4.36: Growth and reproduction Practical

1. Measurement of animal and plant cell size using ocular and stage micrometer.
2. Temporary mount preparations of Drosophila eggs and chick early embryos.
3. Study of whole mounts of frog and chick- early developmental stages
4. Study of chick development from the live eggs (window viewing)
5 Study of section of chick embryo- through selective developmental stages
6 Videos showing selective embryonic evens-n cleavage, gastrulation.
7. Micro and mega sporogenesis in higher plants-slides only
8. Pollen germination in vivo and in vitro
9. Study of gamete/sporesin algae, moss, liverwort, pteridophyte and gymnosperm
10. Embryo development in flowering plant-slides only; dissection of endospermembryo
11. Study of apical and lateral meristem, hypertrophy and hyperplasia
12. Study of asexual and sexual modes of reproduction in various plant groups
13. Survey of dispersal mechanisms of seeds
14. Study of growth curve of any microbial culture

B.Sc. II Semester 4

Paper 37 SCPB 4.37: System physiology & behaviour Practical

1. Recording of simple muscle twitch with electrical stimulation
2. Enumeration of RBC using hemocytometer
3. Estimation of total and differential count of WBC using hemocytometer
4. Study of the effect of various environmental factors on transpiration in an excised twig/leaf
5. Calculation of the stomatal index, stomatal frequency and percentage of leaf areaopen through stomata in a mesophyte and a xerophytes
6. Study of the mechanism of stomatal opening and closing

B.Sc. II Semester 4

Paper 38 OEPB 4.38: Plant tissue culture and Animal cell culture Practical

1. Animal cell culture media preparation
2. Animal cell culture inoculation and incubation
3. Animal cell culture observation
4. Animal cell culture cryopreservation
5. Plant Tissue culture media preparation
6. Plant Tissue culture explants selection, sterilization
7. Plant Tissue culture Callus and cell suspension culture
8. Plant Tissue culture Micropropagation through various explants
9. Plant Tissue culture hardening
10. Plant tissue culture contamination control

B.Sc. II Semester 4

Paper 39 OEPB 4.39: Molecular Biology Practical

1. Isolation of plasmid DNA and its restriction digestion.

2. DNA sequencing by Sangers method

3. DNA cloning using plasmid vectors

4. RFLP analysis.

5. Isolation of RNA

6. Amplification of DNA by PCR.

7. Restriction Digestion of λ DNA.

8. Studies on Ligation Chain Reaction.

9. Transformation

10. Blue white screening

B.Sc. II Semester 4

Paper 40 OEPB 4.40: Biomedical Instrumentation Practical

1. Determination of blood pressure with the help of mercury or aneroid sphygmomanometer.
2. Determination of heart rate of a human being from the ECG records.
3. Interpretation of ECG
4. Interpretation of X-ray report
5. Interpretation of Sonography report

B.Sc. III Semester 5

Paper 41 HCTB 5.41– Immunology

UNIT I Defence in Plants and Animals **10 Hours**

Overview: Introduction; Defence in Plants & Animals*;* Cells and organs of the immunesystem Innate immunity in Plants and Animals*;* Complement system.

UNIT II Adaptive Immunity in Plants **10 Hours**

Adaptive Immunity in Plants; Abiotic- Strategies and mechanisms; Biotic- Interactions with symbionts, pathogens, Biochemical host defences, Basal resistance,Gene for gene concept, Cytological protection and induced resistance; Passive defences; Active defences

UNIT III Adaptive Immunity in Animals **15 Hours**

Adaptive Immunity in Animals; Antigens; Adaptive immunity; B-Cell Biology - Antibody structure, B-cell development, Receptor diversity, Monoclonl Antibodies, Humoral response; T-Cell Biology - T cell development, Structure of TCR, Thymic education, Antigen Processing and Presentation, Cell mediated immune response; Mucosal immune system; Techniques based on antigen- antibody interactions:

UNIT IV Immune Mechanism Dysfunction & Applications **15 Hours**

Immune Mechanism Dysfunction & Applications; Hypersensitivity; Autoimmunity; Immunodeficiency; Immune response against major classes of pathogens; Applications: In agriculture, Pharmaceuticals and biopest control.

Suggested Reading Materials:

1. Deverall, Brain J. 1977. Defences mechanisms of plants, Cambridge University Press.
2. T .J. Kindt, R. A. Goldsby, and B.A. Osborne. 2007. Kuby Immunology, W.H. Freeman and Co, New York.
3. K. Murphy, P. Travers, M. Walport. 2008. Janeway's Immunobiology, Garland Science, Taylor and Francis Group, LLC

B.Sc. III Semester 5

Paper 42 HCTB 5.42: Evolution and adaptation

UNIT I History of Evolutionary thought **10 Hours**

Pre-Darwinian concepts, Darwinism, post Darwinian concepts, Modern synthetic theory

UNIT II Evolution as seen in Geological record **05 Hours**

Evolution as seen in Geological record:Types of fossils, dating of fossils, Evolution of Man Evolution of Plants and Fungi : Origin of land plants, Bryophytes (alternation of generations), early vascular plants (stelar evolution, sporangium evolution), Angiosperms (Phylogeny of major forms of plants), Fungi

UNIT III Process of Evolutionary change **15 Hours**

Process of Evolutionary change: Concept of population, gene pool, gene frequency- conservation allele frequency (Hardy-Weinberg equilibrium), Change in gene frequencies (Genetic drift, gene flow, genetic load) Product of Evolutionary process :Speciation, concept of species, sub species, isolation mechanisms, modes of speciation (allopatric, sympatric, peripatric), anagenesis & cladogenesis, levels of evolutionary change (micro & macroevolution)

UNIT IV Adaptations and extinctions **10 Hours**

Adaptations and extinctions**:** Osmotic regulation and excretion of nitrogenous waste,protective coloration, mimicry, Extinction. Periodic and mass scale, possible causes

Suggested Reading Materials:

1. Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing
2. Stricberger, M.W. Evolution. Jones& Bartlett, USA 1996

B.Sc. III Semester 5

Paper 43 OETB 5.43: Bioinformatics

UNIT I: Introduction to Bioinformatics **15 Hours**

1) Introduction to Bioinformatics: Use of bioinformatics in major research areas. Major Bioinformatics Resources: (National Centre for Biotechnology Information (NCBI), European Bioinformatics Institute (EBI), Expert Protein Analysis System (ExPASy). The knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, purpose and utility in life sciences. 2) Open access bibliographic resources and literature databases: Basic concept of open access bibliographic resources related to Life Sciences,the significance and need for such resources, the major content of the databases, how to search and use these resources/databases with special reference to PubMed, PubMed Central, Public Library of Sciences etc.

UNIT II: Taxonomy and phylogeny **10 Hours**

1) Taxonomy and phylogeny: Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Transformed Distance, Neighbors- Relation, Neighbor-Joining; Probabilistic models and associated algorithms such as Probabilistic models of evolution and Maximum likelihood algorithm.
2) Cheminformatics, Pharmacogenomics – Application of Bioinformatics in drug discovery,

UNIT III: Sequence and Structure Databases **15 Hours**

1) Sequence and Structure Databases: Knowledge of the following databases with respect to: organization of data, contents and formats of database entries, retrieval of data using text-based search tools, sources of data (e.g. sequencing projects, individual scientists, patent offices etc.), method for deposition of data to databases. 2) Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL.Genome Databases at NCBI, EBI, TIGR, SANGER Viral GenomesArcheal and Bacterial Genomes

Unit IV Molecular docking **10 Hours**

Potential energy calculations using semiempirical potential energy function, Electrostatic energy surface generation, Three-dimensional structure using dynamic programming methods, Molecular mechanics and dynamics, Docking of Molecules, Molecular Design, structure similarity searching; structure prediction in proteins.

Suggested Reading Materials:

1) An introduction to Computational Biochemistry. C. S. Tsai, John Wiley and Sons, Inc., publications, 2002.
2) Bioinformatics; Methods and applications, Rastogi, S. C. and N. Mendiratta and P. Rastogi, PHI Learning, 4th Edition, 2013.
3) Developing Bioinformatics Computer Skills. C. Gibas, P. Jambeck. O'Reilly publisher, 1st Edition,

B.Sc. III Semester 5

Paper 44 OETB 5.44: APPLIED BIOLOGY

UNIT I Climate and Adaptations of Agricultural Crops **10 Hours**

Climate and Adaptations of Agricultural Crops: Beneficial Soil Organisms: VAM Fungi and Mycorrhizae, Weed Ecology and Management, Crop Practices (Crop Rotation, Cover Crops, Intercropping, Conservation Tillage, Mulches, Organic Amendments, Irrigation and Salinity): Sustainable Agricultural Practices, Crop Biodiversity.

UNIT II Biofuels, Biofertilizers and Biocides **15 Hours**

Biofuels, Biofertilizers, Biocides, Tissue Culture Techniques and Biotechnology- Applications, Practices of Conservation of Plant Genetic Resources, Intellectual Property Rights, Restoration Ecology, Important Indigenous Medicinal Plants (Eg. Brahmi, Ashwagandha), Multipurpose Trees, Non Timber Forest Produce Management, Industrial Botany.

UNIT III Economic importance of insects **15 Hours**

Economic importance of insects .Insects as agents of human diseases (Mosquito, Flea and Lice). Stored grain insects and their control. Various strategies for Integrated Pest Management: Mechanical, Physical, Cultural, Biological, Chemical, Physiological, Regulatory etc.

UNIT IV

Reproductive Health and Human Welfare **10 Hours**

Infertility in male and female: causes, diagnosis and management, assisted reproductive technology: sex selection, sperm banks, frozen embryos, in vitrofertilization, Modern contraceptive technologies; Demographic terminology used in family planning

Suggestive Reading Materials:

1.Chaudhary, S.K. Practice of fertility control. B.I. Churchill Livingston Pvt. Ltd.
2. Atwal, A.S. Agricultural pests of India and South East Asia. Kalyani Pub. N Delhi1993

B.Sc. III Semester 5

Paper 45 OETB 5.45: Nursery, gardening & horticulture

UNIT I **Nursery & Gardening** **10 Hours**

Introduction, Objectives and scope. Types of gardening–landscape, home gardening and parks, Computer applications in land scaping.

UNIT II The Seed **10 Hours**

Introduction, Structure and types, Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion. Seed production technology. Seed testing and certification.

UNIT III: Vegetative Propagation **10 Hours**

Introduction, Types of layering, cutting, budding and grafting.

UNIT IV: Horticultural Techniques **10 Hours**

Introduction., Application of manure, fertilizers, pesticides, nutrients and PGRs, Weed control

UNIT V: Floriculture **10 Hours**

Introduction, Cut flowers. Bonsai, commerce (market demand and supply), Importance of flower shows and exhibitions.

Suggested Reading-

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M. S. and Kochhar, S. L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A. A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

B.Sc. III Semester 5

Paper 46 SCPB 5.46– Immunology Practical

1. Characterization of diseases symptoms and identification of pathogenic organisms (at least one each from viral, fungal, pest and nematodes injection).

2. Survey of structural plants defenses: viz. cuticle, wax, lignin, bark, thorns, prickles, trichomes, armor in different plants species including thigmotactic, camouflage, mimicry.

3. Survey: Quantitative and qualitative secondary metabolites in plants: alkaloids, glycosides, glycosylates, terpinoids, phenolics, gummosis etc. in healthy and diseased plant/plant organs.

4. Partial purification of Immunoglobulin's by Ion Exchange chromatography

5. Immunodiffusion – DID and SRID.

6. Immunoelectrophoretic (IEP)

7. Countercurrent IEP, Rocket IEP

8. Spleen cell isolation and counting

B.Sc. III Semester 5

Paper 47 SCPB-5.47: Evolution & Adaptation Practical

1. Observation of various evidences of human evolution by using photographs

2. Observation of animal and plant fossils

3. Observation of animal evolution by using specimens

4. Collection of plants species and observation under microscope for evolution study

5. Observation of fungi under microscope

B.Sc. III Semester 5

Paper 48 OEPB-5.48: Bioinformatics Practical

Computational Biology Lab Exercises

1. Visualization Softwares – Rasmol, JMOL – To view 3D structures of biomolecules in various visualization packages available online.

2. Molecule Builder – 2D and 3D using softwares like ISIS Draw and Hyper Chem

3. Databases - Protein databank (PDB): File format, Structure, Sequence of proteins, Retrieval of protein structure & sequences Nucleic acid database (NDB): Structure, GenBank: Whole Genome sequences of bacterial (*E.coli*, Mycobacterial) , viral, plant genomes (Rice, Cotton) , their retrieval from databases

4. Sequence Alignment - Pairwise and Multiple sequence alignment using BLASTn, BLASTp, CLUSTALW

5. Gene Finding Tools - Gene Prediction Softwares like GenScan, GLIMMER

6. Introduction to Proteomics – Primary sequences analyses (Protparam) Secondary Structure Prediction Softwares like GOR, nnPredict, Tertiary structure Prediction Softwares like SWISSMODEL, Transmembrane Protein Prediction (TMPred)

7. Phylogenetic Analyses

8. Molecular docking

9. MD simulation

B.Sc. III Semester 5

Paper 49 OEPB-5.49: Applied biology Practical

1. Specimens of cereals (rice, wheat, maize), legumes (arhar, soybean, alpha alpha, mung, urad, chana, melilotus), fruits and vegetables (mango, apple, banana, guava, bringal, potato, sweet potato, tomato), spices and condiments (clove, ginger, pepper, turmeric, cardamom), beverages (tea, coffee), oils and essential oils (mustard, groundnut, sesame, sunflower, carnola, lemongrass, jasmine, rose, vetiver, sandalwood), drugs (cinchona, poppy, *Rauwolfia*, *Ocimum*, *Atropa*, *Digitalis*, *Cannabis*, tobacco), timber (teak, shisham, pine, cedrus, oak, sandalwood), fibers (cotton, jute, flax, coir, hemp).

2. Microchemical tests for starch, sugar, glucose, oils, proteins using sections/preparations of materials- wheat, maize, soybean, chana, sweet potato, clovepepper, groundnut, mustard.

3. Identification of the following pests: Mosquito, Flea, Louse, Heliothis, Locust, Termite, Leptocorisa, Trogoderma, Sitophilus, Callosobruchus. Determination of LD_{50} or LC_{50} of insecticides

4. Study of modern contraceptive devices, Project on topics associated with human reproduction. Visit to centres of proficiency in reproductive physiology and ART.

B.Sc. III Semester V

Paper 50 OEPB-5.50: Nursery, gardening & horticulture

1. Different types of pots and potting medium & Potting and Repotting.
2. Propagation practices by seed, vegetative propagation, cutting, budding, layering and grafting.
3. Method of preparing Bonsai, Bottle Garden/Terrarium, Hanging Baskets, Dish Garden.
4. Preparation of garden layout.
5. List of plants suitable for garden locations- 2 to 3 plants for each location.
6. Identification of important horticultural plants- herbs (Foliage and flowering); shrubs (Foliage and flowering); trees (Foliage and flowering); climbers; Lianas; Epiphytes; Creepers; Trailers; Aquatic plants; Succulents;(from all types- any two plants).
7. Flower Arrangements- Indian (Gajara, Veni, Garland, Bouquet, Pot, Hanging).
8. Green house plants- Information regarding soil, temperature, irrigation and fertilizer, requirements propagation methods for- Anthurium, Gerbera, Orchids, Tuberose, Carnation, Roses and Capsicum.

B.Sc. III Semester 5

Paper 51 HCTB-6.51: Differentiation and morphogenesis

UNIT I Morphogens **15 Hours**

Morphogens; epithelial and mesenchymal cells; mophogenetic gradients,; cell specifications; determination and differentiation; pattern formation with reference to animal/plant tissue and organ formation ; cell wall, plasmodesmata and chloroplast- as unique component of plant cells in relation to development

UNIT II Cell adhesion **10 Hours**

Cell adhesion (role of cadherins); cell affinity; cell interactions; cell matrix; signal transduction-RTK signal transduction pathway; juxtacrine signaling-Notch path way; c-AMP pathway; embryonic induction.; body coordinates in drosophila

UNIT III Role of plant growth substances **15 Hours**

Role of plant growth substances (auxin, gibberellins, cytokinins, ethylene, abscisic acid, jasmonates, brassicosteroids), light and temperature in plant development; floral development and homeotic genes in lower and in higher plants, apical dominance, abscission;

UNIT IV Stem cells **10 Hours**

Stem cells; therapeutic cloning; teratogenesis; cancer-types, oncogenes and treatment; genetic transformations using pollen grain/embryological systems; Nodule and Gall formation in plant systems.

Suggested Reading Materials:

1. Davis, P,J: Plant hormoneses, Biosynthesis, signal transduction, action. 3rd ed. Kluwer Academic Pub., 2004
2. Gilbert, S: Developmental Biology . 9th ed. ,Sinauer Associates Inc.2010

B.Sc. III Semester 6

Paper 52 HCTB-6.52: Microbiology: Principles & Applications

UNIT I Early history of Microbiology and Microbial Diversity **15 Hours**

Discovery of microorganisms, contributions of scientists, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, Helminthes) Binomial nomenclature

UNIT 2 Microbial Nutrition, Growth and Control **15 Hours**

Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents.

UNIT 3 Harmful and beneficial microbes **10 Hours**

Normal microflora of human body, host-pathogen interaction, bacterial, viral, protozoan and fungal diseases (with reference to symptoms, pathogenesis, transmission, prophylaxis and control) of plants and animals

UNIT 4 Antimicrobial agents **10 Hours**

Antimicrobial agents, drug resistance, interferons, Microorganisms and fermentation; Bioremediation; Bio-indicators**.**

Suggested Reading Materials

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J.(2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.
2. Tortora, G.J., Funke, B.R. and Case, C.L.(2008) Microbiology: An Introduction. 9th edition. Pearson Education.
3. Primrose and Twymann, Principles of Gene Manipulation and Genomics. 7th edition(2008), Blackwell Publishing.

B.Sc. III Semester 6

Paper 53 OETB-6.53: Clinical microbiology

Unit I Clinical Bacteriology (13)
Morphological, cultural and biochemical characters, antigenic structures,modes of transmission, pathogenesis, symptoms, Practicaldiagnosis,prophylaxis and treatment of following diseases - *1. Pseudomonas aeruginosa 2.Mycobacterium leprae 3.Helicobacter pyelori4.Treponemapallidum 5. Clostridium perfringens 6. Mycobacterium tuberculosis7.Vibrio cholera 8. Leptospirosis 9. Rickettsiarickettsiae (Epidemic Typhus Fever)*

Unit II Clinical Mycology
Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, Practicaldiagnosis, prophylaxis and treatment of following diseases 1. Candidiasis2. Aspergillosis

Unit III Clinical Parasitology
Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, Practicaldiagnosis, prophylaxis and treatment of following diseases-
1. Malaria2. Giardiasis3. Amoebiasis

Unit IV Clinical Virology
Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, Practicaldiagnosis, prophylaxis and treatment of following diseases)
1.Herpes (Simplex) 2. Rabies 3. Hepatitis A and B 4.AIDS 5.Swine flu

Suggested reading material

1. Pharmaceutical Microbiology – Huggo
2. Text book of Medical Microbiology – Ananthnarayan
3. Review of Medical Microbiology – Jawetz et al
4. Microbiology – Zinsser
5. Medical Microbiology – Cruickshank
6. Medical Microbiology - Davis and Dulbecco
7. Parasitology – Chattergii
8. Medical Practicaltechnology – RamnaikSood
9. Diagnostic Microbiology – Bailey's and Scotts
10. Medical Bacteriology – Dey and Dey

B.Sc. III Semester 6

Paper 54 OETB-6.54: Bio-resources & Management

Unit I Aquaculture **15 Hours**

Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control; Biofloc fish farming,

UNIT II Economic Zoology

Economic Zoology Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry, Vermiculture Introduction and scope, Species of earthworm, Characteristics features ofearthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer

UNIT III Cultivated Plants

Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).

UNIT IV Definition

Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.

Suggested Reading Materials

1. Manju Yadav, Economic Zoology- Discovery publishing house, New Delhi
2. Lee R E,. Phycology

B.Sc. III Semester 6

Paper 55 OETB-6.55: Molecular Biology II

UNIT I Recombinant DNA and other DNA based techniques and their applications: **15 Hours**

1) Agarose Gel Electrophoresis
2) Blotting techniques (Southern, Northern, Western and Eastern blotting)
3) PCR and RT- PCR
4) DNA sequencing
5) DNA finger printing
6) Fluorescence in situ hybridization (FISH)
6) Gene Microarray
7) RFLP
8) RAPD

UNIT II Construction of genomic and cDNA libraries **10 Hours**

Construction of genomic and cDNA libraries: concept of library construction, differences and ideal examples of each library Selection.

Unit III Human genome project **15 Hours**

Human genome project, Next generation sequencing, CRISPR Cas 9 system, Eukaryotic molecular biology, Plant and Animal Gene cloning, Animal cloning

UNIT IV Applications of Genetic engineering **10 Hours**

Applications of Genetic engineering in Agriculture, Industries, Human health and Environmental pollution control. Gene therapy

B.Sc. III Semester 6

Paper 56 SCPB-6.56: Differentiation & Morphogenesis Practical

1. Life cycles of the model organisms –Dictyostelium, Coenorhabditis, Sea urchin, Drosophila, Zebra fish, Xenopus, Arabidopsis and Maize, Chromosome squash from salivary gland of Drosophila.

2. Lab rearing of Drosophila cultures. Study of the eggs-through cleavage under microscope.

3. Study of tissues-parenchyma, collenchyma, sclerenchyma, xylem, phloem, epidermis, leaf primordia, lenticel, stomata, plasmodesmata etc.- through hand sections/maceration/permanent slides.

4. Study of floral apex

5. Polarity in plant development - from photographs

6. Auxin mediated initiation of roots in plant twigs (demonstration)

7. Bolting by gibberellin (demonstration)

8. Microchemical tests for cellulose, lignin, pectin, hemicellulose, suberin in cell walls of different plant materials.

9. Study of different kinds of plastids from different plant sources- under light microscope/ and EM photographs

B.Sc. III Semester 6

Paper 57 SCPB-6.57: Microbiology: Principles & Applications Practical

1. Isolation of bacteria and fungi from soil.
2. Isolation of bacteria and fungi from air
3. Isolation of bacteria from waste water
4. Gram staining of bacteria
5. Cotton blue staining of fungi

B.Sc. III Semester 6

Paper 58 OEPB-6.58: Clinical microbiology Practical

1. Isolation of pathogen from clinical sample *Pseudomonas aeruginosa/E.coli*

2.Study of determination of effectiveness of antiseptic agents (– tincture iodine, 3% H2O2, 70% alcohol, 5% chlorine bleach) against selected organisms (*Escherichia coli, Staphylococcus aureus, Bacillus*) by disc diffusion method

3.Antimicrobial susceptibility testingby disc diffusion method

4.Study of synergistic action of antibiotics

5Determination of minimum inhibitory concentration (MIC).of penicillin on *S.aureus.*

6.Urine analysis: microscopic examination – pus cells, RBc, bacteria, crystals. Chemical examination – glucose (benedict's method, protein (acetic acid), bile salt (sulphur method), Bile pigment (Fauchet's method) ketone bodies (Rothera's test)

B.Sc. III Semester 6

Paper 59 OEPB-6.59: Bio-resources & Management Practical

1. Identification of economically important fishes of India
2. Identification of different silk moths in India
3. Setting of an aquarium
4. Breeding of aquarium fish: black molly/gambusia/sword tail or Induced breeding of fish.
5. Population enumeration of fish by Peterson's mark and recapture method (simulation exercise).
6. Field report on Apiary
7. To study the impact of salinity on seed germination.
8. Measure the primary productivity (Biomass by Fresh Weight/ Dry Weight method).
9. To determine the chlorophyll content of various species of an ecosystem.
10. To isolate bioactive components from plants of significance by various techniques (TLC/ Column chromatography/ Paper chromatography)
11. Shelf-life management of flowers of importance.
12. Isolation and culture of VAM fungi and study the features through temporary preparations.
13. Study the root nodule and preparation of bacterial slides (gram stained).
14. Study of petro-crops/ biofuel plants (specimens).
15. Study of Industrially important plants (specimens/products) morphology, botany and uses.

B.Sc. III Semester 6

Paper 60 OEPB-6.60: Molecular Biology II Practical

1. Restriction endonuclease finder software
2. Plasmid selection
3. Gene sequence download
4. PCR primer design
5. Gene amplification by PCR
6. Gene amplification by RT- PCR
7. Southern blotting
8. Northern blotting
9. Western Blotting
10. DNA fingerprinting
11. RFLP
12. RAPD

B.Sc. IV Semester 7

Paper 61 HCTB-7.61: Endocrinology

UNIT I Introduction to Endocrinology **10 Hours**

History of endocrinology, Brief introduction of endocrine glands, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

UNIT II Epiphysis **10 Hours**

Location and structure of pineal gland, Secretions and their functions in biological rhythms and reproduction.

UNIT III Hypothalamo-hypophysial Axis **10 Hours**

Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanism.

UNIT IV **10 Hours**

Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Control and Disorders of pituitary gland.

UNIT V Regulation of Hormone Action **10 Hours**

Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action, Structure, Hormones, Functions and Regulation and Disorders of Testis, Ovary and Placenta. Treatments for hormone disorders.

Suggested readings Material

1) General Endocrinology C. Donnell Turner Pub- Saunders Toppan
2) Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
3) Oxford: BIOS Scientific Publishers; 2001.
4) Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.

B.Sc. IV Semester 7

Paper 62 HCTB-7.62: Wildlife Conservation & Management

UNIT I Introduction to Wild Life **10 Hours**

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies**.**

UNIT II Evaluation and Management of Wild life **10 Hours**

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS. Management of Habitats Setting back succession; Grazing logging; Mechanical treatment; Advancing the succession process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats.

UNIT III Population Estimation **10 Hours**

Methods of population estimation: Sex ratio computation; Fecal analysis of ungulates and carnivores: Hair identification, Pug marks and census method. Application of biostatistics in Biodiversity estimation: Analysis of Shannon and Simpson‘s Diversity Indices.

UNIT IV Management Planning of Wild life in Protected Areas **10 Hours**

Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence. Management of Excess Population -Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

UNIT V Protected areas **10 Hours**

National parks & sanctuaries in India, Community reserve; important features of protected areas in India; Tiger conservation- Tiger reserves in India & its management challenges; Great Indian Bustard (GIB) Reserve & its management. Wildlife Protection Acts: National: Wildlife Protection Act-1972; International: CITES, 1973

Suggested readings

1) Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

2) Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.

3) Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.

4) Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences

5) Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Practical. Blackwell Publishing.

B.Sc. IV Semester 7

Paper 63 OETB-7.63: Plant Breeding

UNIT I Plant Breeding **05 Hours**

Introduction, Aim and objectives, Scope of plant breeding.

UNIT II Methods of Crop Improvement **15 Hours**

Plant genetic resources, Introduction and acclimatization. Selection methods: Pure line, Mass and Clonal selection.

UNIT III **15 Hours**

Hybridization: Procedure**,** Hybridization in self-pollinated crop plants. Hybridization in cross pollinated crop plants.

UNIT IV Mutation and Plant Breeding **15 Hours**

Role of mutation, Role of polyploidy, Role of biotechnology in crop improvement.

Suggested Readings

1. Singh, B. D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.
4. Kader, A. A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, U. S. A. 5.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

B.Sc. IV Semester 7

Paper 64 OETB-7.64:Plant Pathology

UNIT I Introduction **10 Hours**

Terms, Nature, and concept of plant diseases, Cause of disease, Classification of Plant Diseases Based on- Symptoms, Spread and Severity of Infection, Importance of plant diseases.

UNIT II Rots, Damping offs, Downy mildews, Powdery Mildews, White rusts and Smuts 10 Hours

Study of following plant diseases with respect to causal organisms, symptoms, and control measures- Fruit rot of Cucurbits Late blight of Potato, Downy mildew of Grapes, Powdery mildew of Mango White rust of Crucifers, Smut of Jowar

UNIT III Rusts, Wilts, Leaf spots & blights and Anthracnoses **10 Hours**

Study of following plant diseases with respect to causal organisms, symptoms, and control measures- Brown rust of Wheat 2. Wilt of Pigeon pea (*Cajanus cajan*), Brown spot of Maize, Tikka disease of Groundnuts, Red-rot of Sugarcane

UNIT IV Mycoplasmas, Bacteria and Viruses **10 Hours**

Study of following plant diseases with respect to causal organisms, symptoms, and control measures- Little leaf of Brinjal, Oily spot of Pomegranate (Telya diseases) Citrus canker, Tobacco & Tomato mosaic

UNIT 5 Aerobiology and Seed Pathology **10 Hours**

Aerobiology- Definition, scope and importance and disease forecasting, Seed pathology- Definition, seed borne pathogens (external and internal) seed treatment (hot water, solar, chemical) and seed certification.

Suggested readings material

1. Introductory Mycology John Wiley and Sons Inc. by Alexopoulos C.J., Mims
C.W. and Blackwel. M. (1996).
2. Introduction to Bacteria McGraw Hill book Co. New York by Clifton. A.(1958)
3. Introductory Phycology Affiliated East – West Press Ltd. New Delhi by Kumar H. D. (1988).
4. Introduction to Plant Viruses Chand and Co. Ltd. Delhi by Mandahar C. L. (1978).
5. Diseases of crop plants in India Prentice Hall of India Pvt. Ltd. New Delhi by Rangaswamy G. and Mahadevan A.

B.Sc. IV Semester 7

Paper 65 OETB-7.65: Environmental Microbiology

UNIT I Air microbiology **15 Hours**

Microorganisms in air – Launching, transport and deposition of aerosols, survival of microorganisms in air Significance of microorganisms in air (extramural and intramural), Methods to study air borne microorganisms. Sampling, qualitative and quantitative methods. Bioaerosal control (ventilation, filtration, biocidal control, UV, gaseous (quarantine)

UNIT II Fresh water ecosystem **10 Hours**

Fresh water ecosystem: Eutrophication, Types of fresh water bodies a) Classification of lakes b) Sources c) Consequences d) Control

UNIT III Industrial waste treatment **15 Hours**

Types of wastes, Waste water assessment and management, BOD, COD, Characteristics and treatment of wastes from different industries, – paper and pulp, sugar and distillery, textile, and dairy industries, Bioremediation: Lead, mercury, arsenic and radioactive substances

UNIT IV Geomicrobiology **10 Hours**

Introduction, Microorganisms involved, Biochemistry of microbial leaching Commercial leaching – slope, heap, in situ leaching, Leaching of Iron, Copper and Uranium Oilrecovery: Methods – primary, secondary, and microbially enhanced oil recovery.

Suggested reading material

1. Physiology and Biochemistry of Extremophiles- Charles Gerday and Nicolas Glansdorff
2. Environmental Microbiology – Maier
3. Microbial ecology – Fundamentals and applications - Atlas and Bartha
4. Microbial dynamics and diversity – Desy Staley
5. Biology of Microorganisms – Brock, Parker, Madigen, 9th edition
6. Microbiology – Prescott and Harley, 5th edition

B.Sc. IV Semester 7

Paper 66 SCPB-7.66: Endocrinology Practical

1. Identify, sketch and discuss location structure and function of endocrine glands of rat from model/chart (any two) Identify, sketch and discuss: insect life cycle & its hormonal control/ amphibian metamorphosis & its hormonal control

2. Spottings based on:

   a) Identify and describe: Temperature variation during menstrual cycle/Circadian cycle & its hormonal correlation

   b) Identify and describe: Flight & Fight response/contraceptive pill

   c) Identify and describe: hormonal regulation of reproduction

B.Sc. IV Semester 7

Paper 67 SCPB-7.67: Wildlife Conservation & Management Practical

1. Calculate Shannon Diversity Indices from given data

2. Perform line transect/quadrat method to study diversity

3. Perform temporary mount & identification of zooplanktons/insects/mollusca from given sample

4. Perform temporary mount of cycloid/placoid scales from preserved specimens

5. Spotting based on:

a) Identify and describe: GPS/Binocular/Plankton collection Net/camera

b) Identify and describe: Pug mark/bio-geographical distribution of endangered species from India

c) Identify and describe: IUCN categorization of given fauna / air breathing organs in fish

d) Identify and describe morphology & economic importance of fish /types of castes of honey-bee/poultry & dairy breeds (chart/photo)

B.Sc. IV Semester 7

Paper 68 OEPB-7.68: Plant Breeding Practical

1. To study floral biology in self-pollinated crop plants.
2. To study floral biology in cross pollinated crop plants.
3. To study pollen viability.
4. Calibration of ocular micrometer and estimate the size of pollen grain.
5. To study hybridization techniques in Malvaceae.
6. To study hybridization techniques in Fabaceae.
7. To study hybridization techniques in Brassicaceae.
8. To study hybridization techniques in Poaceae.
9. Study of male sterility in sorghum in field or in Practicalby staining the pollen grain.

B.Sc. IV Semester 7

Paper 69 OEPB-7.69: Plant Pathology Practical

1. Study of air-borne pathogen by exposed petri plates/air sampler.
2. Isolation of plant pathogens (Serial Dilution Agar Plate Method).
3. Estimation of chlorophylls (Any healthy & diseased/infected plant material).
4. Study of symptoms and causal organisms of-
5. Rots- Fruit rot of Cucurbits
6. Damping offs- Late blight of Potato
7. Downy mildews- Downy mildew of Grapes.
8. Study of symptoms and causal organisms of- White rusts- White rust of Crucifers, Powdery Mildews- Powdery mildew of Mango Smuts- Smut of Jowar
9. Study of symptoms and causal organisms of- rusts- Brown rust of Wheat Wilts- Wilt of Pigeon pea (*Cajanus cajan*) Leaf spots- Brown spot of Maize
10. Study of symptoms and causal organisms of- Leaf blights- Tikka disease of Groundnuts
11. Study of symptoms and causal organisms of- Bacteria- Citrus canker, Oily spot of Pomegranate (Telya diseases) Viruses- Tobacco & Tomato mosaic

B.Sc. IV Semester 7

Paper 70 OEPB-7.70: Environmental Microbiology Practical

1. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD of different effluents.
3. Determination of indices of pollution by measuring COD of different effluents.
4. Bacterial reduction of nitrate from ground waters
5. Microbial testing of drinking water MPN and Presumptive, Confirmed and Completed test
6. Utilization of microbial consortium for the treatment of sewage solid waste
7. Microbial dye decolourization/adsorption.

B.Sc. IV Semester 8

Paper 71 HCTB-8.71: Virology

Unit I Introduction and Classification of Viruses **10 Hours**

General properties and structure of virus, Viroids and Prions, Viral classification on the basis of LHT system and as per international committee

Unit II Viral Multiplication **15 Hours**

Bacteriophages: Lytic and lysogenic interactions, Animal viruses:. Mechanism of virus adsorption and entry into the host cell, genome replication, Transcription, post transcriptional changes, translation, assembly, exit and maturation of progeny virions

Unit III Animal Viruses **15 Hours**

Structure, Mode of transmission, Prophylaxis, Treatment, Epidemiology of Animal viruses Zika virus, Ebola virus, Nipah virus, Influenza viruses, Corona virus SARS CoV-2 (COVID-19)

Unit IV Techniques in Virology **10 Hours**

Isolation, cultivation, Purification and Enumeration of viruses, Viral vaccines manufacturing, Vaccination schedule

Suggested Reading material

1. General microbiology – Stanier
2. General microbiology – Pawar and DaginawalaVol I and II
3. Genetics of bacteria and their viruses – William Hays
4. Virology – Biswas
5. Virology – Luria
6. Microbiology - Prescott, Harley and Klein’s, Willey Sherwood Woolverton,McGraw – Hill International Edition, (2008).
7. Plant viruses- by Mathews

B.Sc. IV Semester 8

Paper 72 HCTB-8.72: Cancer Biology

Unit I General principles of Cancer Biology **10 Hours**

Introduction, Types of Cancer, the cell cycle, Apoptosis, causes of cancer, Different types of cancer based on organs.

Unit II Tumor Initiation, Promotion and Progression **10 Hours**

Mechanisms of tumor initiation, Endogenous carcinogenesis, Mechanisms of tumor Progression, Central dogma of tumor progression

Unit III Oncogenes **15 Hours**

Growth Factors and Growth Factor Receptors, G Proteins, Serine/Threonine Kinases, Nonreceptor Tyrosine Kinases, Transcription Factors as Oncogenes, Cytoplasmic Proteins, Tumor Suppressor Genes

Unit IV Transforming Growth Factor **15 Hours**

Heritable Cancer Syndromes, Diagnosis and therapy of cancer

Suggested reading material

1. Molecular Biology of Cancer**,** Jesse d. Martinez**,** Michele Taylor Parker
Kimberly E. Fultz, Natalia a. Ignatenko, Eugene w. Gerner, John Wiley & Sons, Inc.
2. Molecular Biology of Human Cancers, Wolfgang Arthur Schulz, Springer Science
3. Cancer biology, Raymond W. Ruddon, Oxford University Press

B.Sc. IV Semester 8

Paper 73 OETB-8.73: Bio-nanotechnology

Unit I Nanomaterial in biotechnology **10 Hours**

Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Development of nanobiotechnology - timelines and progress, overview

Unit II Biosensors **15 Hours**

Biosensors; different classes -molecular recognition elements, transducing elements, Applications of molecular recognition elements in nanosensing of different analytesApplication of various transducing elements as part of nanobiosensors

Unit III Miniaturized devices in nanobiotechnology **10 Hours**

Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept. Biological nanoparticles production - plants and microbial.

Unit IV Nanobiotechnological applications **15 Hours**

Nanobiotechnological applications in health and disease - infectious and chronic, Nanotechnology and Nanomedicine: New Medical Approaches, Nanomedicine¸ Regenerative Medicine, Nanorobots" and Nanodevices, Biocompatibility and Orthopaedic Implants, Nanotechnology in Cardiology, Nanotechnology Against Cancer, Theragnostic, Prospects of Nanotechnology in Medicine and virtual Environments

Suggested reading material

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christof M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications
4. Nanomedicine and Nanobiotechnology, Stergios Logothetidis, Springer

B.Sc. IV Semester 8

Paper 74 OETB-8.74: Food and Industrial Microbiology

Unit I Food Microbiology **15 Hours**

Food as a substrate for microorganisms, Food Spoilage (Meat and Poultry, Fruits and Vegetables) & food borne diseases-food infection (Salmonella) & food poisoning (Clostridium), Principle and methods of food preservation, Food Fermentations – i) Idli ii) Bread

Unit II Dairy Microbiology and food spoilage **10 Hours**

Spoilage of milk, Pasteurization of Milk, Fermented dairy products: i) Cheese ii) Yogurt, Spoilage of different foods.

Unit III Fermenters and Industrial products **15 Hours**

Fermenters and Types of Fermenters, Design of fermenters, Animal cell culture fermenter Streptomycin, Lysine, rDNA products – Insulin, Vitamin B12

Unit IV Production of alcoholic beverages **10 Hours**

Grape wine – Definition, types, production of White table wine and Red table wine, Beer – Definition, types, production of Lager beer and Ales Beer.

Suggested reading material

1. Principles of fermentation technology – Whitkar and Stanbury
2. Pharmaceutical Microbiology – Huggo
3. Biochemistry – Fox and Nelson
4. Industrial Microbiology – Prescott and Dunn
5. Microbial technology – Peppler
6. Advances in Biotechnology – S.W. Jogdand.
7. Textbook of Biotechnology – R.C. Dubey,
8. Biotechnology – B.D. Singh

B.Sc. IV Semester 8

Paper 75 OETB-8.75: Agricultural Microbiology

Unit I Introduction to Soil Microbiology **10 Hours**

Soil as an ecosystem, rhizosphere and phyllosphere, Soil microorganisms, types and their role in soil fertility, humus. Interactions in soil.

Unit II Role of microorganisms in elemental cycles **10 Hours**

Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorous cycle

Unit III Composting and Biodegradation **10 Hours**

Compost production with reference to organic waste, types of microorganisms, and factors affecting - aeration, C: N:P ratio, moisture content, temperature, pH, and period of composting, Green manure, Farm yard manure Town compost

Unit IV Plant pathology **10 Hours**

Common symptoms produced by plant pathogens, Modes of transmission of Plant diseases, Different types of plant disease caused by bacteria, fungi and viruses.

Unit V Applications of Biotechnology in Agriculture **10 Hours**

Biofertilizers (Azo and Rhizo and PSB) production and applications, Bioinsecticides – *Bacillus thuriengenesis* and *Trichoderma viridae*, Other examples, Genetically Modified Crops with examples

Suggested reading material

1. Soil Microbiology – Subbarao,N.S.
2. Microbial dynamics and diversity – DesyStaley
3. Biology of Microorganisms – Brock, Parker, Madigen, 9thedition
4. Agricultural Microbiology- Bagyaraj andGhosh
5. Plant Diseases- SinghR.S.
6. Soil Microbiology –Alexander.
7. Industrial Microbiology – PatelA.H.
8. Textbook of Biotechnology – R.C.Dubey,

B.Sc. IV Semester 8

Paper 76 SCPB-8.76: Virology Practical

1. Study of Egg inoculation techniques used for virus culture.
2. Diagnosis of viral diseases by ELISA technique.
3. Rapid antigen test for COVID-19 diagnosis.
4. Antibody test for COVID-19 diagnosis.
5.. Study of Virally infected lesions of Plant materials

B.Sc. IV Semester 8

Paper 77 SCPB-8.77: Cancer Biology Practical

1. Staining of human cell chromosome
2. Study of human cell cycle stages
3. Staining of cancer cells
4. Diagnosis of cancer various techniques

B.Sc. IV Semester 8

Paper 78 OEPB-8.78: Bionanotechnology Practical

1. Synthesis of silver nano particles by chemical method
2. Study antibacterial activity of nanoparticles
3. Synthesis silver nanoparticles by using microbial cells
4. Analysis of nanoparticles by SEM
5. Analysis of Nanoparticles by FTIR

B.Sc. IV Semester VIII

Paper 79 OEPB-8.79: Industrial Microbiology Practical

1. Examination of milk i) DMC ii) Quantitative analysis of milk by SPC (using nutrient agar)
2. Phosphatase Test (qualitative)
3. Isolaton and identification of microorganisms from spoiled food
4. Bioassay of Streptomycin
5. Estimation of alcohol by using K2Cr2O7
6. Diauxic growth curve of Escherichia coli (glucose and lactose). 7.Immobilization of enzyme by using Sodium alginate
8. Thin layer chromatography- amino acid
9. Study of Substrate concentration on enzyme activity. 10.Purification of enzyme and study of its activity
11.Production of citric acid by *Aspergillus niger* and estimation of Citric acid by titration method 12. Bioassay of Vitamin B12
12.Sterility testing of media and pharmaceutical products
13.Isolation of Lactic acid Bacteria (MRS Medium)
14.Amylase assay (Iodometric method)

B.Sc. IV Semester 8

Paper 80 OEPB-8.80- 58: Agricultural Microbiology Practical

1. Isolation of Azotobacter from soil. (Identification up to genus level).
2. Isolation of *Rhizobium* from root nodules.
3. Isolation of *Xanthomonas* from infected plant material
4. Biological Oxygen Demand (BOD)
5. Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test
6. SPC of market Biofertilizers.
7. Determination of potability of water by MPN.
8. Estimation of available phosphorous from soil (Stannous chloride method)
9. Estimation of Calcium and Magnesium from soil (EDTA method)
10. Determination of organic carbon contents of soil (Walkley and Black method)
11. Waste water analysis: Chemical Oxygen Demand (COD)

Research project

Students have to carry out a research project in 7^{th} and 8^{th} semester of this course. Students should submit a dissertation which is a detailed research project report at the end of the semester. A dissertation should contain Introduction, Literature review, Materials and methods, Results and discussions and references and publications. Students should submit a dissertation as hard copy as well soft copy to the department. Students should also write a research article based on research project and publish in scientific journal.