I.K. Gujral Punjab Technical University

Scheme and Syllabus of B.Sc. Biotechnology Batch 2018 onwards

Semester: First

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 101-18	Inorganic Chemistry	Core	3	1	-	40	60	100	4
BSBT 102-18	Introduction to Biotechnology	Core	3	1	-	40	60	100	4
BSBT 103-18	Biochemistry and Metabolism	Core	3	1	-	40	60	100	4
BSBT 104-18	Inorganic Chemistry Lab	Core Practical	0	0	4	60	40	100	2
BSBT 105-18	Introduction to Biotechnology Lab	Core Practical	0	0	4	60	40	100	2
BSBT 106-18	Biochemistry and Metabolism Lab	Core Practical	0	0	4	60	40	100	2
BSBT 107-18	Basics of Biosciences *	Foundation Course *	2	0	0	20	30	50	Non Credited
BSBT 108-18	Basics of Biosciences Lab *	Foundation Course *	0	0	2	20	30	50	Non Credited
BTHU 103-18	English	Ability Enhancement Compulsory Course (AECC)	1	0	0	40	60	100	1
BTHU 104-18	English Lab	Ability Enhancement Compulsory Course (AECC-) Lab	0	0	2	30	20	50	1
HVPE 101-18	Human Values, Deaddiction and Traffic Rules	Ability Enhancement Compulsory Course (AECC)	3	0	0	40	60	100	3
HVPE 102-18	Human Values, Deaddiction and Traffic Rules (Lab-seminar)	Ability Enhancement Compulsory Course (AECC) Lab	0	0	1	25	-	25	1
	Mentoring & Professional Development		0	0	1	25	-	25	1
TOTAL			**13**	**3**	**16**	**460**	**440**	**900**	**25**

***** BSBT 107-18 and BSBT 108-18: For students having passed 10+2 with Mathematics to take compulsory deficiency course and to be awarded Satisfactory and Non- Satisfactory during their final results by PTU. This course is a deficiency course for a specific section of students so no credits has been allotted.

Semester: Second

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 201-18	Physical Chemistry	Core	3	1	-	40	60	100	4
BSBT 202-18	Introduction to Microbiology	Core	3	1	-	40	60	100	4
BSBT 203-18	Biostatistics	Core	3	1	-	40	60	100	4
BSBT 204-18	Physical Chemistry Lab	Core Practical	0	0	4	60	40	100	2
BSBT 205-18	Introduction to Microbiology Lab	Core Practical	0	0	4	60	40	100	2
BSBT 206-18	Biostatistics Lab	Core Practical	0	0	4	60	40	100	2
EVS102 -18	Environment Science	Ability Enhancement Compulsory Course (AECC)	2	0	0	40	60	100	2
Mentoring & Professional Development			0	0	1	25	-	25	1
TOTAL			**11**	**3**	**13**	**365**	**360**	**725**	**21**

Semester: Third

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 301-18	Organic Chemistry	Core	3	1	-	40	60	100	4
BSBT 302-18	Immunology	Core	3	1	-	40	60	100	4
BSBT 303-18	Molecular Biology	Core	3	1	-	40	60	100	4
BSBT 304-18	Organic Chemistry Lab	Core Practical	0	0	4	60	40	100	2
BSBT 305-18	Immunology Lab	Core Practical	0	0	4	60	40	100	2
BSBT 306-18	Molecular Biology Lab	Core Practical	0	0	4	60	40	100	2
BSBT 307-18	Introduction to Computers	Skill Enhancement Course-I	1	0	0	40	60	100	1
BSBT 308-18	Introduction to Computers Lab	Skill Enhancement Course-I Lab	0	0	2	30	20	50	1
Mentoring & Professional Development			0	0	1	25	-	25	1
TOTAL			**10**	**3**	**15**	**395**	**380**	**775**	**21**

Semester: Fourth

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 401-18	Genetic Engineering	Core	3	1	-	40	60	100	4
BSBT 402-18	Plant Tissue Culture	Core	3	1	-	40	60	100	4
BSBT 403-18	Industrial Biotechnology	Core	3	1	-	40	60	100	4
BSBT 404-18	Genetic Engineering Lab	Core Practical	0	0	4	60	40	100	2
BSBT 405-18	Plant Tissue Culture Lab	Core Practical	0	0	4	60	40	100	2
BSBT 406-18	Industrial Biotechnology Lab	Core Practical	0	0	4	60	40	100	2
BSBT 407-18	Analytical Techniques in Biotechnology	Skill Enhancement Course-II	3	1	0	40	60	100	4
BSBT 408-18	Analytical Techniques in Biotechnology Lab	Skill Enhancement Course-II Lab	0	0	2	30	20	50	1
Mentoring & Professional Development			0	0	1	25	-	25	1
TOTAL			**12**	**4**	**15**	**395**	**380**	**775**	**24**

Semester: Fifth

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 501-18	Organic Farming	Skill Enhancement Course-III	1	0	-	40	60	100	1
BSBT 502-18	Organic Farming Lab	Skill Enhancement Course-III Lab	0	0	2	30	20	50	1
BSBT XXX	Open Elective -I	Open Elective	3	1	-	40	60	100	4
BSBT YYY	Elective -I	Elective	3	1	0	60	40	100	4
BSBT ZZZ	Elective -II	Elective	3	1	0	60	40	100	4
BSBT AAA	Elective -I Lab	Elective Practical	0	0	4	60	40	100	2
BSBT BBB	Elective -II Lab	Elective Practical	0	0	4	40	60	100	2
BSBT 503-18	Minor Project	Project	0	0	2	30	20	50	2
Mentoring & Professional Development			0	0	1	25	-	25	1
TOTAL			**10**	**3**	**11**	**335**	**340**	**675**	**21**

Semester: Sixth

Course Code	Course Title	Course Type	Load Distribution			Marks Distribution		Total Marks	Credits
			L	T	P	IE	EE		
BSBT 601-18	Technical Writing	Skill Enhancement Course-IV	1	0	-	40	60	100	1
BSBT 602-18	Technical Writing Lab	Skill Enhancement Course-IV Lab	0	0	2	30	20	50	1
BSBT XXX	Open Elective- II	Open Elective	3	1	-	40	60	100	4
BSBT YYY	Elective -III	Elective	3	1	0	60	40	100	4
BSBT ZZZ	Elective -IV	Elective	3	1	0	60	40	100	4
BSBT AAA	Elective -III Lab	Elective Practical	0	0	4	60	40	100	2
BSBT BBB	Elective -IV Lab	Elective Practical	0	0	4	40	60	100	2
BSBT 503-18	Major Project	Project	0	0	6	Satisfactory/ Unstaisfactory			6
Mentoring & Professional Development			0	0	1	25	-	25	1
TOTAL			**10**	**3**	**17**	**335**	**340**	**675**	**21**

Open Elective-I
BSBT 137-18 Human Behaviour & Psychology
BSBT 138-18 Renewable Energy Resources

Elective-I
BSBT 139-18 Animal Biotechnology
BSBT 140-18 Fermentation Technology

Elective-II
BSBT 141-18 IPR, Entrepreneurship Bioethics & Biosafety
BSBT 142-18 Biotechnology in Forensic Sciences

Elective-I Lab
BSBT 143-18 Animal Biotechnology Lab
BSBT 144-18 Fermentation Technology Lab

Elective-II Lab
BSBT 145-18 IPR, Entrepreneurship Bioethics & Biosafety Lab
BSBT 146-18 Biotechnology in Forensic Sciences Lab

Open Elective-II

BSBT 147-18 Developmental Biology
BSBT 148-18 Biotechnology and Human Welfare

Elective-III
BSBT 149-18 Bioinformatics
BSBT 150-18 Environment Biotechnology

Elective-IV

BSBT 151-18 Plant Biotechnology

BSBT 152-18 Medical Microbiology

Elective-III Lab

BSBT 153-18 Bioinformatics Lab

BSBT 154-18 Environment Biotechnology Lab

Elective-IV Lab

BSBT 155-18 Plant Biotechnology Lab

BSBT 156-18 Medical Microbiology Lab

FIRST SEMESTER

BSBT-101-18
Inorganic Chemistry

Unit-I

Periodic Properties Position of elements in the periodic table, effective nuclear charge and its calculations, atomic and ionic radii, ionization energy, electron affinity and electro negativity definition.

Unit –II

Chemical Bonding

(a) Covalent bond, directional characteristics of covalent.

(b) Valence bond theory and its limitations.

(c) Various types of hybridization and shapes of inorganic molecules and ions-BeF2, SnCl2, XeF4, BF3, NH4, H2O, ClF4, ICl2, PF6, SF6 and IF7.

(d) Molecular orbital theory,

(e) Weak interactions, Hydrogen bonding & vandor walls forces.

Unit –III

Werner's coordination theory, naming of coordination compounds, stereochemistry, Geometrical isomerism and optical isomerism in compounds.

Unit –IV

Bonding in metal complexes Valence bond theory, electro neutrality and back bonding, limitations of VB theory, Crystal field theory, paramagnetism, diamagnetism, ferromagnetism and anti-ferromagnetism.

Suggested Readings / Books

- J.D. Lee, Inorganic Chemistry, 5th edition chapman & Hall, London.
- Inorganic Chemistry by Puri, Sharma and Kalia
- F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry
- F. Basalo and R.C. Johson, Co-ordination Chemistry,1964.

BSBT 102-18
Introduction to Biotechnology

Unit-I Scope and Introduction to Biotechnology

History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Overview of Branches of Biotechnology: Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology. Overview of Biotechnology Research in India. Overview of Biotechnology Institutions in India (Public and Private Sector) Biotech Success Stories.

Unit –II Applications of Biotechnology

Overview of Applications of Biotechnology in Agriculture: GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants, BT Crops, BT Cotton and BT Brinjal, Pros and Cons.

Unit –III Food Biotechnology

Overview of Biotechnological applications in enhancement of Food Quality, Quality Factors in Preprocessed Food, Microbial role in food products (Yeast and Bacterial based process and products).

Unit –IV Fermentation Biotechnology

Definition, Applications of Fermentation Technology Microbial Fermentations Overview of Industrial Production of Chemicals (Acetic Acid), Antibiotic (Penicillin), Enzymes (L-Asparaginase) and Beverages (Beer and Ethanol)

Suggested Readings / Books

- McGregor, C.W.; Membrane separation in Biotechnology; Marcel Dekker, Inc, New York.
- Frieferder, S.; Physical Biochemistry; Freeman and Co., New York.
- Biotol Series (I - IV); Techniques used in Bioproduct Analysis; Buterworth Heineman,U.K.
- Work, T.S.; Lab. Techniques in Biochemistry and Molecular Biology, Elsevier, New York.
- Microbiology: Michael J. Pelczar Jr., E. C. S Chan, Noel R. Krieg

BSBT 103-18
Biochemistry and Metabolism

Unit -I

Introduction to Biochemistry: A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Different Level of structural organization of proteins. Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoprotein's and their biological functions

Unit -II

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Unit -III

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines.

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites

Unit -IV

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Suggested Readings / Books

- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
- Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
- Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
- Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
- Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

BSBT-104-18
Inorganic Chemistry Lab

1. Safety Measures and Practices in Chemistry Laboratory, Working and use of a Digital Balance, Functioning and Standardization of pH Meter, Optical Activity of a Chemical Compounds by Polarimeter
2. Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions
3. Qualitative Analysis of Inorganic Compounds - Three experiments
4. Four ions including interfering ions.
5. Volumetric Analysis.
6. Iodimetry, Iodometry, Redox titrations using Ce(SO4)2 K2Cr2O7 and KMnO4, Complexometric titrations using EDTA Ca++, Mg++, Zn++ & Ni++

BSBT 105-18
Introduction to Biotechnology Lab

1. Assignment- Study of any branch of biotechnology and its applications
2. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test
3. Extraction of Caesin from Milk
4. Fermentative production of Alcohol
5. Determination of Alcohol content
6. Agarose Gel Electrophoresis of the genomic and plasmid DNA

BSBT 106-18
Biochemistry Lab

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry:
    i. Verification of Beer's law, estimation of protein.
    ii. To study relation between absorbance and % transmission.
6. Separation of Amino acids by paper chromatography.
7. Qualitative tests for Carbohydrates, lipids and proteins

BTHU 103-18 (AECC)
English

Course Outcomes:

- The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to their personal, social and professional interactions.
- The syllabus shall address the issues relating to the Language of communication.
- Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills such as report writing, note taking etc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Detailed Contents:

Unit1- 1 (Introduction)

- Theory of Communication
- Types and modes of Communication

Unit- 2 (Language of Communication)

- Verbal and Non-verbal
- (Spoken and Written)
- Personal, Social and Business
- Barriers and Strategies
- Intra-personal, Inter-personal and Group communication

Unit-3 (Reading and Understanding)

- Close Reading
- Comprehension
- Summary Paraphrasing
- Analysis and Interpretation
- Translation(from Hindi/Punjabi to English and vice-versa)
- Literary/Knowledge Texts

Unit-4 (Writing Skills)

- Documenting
- Report Writing
- Making notes
- Letter writing

Suggested Readings:

- Fluency in English - Part II, Oxford University Press, 2006.
- Business English, Pearson, 2008.
- Language, Literature and Creativity, Orient Blackswan, 2013.
- Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas
- On Writing Well. William Zinsser. Harper Resource Book. 2001
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

BTHU 104-18 (AECC- Lab)
English Lab

Course Outcomes:

- The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to personal, social and professional interactions.
- The syllabus shall address the issues relating to the Language of communication.
- Students will become proficient in professional communication such as interviews, group discussions and business office environments, important reading skills as well as writing skills such as report writing, note taking etc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Monologue
- Effective Communication/ Mis- Communication
- Public Speaking

Suggested Readings:

- *Fluency in English* - Part II, Oxford University Press, 2006.
- *Business English*, Pearson, 2008.

- Practical English Usage. Michael Swan. OUP. 1995.
- *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
- *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

HVPE 101-18 (AECC)
Human Values, De-addiction and Traffic Rules

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education [6]

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Module 2: Understanding Harmony in the Human Being - Harmony in Myself! [6]

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure *Sanyam* and *Swasthya*
    - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship [6]

13. Understanding harmony in the Family- the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
    Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
15. Understanding the meaning of *Vishwas*; Difference between intention and competence
16. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha)*- from family to world family!
    - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence [4]

19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
21. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics [6]

23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in professional ethics:
    a) Ability to utilize the professional competence for augmenting universal human order,

    b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,

    c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
27. Case studies of typical holistic technologies, management models and production systems
28. Strategy for transition from the present state to Universal Human Order:
    a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b) At the level of society: as mutually enriching institutions and organizations

Text Book

R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education*.

Reference Books

1. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
3. A Nagraj, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
5. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
6. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.
7. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *Limits to Growth – Club of Rome's report*, Universe Books.
9. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers ,* Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, *Engineering Ethics (including Human Values)*, Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, *Foundations of Ethics and Management*, Excel Books.
12. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, *http://uhv.ac.in*
2. Story of Stuff, *http://www.storyofstuff.com*
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA

5. IIT Delhi, *Modern Technology – the Untold Story*

HVPE 102-18 (AECC Lab)
Human Values, De-addiction and Traffic Rules Lab

One each seminar will be orgnizied on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar atleast once during the semester. It will be binding for all the students to attend the seminar.

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

BSBT -107/18 Basics of Biosciences

(Deficiency Course for Students having passed 10+2 with Mathematics)

Unit I Diversity in the living world; The living world, Biological classification, Kingdom Monera, Kingdom Protista, Kingdom Fungi, Plant kingdom; Classification of animals in general

Unit II Structural organization in plants; Morphology of flowering plants, Anatomy of plants,

Unit III Structural organization in animals; Structural organization in animals: animal tissues, morphology and anatomy of animals

Unit IV Cell- Basic unit of life; Cell structure and functions; Cell cycle and cell division; Bio-molecules

BSBT 108/18Basics of Bioscience Lab

(Deficiency Course for Students having passed 10+2 with Math)

LIST OF PRACTICALS

1. Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
2. Each student required to submit a family wise herbarium consisting of at least 20 properly pressed and mounted plants.

SECOND SEMESTER

BSBT 201-18 Physical Chemistry

Unit-I Chemical Thermodynamics: State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, intensive and extensive properties, various types of processes, First Law of Thermodynamics, internal energy and enthalpy, change in internal energy an exchange in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between Cp and Cv internal energy change and enthalpy change in a chemical process. Hess's Law of heat summation. Second Law of Thermodynamics, Enthalpy of formation, enthalpy of ionisation and second law of thermodynamics, entropy and Gibb's free energy, Carnot's Cycle, Gibb's Helmholtz Equation, Third Law of Thermodynamics, Nernst Heat Theorem.

Unit-II Solution: Definition, types of solutions, vapour pressure of solution and Raoult's law. Factors influencing the solubility of gas in liquids, Henry's Law. Ideal solutions, Distillation of ideal solutions, lever rule, vapour pressure of ideal solutions and non-ideal pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common features and applications.

Unit-III Phase Equilibria: Definition of phase, component and degree of freedom phase rule and its thermodynamic derivation Clausius chaperon (Derivation not included) phase diagrams of water system, KI water system.

Chemical Kinetics: Rate of reaction, constant factors influencing rate of reaction, order, molecularity, rate equations for 1st order, 2nd order & 3rd order reactions. Half life complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions.

Unit-IV Electrochemistry: Specific conductance, molar conductance and their dependence on electrolyte concentration, ionic equilibria and conductance, theory of strong electrolytes. Transport number conductometric titrations. pH scale. Buffer solutions, salt hydrolysis.

Suggested Readings / Books

- Atkin's Physical Chemistry by Peter Atkins and Julio de Paulk. Publisher Oxford University Press
- Textbook of Physical chemistry by Samuel Glasston. MacMillan India Ltd
- Kalyani Physical Chemistry by K.L. Chug and S.L. Agnish. Kalyani Publisher

BSBT 202-18 Introduction to Microbiology

Unit- I History of Microbiology: A. Leewenhook, L. Pasteur, R. Koch, J. Lister, J. Tyndall. Biogenesis vs abiogenesis, Koch postulates, discovery of antibiotics. Principle of microscopy: Bright field, dark field, phase contrast, fluorescent, electron microscopy.

Unit -II Microbial classification: Bacteria, fungi and algae. Morphology of bacteria, viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, sporulation/ germination process.

Unit -III Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rate, monoauxic, diauxic and synchronous growth. Chemostat Microbes in extreme environment like high temperature and high/ low pH values Physical and chemical agents to kill microbes, sterilization and pasteurization processes.

Unit -IV Normal micro flora in human/ animals. Types of microbial pathogens and diseases caused by them. Microbial interactions like symbiosis and antibiosis etc. Host defense mechanism against pathogens. Nitrogen fixing microbes in agriculture. Photosynthesis Fermentation and its products Production of heterologous proteins in microbes.

Suggested Readings / Books:

- Tortora, G.J., Funke, B.R. and Case, C.L. (2009) Microbiology: An introduction (Benjamin/ Cummings publishing company, Inc).
- R. Y. Stanier, M. Doudoroff, E. A. Adelberg (1999). General microbiology (MacMillian Press London).
- M.J. Pelczar, E.C. Sun Chan, N.R. Krieg (1986). Microbiology (Tata McGraw Hill Publication, New Delhi).
- H.G. Schlegel, C. Zaborosch, M. Kogut (1993). General microbiology (Cambridge University Press).
- S.C. Prescott, C.G. Dunn (1959). Industrial microbiology (McGraw- Hill).
- Purohit, S.S. (2003). Microbiology: Fundamentals and applications (Agrobios, India)
- Postgate, J.R. (2000). Microbes and man (Cambridge University Press).

BSBT 203-18 BIOSTATISTICS

Unit I Statistical population, sample from population, random sample. Tabular and graphical presentation, mean and standard deviation of grouped and ungrouped data, probability, relative frequency, probability, distribution, binomial, poison and normal distributions.

Unit -II Tests of deviations, F and Z residuals, precision, measure of precision, probable error of function, rejection of observations. Methods of averages and least squares. Correlations and linear regression, associated test of significance. Analysis of variance for one and two-way clarification.

Unit -III Design of experiments, randomization, replication, local control, completely randomized and randomized block design. Determinant evaluations of 3x determinants, matrices manipulations, simultaneous and inversion. Interpolation and polynomial filling.

Unit -IV Introduction of curve smoothening, derivative curves, numerical integration, Fourier transformation.

Suggested Readings/ Books:

- Biostatistics (1996) P.N. Arora, P.K. Malhotra, Himalaya Publishing House, Mumbai.
- Introduction to Biostatistics (1972) Sokal & Rohit – Toppan Co. Japan.
- Fundamentals of Biostatics. Bernard Rosner. sixth edition (2004). Thompson learning academic resources

BSBT 204-18 Physical Chemistry Lab

1. Study of distribution law by iodine distribution between water and CC14. Given standard solution Na2S2O3.
2. Study of distribution law of Benzoic acid between benzene and water.
3. Determination of adsorption isotherm of oxalic acid on charcoal.
4. Surface tension: determination of surface tension of a given liquid by Stalgmimeter.
5. Determination of viscosity of a pure liquid (Acetone, ethanol, propanol, butanol, glycol) (Effect of hydrogen bonding on viscosity).
6. Refractometry: Determine refractive index of a given liquid as a criterion for its purity. (Benzene i.e. commercial) benzene + A.R. acetone).
7. Polarimetry: Determine the %age composition of an optically active solution.
8. Conductometry:
   a) Determination of cell constant
   b) Determination of specific and equivalent conductance of electrolyte (NaC1 and HC1).
   c) Precipitation titration of Na_2SO_4 vs $BaC1_2$.
   d) Neutralization titrations NaOH vs HC1 and NaOH vs CH_3COOH.
9.
   a) pH of buffer solution.
   b) Acid base titration HC1 vs. NaOH.
   c) Determination of ionization constant of a week acid (CH_3COOH).
10. Calorimetry:
    a) Determination of Heat of neutralization
       i) Strong acid-strong base
       ii) Weak acid-strong base
11. Photometry: Verification of Lambert beer's law for solution of CoC12. 5H2O (in water) and K2Cr2O7 (in water).

BSBT 205-18 Introduction to Microbiology Lab

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

Suggested Book

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

BSBT 206-18 Biostatistics Lab

1. Presentation of data by frequency tables, diagrams and graphs.
2. Calculation of measures of central tendencies.
3. Calculation of measures of skewness and Kurtosis.
4. Calculation of dispersion.
5. Fitting of binomial distribution.
6. Fitting of Poisson distribution.
7. Probability
8. Bivariate frequency table.

Suggested Book

W.J. Evens, G.R. Grant (2005). Statistical methods in bioinformatics: An introduction (Springer).

Ability Enhancement Compulsory Course
(EVS102-18 Environment Studies)

Course Code	Course Type	Course Title	Load Allocations			Mark Distribution		Total Marks	Credits
						Internal	External		
EVS 102-18	Ability Enhancement Compulsory Course (AECC)-III	Environmental Studies	2	0	0	40	60	100	2

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Unit 1 : Introduction to environmental studies (2 lectures)

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems (6 lectures)

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

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

Unit 3 : Natural Resources : Renewable and Non---renewable Resources (8 lectures)

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).

- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation (8 lectures)

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5 : Environmental Pollution (8 lectures)

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

Unit 6 : Environmental Policies & Practices (7 lectures)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context

Unit 7 : Human Communities and the Environment (6 lectures)

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8 : Field work (5 lectures)

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.

10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.

12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.

13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.

14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.

15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.

17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.

18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.

19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.

20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

Third Semester

BSBT-301-18
Organic Chemistry

Unit I

Fundamental Aspects of Organic Chemistry: Inductive effects, electrometric effects, resonance, hyper conjugation, type of reagents, electrophile and nucleophile, types of organic reactions, reaction intermediates, carbocations, carbanions, free radical carbenes with complex.

Unit II

Alcohols And Phenols: Nomenclature, methods of formation, physical and chemical properties (Measurement of dehydration, acidity, mechanism of Kolbe's reaction, Reimer Tiemann reaction and mechanism).

Unit III

Alkenes, Cycloalkenes, Dienes And Alkynes: Nomenclature, methods of formation, physical and chemical properties, conformation of Alkenes and cycloalkenes. **Alkanes And Cycloalkanes:** Nomenclature, methods of formation, physical and chemical properties.

Unit IV

Arenes And Aromaticity: Nomenclature of benzene derivatives, aryl group, aromatic nucleus and side chain, structure of benzene, molecular formula, Kekule structure, stability, Carbon-carbon bond length of Benzene, resonance structure, MO picture.

Suggested Readings / Books

1. Organic Chemistry – FINAR IL

2. Organic Chemistry _ Morrison and Boyd

3. Voge's text book of Organic Chemistry – Furniss

4. Organic Chemistry – Ege Sezham

BSBT-302 – 18
Immunology

Unit I

Introduction: Overview, Milestones in immunology, general immuno-biology, introduction to specific and non-specific immunity, and features of immune response.

Unit II

Cells And Organs Of The Immune System: lymphoid cells, heterogenecity of lymphoid cells, T cells, B cells, Null Cells, Monocytes, Polymorphs, primary and secondary lymphoid organs- thymus. Bursa of fabricus, spleen, lymph nodes, lymphatic system, mucosa associates lymphoid tissue (MALT), lymphocyte traffic.

Unit III

Humoral Immunity: Structure and function of antibody, structure and function of antigen, Antigen-Antibody reaction, affinity and avidity, high and low affinity antibody, immuno-globulins, classes and structure, molecular mechanism of generation of antibody, diversity, complement fixing antibodies and complement cascade.

Unit IV

Cell Mediated Immunity: T-cell subsets and surface markers, T dependent and T independent antigen, recognition of antigens by T cells and role of MHC, class of MHC, structure of T cells antigen receptor, examples of cell mediated immunity.

Suggested Readngs / Books

1. Immunology- Robin IM, Brostoff J and Male DK.

2. Principles of Cellular and molecular Immunology- Austyn JM and Wood KJ.

3. Immunology and Medical Microbiology -Singh RP

4. Introductory Immunology – Shetty, Nandini

5. Immuno-biotechnology – Yadav and Tyagi

6. Immuno-biotechnology- Naha and Narain.

7. Immunology –Singh and Bharat

8. Medical Immunology- StritesDP, Terr AL Opar TG.

MSBT 303-18
Molecular Biology

Unit –I
Genome organization: Organization of Chromatin, Histone and Non-histone proteins, Nucleosome. Concept of Gene, Introns and Exons. Nature and Properties of Genetic Code.

Unit –II
DNA Replication and Damage Prokaryotic DNA replication: Enzymes and proteins involved Mechanism of Replication: Initiation, Elongation, synthesis of Leading and lagging strands, Termination. Mutation concept: types: Spontaneous Mutation and Induced Mutation Mutagens: Physical Mutagens and Chemical Mutagens DNA repair mechanisms: Photoreactivation and Dark Excision repair

Unit –III
Central Dogma of Molecular Biology : Transcription: RNA polymerase, Initiation, Elongation and Termination. Translation: Role of Ribosome, Activation of amino acids, Initiation, chain. Elongation and termination of translation. Inhibitors of translation

Unit –IV
Regulation of Gene Expression: Concept of Operon and regulon. Promoter, Operator, Structural and Regulatory genes. Model of Lactose operon: Structure, Positive and Negative regulation.

Suggested Readings/ Books-

- Rastogi S.C.; " Concepts in Molecular Biology", New Age International
- (P) Ltd, New Delhi.
- Verma P.S. and Agrawal V.K.(2001), " Concepts in Molecular Biology",
- S.Chand and Co.Ltd; New Delhi.
- Pasupuleti Mukesh, "Molecular Biotechnology",MJP (P) Chennai.
- Powar C.B, "Gene Regulation",Himalaya Book Pvt.Ltd, Mumbai.
- Lohar P.S. (ISBN 81-8094-027-6)"Cell and Molecular Biology", MJP Publishers
- Chennai.
- Friefilder D,"Basics of Molecular Biology",Barlett Publications.
- Strickburger M.W,(1995) "Genetics", Practice hall of India pvt Ltd,new Delhi.
- Upadhyay Avinash and K.Upadhyay (2005),"Basic Molecular Biology", Himalaya Publishing House, Mumbai.

MSBT 304-18
Organic Chemistry Lab

1) Introduction to laboratory techniques through demonstration involving synthesis of selected organic compounds (e,g Aspirin, parabromoacetanilide, anthraquinone from anthracine, reduction of nitrobenzene.(any two)
2) Identification of organic compounds and derivatives (Any Ten)
3) Introduction to the use of stereo models

MSBT 305-18
Immunology Lab

1. Haemagglutination assay
2. Haemagglutination inhibition assay.
3. Separation of serum from blood
4. Separation of T and B cells from PBMC by nylon wool method.
5. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods.
6. Direct and indirect ELISA.
7. Precipitation test
8. Study of Lymph nodes in rats.
9. Study of types of inflammation

MSBT 306-18
Molecular Biology

1. Isolation of Bacterial DNA
2. Silver staining of proteins
3. Analysis of DNA by fluorescent and spectroscopical method
4. PCR
5. Isolation and analysis of RNA
6. Preparation of Competent E.coli cells

MSBT 307-18
Introduction to Computers

Unit –I

General introduction: computers, organization of computers, digital and analogue computers, computer algorithms. Introduction to computers and its uses: milestones in hardware and software, batch oriented/ online/ real. Computers as a system: Basic concepts, stored programs, functional units and their interrelation: communication with computer.

Unit –II

Data storage devices primary storage: storage addressed and capacity, type of memory, Secondary storage Devices, Magnetic Tape-data representation and R/W, Magnetic disks, fixed and removable, data representation and R/W: Floppy and hard disks, Optical disks CD-Rom, Mass Storage Devices.

Unit –III

Input/Output Devices: Key-tape/diskette devices, light pen mouse, joystick, source data automation, Printed outputs: serial, line, page, printers, Plotters, voice response units

Unit –IV

Introduction to Bioinformatics: Internet and the Biologist, Bibliographic databases, genebank sequence database, sequence analysis using GCG, sequence alignment and database searching, Multiple sequence alignments, Phylogenetic analysis, Preiction of Protein structures, submitting DNA sequences to the database, The NCBI data model

Suggested Readings / Books

1. Bioinformatics: The Machine Learning Approach, Eds – P. Baldi and S. Brunak
2. Trends in Biotechnology: Trends guide to Bioinformatics, Trends Supplement, Elsvier Trends Journals

MSBT 308-18

Introduction to Computers Lab

1. Familiarization of the computer system
2. Loading window, closing, maximizing, icon shifting & ordering.
3. Changing drives and searching files and understanding file extensions.
4. Saving files, protecting and unprotecting.
5. Formatting floppies and practice on virus recognisation and protection.
6. Practice with control panel and file manager.
7. Practice with MS Word, Operating and closing document, Preparation of document, setting of document, familiarization with various tools, mail- merge practice.
8. Internet Browsing.

Fourth Semester

BSBT401-18 Genetic Engineering

Unit -I Gene Recombination and Gene transfer: Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser.

Unit -II Changing genes: Site-directed mutagenesis and Protein engineering: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.

Unit -III Genetic engineering in animals: Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.

Unit -IV Genetic engineering in plants: Use of Agrobacterium tumefaciens and Arhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

Suggested Readings/ Books

1. Sambrook, J., Fritsch, E.F., and Maniatis, T., "Molecular cloning: A laboratory Manual", Cold Spring Harbor Laboratory. 2001
2. Brown, T.A., "Gene Cloning and DNA Analysis", Blackwell Science. 2001
3. Winnacker, E.L., "From Genes to Clones: An Introduction to Gene Technology", VCH. 1989
4. Old, R.W. and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication. 1999
5. Gupta, P.K., "Biotechnology and Genomics", Rastogi Publications.2004

BSBT402-18 Plant Tissue Culture

Unit -I Introduction to Techniques - Introductory history, Laboratory organization, Media, Aseptic manipulation. Basic concepts in cell culture - Cell culture, Cellular Totipotency, Somatic Embryogenesis

Unit -II In vitro culture: Approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture.

Unit -III Tissue nutrition: Growth Hormones - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media)

Unit IV Tissue culture methodologies - Plant cells (Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis). **Cloning & Selection of specific cell types –** cloning, somatic cell fusion and HAT selection, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies.

Suggested Readings/ Books

1. Gupta, P. K., "Plant Biotechnology", Rastogi Publication. 2004

2.Chawla, H. S., "Introduction to Plant Biotechnology" 2nd Edn, Science Publishers Inc. 2002

3. Razdan, M.K., "Introduction to Plant Tissue Culture", 2nd End, Science Publishers Inc. 2003

BSBT403-18 Industrial Biotechnology

Unit I Introduction: Industrially important microbes (E.Coli, Bacillus, Saccharomyces); Role of Yeast in Industry: Transformation procedures, genetic markers for yeast transformation, industrial application. Fermented Beverages: Beer, Whisky, Wine making and Vinegar making.

Unit II Fermentation: Large scale fermentation: Design and operation of fermentors, Preparation of ideal growth medium for production of biomass and microbial products; Fermentation reactions: Metabolic groups and pathways, culture preservation

Unit III Microbial Products: Microbial production of antibiotics, vitamins, organic acids; Industrial Biocatalyst: Introduction, scope and application, immobilization and its applications

Unit IV Role of Industrial Biotechnology: Introduction to fuel biotechnology, biofertilizers, biocontrol agents, scope and applications of environmental biotechnology and biosafety in industry.

Suggested Readings/ Books

1. Pelczar and E.C.S. (Jr.) Chan, 2000 : Microbiology, Tata McGraw Hill Pub Co., New Delhi.
2. D.D. Bernard, R. Dulbecco, H.N. Eisen, and H.S. Ginsbery , 1990: Medical Microbiology, Harper and Row, New York.
3. MK.J. Waites et al ., 2001 : Industrial Microbiology, Blackwell Science Ltd., London.
4. Nicklin et al., 2001: Instant Notes in Microbiology, BIOS Scientific Publishers Ltd, U.K.
5. G.J. Tortora et al 1995: Microbiology : An introduction, Benjamin/Cummings Pub Co.,Inc.B.T.
6. Principles of fermentation Technology : By Stanbury and Whittakar, Orgamon Press
7. Industrial biotechnology by Cruger & Cruger , Tata McGraw Hill

BSBT404-18 Genetic Engineering Lab

Demonstrate the following experiments

1. Transformation in E. coli DH5
2. 2. Bacterial conjugation
3. Phage Titration
4. Plasmid preparation
5. Restriction enzyme digestion
6. Ligation
7. Genomic DNA extraction
8. DNA molecular size determination
9. Bacterial Antibiotic sensitivity
10. Bacterial gene expression (using Lac promoter system)

BSBT 405-18 Plant Tissue Culture Lab

1. In vitro Culture - Washing & Sterilization, Preparatory steps for tissue culture, surface sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture.
2. Preparation of Culture media & Reagents - Media composition, Nutrition, Hormones.
3. Tissue Culture – Callus culture, Cell suspension.
4. Organ Micro-culture - Shoot tip, excised root, Leaf culture
5. Plant micro-propagation – micro-culture of plants

BSBT 406-18 Industrial Biotechnology Lab

1. Preparation of Baker’s Yeast from molasses
2. Production of Biodiesel
3. Production of Enzymes & Antibiotics
4. Bioleaching of Chalcopyrites (CuFeS2)

BSBT 407-18 Analytical Techniques in Biotechnology

Unit- I General Biophysical methods – Measurement of pH, Radioactive labeling & counting, Autoradiography. Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

Unit -II Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation.

Unit -III Microscopy – Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM. Theory of Electrophoresis, Factors affecting the migration of substances, supporting media in electrophoresis, Boundary electrophoresis, Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting.

Unit -IV Spectroscopy: Raman Spectroscopy – What is Raman effect, Quantum mechanical reason of Raman effect, Molecular Polarizability, Polarizability ellipsoid, Experimental technique of Raman effect, Basic concept of Pure Rotational & Vibrational, Raman spectra of simple molecule (linear molecule).

NMR Spectroscopy – Basic principle of NMR spectroscopy, Experimental technique & instrumentation, Chemical shift, Hyperfine splitting, Relaxation process.

Absorption Spectroscopy – Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a Chromophore

Suggested Readings / Books

1. Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Biotechniques, Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis, Saroj Dua And Neera Garg : Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques, M.L. Srivastava, Narosa Publishing House, New Delhi.

BSBT 408-18 Analytical Techniques in Biotechnology

1. Principles & operations of Incubators & Shakers
2. Principle & operation of Centrifuge and ultracentrifuge
3. Principle & operation of pH meter
4. Principle & operation of Colorimeter
5. Principle & operation of UV visible Spectrophotometer
6. To study the structure & function of basic microscope.
7. To study the analysis of DNA by agarose gel electrophoresis method.
8. To study the analysis of protein by SDS- PAGE method
9. Principle & operation of column chromatography, TLC and HPLC

Fifth Semester

BSBT 501-18 Organic Farming

Unit -I

Organic farming – Introduction, Significance and practices. Organic farming for sustainable agriculture- Manures (Bulky and concentrated)

Unit -II

Sewage and sludge, green manures – potentials and limitations. Quality parameters of organic manures and specifications.

Unit -III

Bio remediation and phytoremediation. Role of microorganisms in degradation of pesticides.

Unit -IV

Biofertilizers, Soil health, Soil Health Card, Soil enzymes: biological tests and harmful effect of non-judicious chemical fertilization.

Suggested Readings/ Books

- Sharma A. 2002. Hand Book of Organic Farming. Agrobios
- Lampin N. 1990. Organic Farming. Press Books, lpswitch, UK.
- 2. Palaniappan SP & Anandurai K. 1999. Organic Farming – Theory and Practice. Scientific Publ.

BSBT 502-18 Organic Farming Lab

Perform (Any 05)

1. Sampling of manure materials - moisture determination, bulk density, pH, E.C,
2. Estimation of organic carbon, total nitrogen, C:N ratio, phosphorus and potassium in manures/ compost.
3. Preparation of soil samples for chemical and biological tests
4. Determination of soil biological activity by monitoring dehydrogenase activity.
5. Study of cellulose decomposition and CO2 evolution.
6. Nitrate reductase activity in soils.
7. Preparation of vermicompost and other manures -preparation of enriched manures.

BSBT 137-18 Human Behaviour and Psychology

Unit -I

Psychological Perspectives and Approaches: Nature and Scope of psychology; historical perspective; sub-fields and applications; methods of psychology. Introduction to the science of human behaviour

Unit -II

Perception: Sensory and perceptual processes; pattern recognition; attention; perception of objects, space, and time; feature and attribute perception; Learning: Models and theories of learning; Memory: Functions and processes; models and theoretical views

Unit -III

Motivation and Emotion: Physiological and cognitive bases of motivation; expression and perception of emotions; physiological correlates and theories of emotion. Intelligence: Nature of intelligence; theories and models of intelligence; psychological tests and assessment of intelligence; Issues in intelligence testing; creativity.

Unit -IV

Personality: Nature and theories of personality; personality assessment; determinants of personality; psychological conflict and conflict handling mechanisms. Individual Differences: Genetic and environmental bases of individual differences in human behaviour.

Suggested Readings/ Books:

- Baron, R.A. Psychology. New Delhi: Prentice Hall of India
- Atkinson, R.L., Atkinson, R.C., and Hilgard, E.R. Introduction to Psychology. Harcourt Brace Jovanovich Inc.
- Atkinson, R.L., Atkinson, R.C., and Hilgard, E.R. Introduction to Psychology. Harcourt Brace Jovanovich Inc.

BSBT 138-18 Renewable Energy Sources

Unit I: Solar Energy

Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

Unit II: Wind Energy and Ocean Energy

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator. Ocean Energy: Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants.

Unit III: Bio-Mass and Geothermal Energy

Principles of Bioconversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking. Geothermal Energy: Resources, types of wells, methods of harnessing the energy, scope in India.

Unit IV: **Energy Conservation**

Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Suggested Readings/ Books:

- Reneweble energy resources: Tiwari and ghosal, Narosa publication.
- Non conventional Energy Sources,Khanna Publication
- Renewable Energy Sources:Twidell& Weir, CRC Press.
- Solar Energy/ S.P. Sukhatme, Tata McGraw-Hill.
- Non Conventional Energy Systems: K M. Mittal, A H WheelerPublishing Co Ltd.
- Renewable Energy Technologies: Ramesh & Kumar, Narosa publication.
- Biomass Energy, Oxford &IBH Publication Co.

BSBT 139-18 Animal Biotechnology

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology- Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

Suggested Readings/ Books

- Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
- Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
- Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
- Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA

BSBT 140-18 Fermentation Technology

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid and butyric acid, Biofuels: Biogas, Ethanol, biodiesel; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

UNIT II

Microbial products of pharmacological interest, steroid fermentations and transformations. Overproduction of microbial metabolite, Secondary metabolism – its significance and products. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis.

UNIT III

Purification & characterization of proteins, Upstream and downstream processing, solids, and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra-centrifugation, liquid extraction, ion-exchange recovery of biological products.

UNIT IV

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Metabolic engineering of antibiotic biosynthetic pathways.

Suggested Readings/ Books

- Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
- Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
- Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
- Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
- Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
- Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004

BSBT 141-18 IPR, Entrepreneurship Bioethics & Biosafety

UNIT-I

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT II

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

UNIT III

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT IV

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Suggested Readings/ Books

- Entrepreneurship: New Venture Creation : David H. Holt
- Patterns of Entrepreneurship : Jack M. Kaplan
- Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
- Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
- Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BSBT 142-18 Biotechnology in Forensic Sciences

Unit I

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II

Classification of firearms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit III

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,Unit IV

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security

Suggested Readings/ Books

- Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
- M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
- S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
- W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
- R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

BSBT 143-18 Animal Biotechnology Lab

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
5. Preparation of Minimal Essential Growth medium
6. Isolation of lymphocytes for culturing
7. DNA isolation from animal tissue
8. Quantification of isolated DNA.
9. Resolving DNA on Agarose Gel.

BSBT 144-18 Fermentation Technology Lab

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

BSBT 145-18 IPR, Entrepreneurship Bioethics & Biosafety Lab

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

BSBT 146-18 Biotechnology in Forensic Sciences

1. Documentation of crime scene by photography, sketching and field notes.
2. A. Simulation of a crime scene for training.
   B. To lift footprints from crime scene.
3. Case studies to depict different types of injuries and death.
4. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
5. Investigate method for developing fingerprints by Iodine crystals.
6. PCR amplification on target DNA and DNA profiling
7. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

Sixth Semester

BSBT 601-18 Technical Writing

Unit -I Introduction to technical writing, types audience analysis, and persuasion, definition writing and analysis of material, description of mechanisms and processes, library resources, research techniques, and proposal writing.

Unit -II Collecting notes, writing outlines, and writing rough drafts, elements of the formal research report, grammar, technical writing style, and paper revision, job application procedure, including application letters and resumes, plagiarism and professional ethics.

Suggested Readings/ Books

- Markel, Mike. Technical Communication. 7th ed. New York, NY: Bedford/St. Martin's, 2003. ISBN: 9780312403386.
- Hacker, Diana. A Pocket Style Manual. 4th Ed. New York, NY: Bedford/St. Martin's, 1999. ISBN: 9780312406844.
- Perelman, Leslie C., James Paradis, and Edward Barrett. The Mayfield Handbook of Technical and Scientific Writing. New York, NY: McGraw-Hill, 1997. ISBN: 9781559346474.

BSBT 602-18 Technical Writing Lab

1. Vocabulary building, Creativity, using Advertisements, Case Studies etc.
2. Personality Development: Decision-Making, Problem Solving, Goal Setting, Time Management & Positive Thinking
3. Cross-Cultural Communication : Role-Play/ Non-Verbal Communication.
4. Meetings- making meeting effective, chairing a meeting, decision making, seeking opinions, interrupting and handling interruptions, clarifications, closure- Agenda, Minute writing
5. Group Discussion – dynamics of group discussion, Lateral thinking, Brainstorming and Negotiation skills
6. Resume writing – CV – structural differences, structure and presentation, planning, defining the career objective
7. Interview Skills – formal & informal interviews, concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing
8. Writing Skills - Business Communication, Essays for competitive examinations.
9. Technical Report Writing/ Project Proposals – Types of formats and styles, subject matter – organization, clarity, coherence and style, planning, data-collection, tools, analysis.- Feasibility, Progress and Project Report.

BSBT 147-18 Developmental Biology

Unit I: Gametogenesis and Fertilization Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs based on yolk.

Unit II: Early embryonic development Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

Unit III: Embryonic Differentiation: Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

Unit IV: Organogenesis: Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in
Mammals.

Suggested Readings / Books

- Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

BSBT 148-18 Biotechnology and Human Welfare

Unit I Agriculture: Nitrogen fixation; transfer of pest resistance genes to plants; Interaction between plants and microbes; Qualitative improvement of livestock.

Unit II Environment: Chlorinated and non-chlorinated organ pollutant degradation; Degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

Unit III Health and Forensic Science: Development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, Monoclonal antibody production in *E.coli*, Human genome project; Role of forensic science in solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

Unit IV Industry: Protein Engineering; Enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

Suggested Readings/ Books

- Sateesh MK (2010) Bioethics and Biosafety, I. K. International Publishing House Private Ltd.
- Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New Age International Private Ltd. First Edition

BSBT 149-18 Bioinformatics

Unit I

Introduction to Bioinformatics: Goals, applications and limitations of Bioinformatics, Biological sequence and molecule, file formats, DNA and protein sequence databases, Structure databases; database searching using keywords, Data Submission tool.

Unit II

Pairwise sequence alignment: Evolutionary Basis of sequence alignment, Homologous sequence, Global alignment and local alignment, Gap penalties, Dot matrix method, Scoring matrices, Dynamic programming methods: Needleman-Wunsch and Smith-Waterman algorithm, Database similarity search, Heuristic methods: FASTA, BLAST and types of BLAST

Unit III

Multiple Sequence Alignment and Phylogenetic: Scoring multiple sequence alignments, Progressive alignment method, Iterative alignment method, Block-based alignment, Molecular evolution and phylogenetics, Phylogenetic trees, Molecular Clock theory, Maximum Parsimony, Distance based methods: UPGMA,

Genome Annotation tools: Pattern and repeat finding tools, Gene identification tools

Unit IV

Structural Bioinformatics: Protein secondary structure prediction, Chou-Fasman and GOR method, Neural networks, Protein three dimensional structure prediction: Homology modelling and protein Threading, Molecular visualization tools, Computer aided drug design, Docking

Suggested Readings/ Books

- Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. OxfordUniversity Press.
- Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
- Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. IIEdition. Benjamin Cummings.
- Mount D W, Bioinformatics - Sequence and Genome Analysis, Cold Spring Harbour Laboratory Press (2001)

BSBT 150-18 Environment Biotechnology

Unit I Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

Unit II Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

Unit III Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

Unit IV Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

Suggested Readings/ Books

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology, Milton Wainwright
- Principles of Environmental Engineering, Gilbert Masters
- Wastewater Engineering – Metcalf & Eddy

BSBT 151-18 Plant Biotechnology

Unit I Introduction, Cryo and organogenic differentiation, Types of culture: Seed, Embryo, Organs, Callus, and Cell suspension culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

Unit- II In vitro haploid production: Anther culture and Microspore culture. Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, ovule culture, chromosome elimination techniques for the production of haploids in cereals.

Unit - III Protoplast Isolation, culture and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation and applications

Unit - IV Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

Suggested Readings / Books

- Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
- Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
- Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
- Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
- Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue andOrgan Culture. Narosa Publishing House.
- Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
- Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
- Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation ofPlants, Oxford University Press.

BSBT 152-18 Medical Microbiology

Unit I Gram positive bacteria: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum*, C.diphtheriae *M.tuberculosis, M. leprae.*

Unit II Gram Negative bacteria Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.*

Unit III Viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

Unit IV Fungal and Protozoan infections. Dermatophytoses (Trichophyton, Microsporun and Epidermophyton) Subcutaneous infection (Sporothrix, Cryptococcus), systemic infection (Histoplasma, Coccidoides) and opportunistic fungal infections (Candidiasis, Aspergillosis), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

Suggested Readings / Books

- Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's
- Medical Microbiology. 24th edition. McGraw Hill Publication.
- Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's
- Microbiology. 7th edition. McGraw Hill Higher Education.

BSBT 153-18 Bioinformatics Lab

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

BSBT 154-18 Environment Biotechnology Lab

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.

BSBT 155-18 Plant Biotechnology Lab

1. Preparation and sterilization of standard tissue culture media.
2. Sterilization of explants and generation of undifferentiated mass of cells.Regeneration of plants from undifferentiated cells.
3. Preparation of competent cells, transformation and colony PCR for confirmation of transformation in *Agrobacterium tumefaciens*.
4. Agrobacterium-mediated transformation of plants.
5. Selection and screening of transgenic plants.
6. Evaluation of a transgenic phenotype (viz., Herbicide resistance) under contained conditions.
7. Analysis of crude extracts from medicinal plants using HPLC.
8. Use of microsatellite markers for DNA fingerprinting

BSBT 156-18 Medical Microbiology Lab

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of Aspergillus and Candida by appropriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.