

# NOIDA INTERNATIONAL UNIVERSITY

## DEPARTMENT OF BIOTECHNOLOGY & MICROBIOLOGY

### SYLLABUS OF COURSES TO BE OFFERED Core Courses, Elective Courses & Ability Enhancement Courses

#### UNDERGRADUATE PROGRAMME (BIOTECHNOLOGY) Choice Based Credit System (CBCS)



**(Academic Year 2020-21)**



## **Preamble**

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So, it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## CHOICE BASED CREDIT SYSTEM (CBCS)

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, the UGC has formulated the guidelines to be followed.

### **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.
  - 2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
  - 2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.
  - 2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.  
P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.
3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.
  - 3.1 AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication.
  - 3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

**Project work/Dissertation** is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

### Details of courses

	Theory+ Practical	Theory + Tutorial
<b>I. Core Course</b>		
<b>(14 Papers)</b>	14X4= 56	14X5=70
<b>Core Course Practical / Tutorial*</b>		
<b>(14 Papers)</b>	14X2=28	14X1=14
<b>II. Elective Course</b>		
<b>(8 Papers)</b>		
A.1. Discipline Specific Elective	4X4=16	4X5=20
<b>(4 Papers)</b>		
A.2. Discipline Specific Elective		
Practical/ Tutorial*	4 X 2=8	4X1=4
<b>(4 Papers)</b>		
B.1. Generic Elective/		
Interdisciplinary	4X4=16	4X5=20
<b>(4 Papers)</b>		
B.2. Generic Elective		
Practical/ Tutorial*	4 X 2=8	4X1=4
<b>(4 Papers)</b>		
<ul style="list-style-type: none"> <li>• <b>Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6<sup>th</sup> Semester</b></li> </ul>		
<b>III. <u>Ability Enhancement Courses</u></b>		
<b>1. Ability Enhancement Compulsory</b>		
<b>(2 Papers of 2 credit each)</b>	2 X 2=4	2 X 2=4
Environmental Science		
English/MIL Communication		
<b>2. Ability Enhancement Elective (Skill Based)</b>		
(Minimum 2)	2 X 2=4	2 X 2=4
<b>(2 Papers of 2 credit each)</b>		
<b>Total credit</b>	<b>140</b>	<b>140</b>

\* wherever there is a practical there will be no tutorial and vice-versa

## **B.Sc. (Hons) Biotechnology**

**Core Papers (C):** (Credit: 06 each) (1 period/week for tutorials or 4 periods/week for practical)

1. STUGBT/C01: Bio instrumentation (4 + 4)
2. STUGBT/C02: Elementary Cell Biology (4 + 4)
3. STUGBT/C03: Fundamentals of Biochemistry (4 + 4)
4. STUGBT/C04: Basics of Immunology (4 + 4)
5. STUGBT/C05: Microbial Genetics (4 + 4)
6. STUGBT/C06: Cell & Tissue Culture Technology (4 + 4)
7. STUGBT/C07: Environmental Biotechnology (4 + 4)
8. STUGBT/C08: Microbiology (4 + 4)
9. STUGBT/C09: Food technology & Bioprocess technology (4 + 4)
10. STUGBT/C10: Recombinant DNA Technology (4 + 4)
11. STUGBT/C11: Principle of Genomics and Proteomics (4 + 4)
12. STUGBT/C12: Elementary Molecular Biology (4 + 4)
13. STUGBT/C13: Nanotechnology (4 + 4)
14. STUGBT/C14: Entrepreneurship (4 + 4)

**Discipline Specific Elective Papers:** (Credit: 06 each) - DSE 1-4

(4 papers to be selected: 02 each for Odd semester and Even semester as listed below)

1. STUGBT/DSE01: Plant Biotechnology (4) + Lab (4)
2. STUGBT/DSE02: Animal Biotechnology (4) + Lab (4)
3. STUGBT/DSE03: Microbial Biotechnology (4) + Lab (4)
4. STUGBT/DSE04: Industrial Microbiology (5) + Tutorial (1)
5. STUGBT/DSE05: Parasitology (4) + Lab (4)
6. STUGBT/DSE06: Clinical Research (4) + Lab (4)
7. STUGBT/DSE07: Host Pathogen interaction (4) + Lab (4)
8. STUGBT/DSE08: Biological physics (4) + Lab (4)
9. STUGBT/DSE09: Bio-pesticide & Bio-fertilizer (5) + Tutorial (1)
10. SDUGBT/DSE12: Dissertation

**Skill Enhancement Courses** (02 to 04 papers) (Credit: 02 each)- SEC1 to SEC4

1. SDUGBT/SEC01: Molecular Diagnostics
  2. SDUGBT/SEC02: Enzymology
  3. SDUGBT/SEC03: Industrial Fermentations
  4. SDUGBT/SEC04: Basic Instrumentation Skills
  4. SDUGBT/SEC05: Fermentation technology
  5. SDUGBT/SEC06: Drug Designing
  6. SDUGBT/SEC07: Basics of Forensic Science
  7. SDUGBT/SEC08: Food technology
  8. SDUGBT/SEC09: Bioprocess technology
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**Generic Elective Papers (GE): (Credit: 06 each)**

1. SDUGBT/GE01: Fund. of Computer Applications (4) + Lab (4)
2. SDUGBT/GE02: Chemistry-1 (4) + Lab (4)
3. SDUGBT/GE03: Bioinformatics (4) + Lab (4)
4. SDUGBT/GE04: Recombinant DNA Technology (4) + Lab (4)
5. SDUGBT/GE05: Bioethics, Biosafety and IPR (4) + Lab (4)
6. SDUGBT/GE06: Plant Pathology (4) + Lab (4)

**B.Sc. (H) Biotechnology 1<sup>st</sup> Year  
SEMESTER-I**

**BIO INSTRUMENTATION (C1)**

L	T	P
4	0	2

**Unit I: General Biophysical methods:** Measurement of pH, pOH, Buffer action, Isoelectric focusing.

**Unit II: 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 III: 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 IV : Microscopy:** Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM.

**Unit V: X-Ray Crystallography:** X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure (concept of rotating crystal method, powder method).

**Unit VI : Spectroscopy:** Basic concepts, principle, working, care & maintenance and applications of Raman Spectroscopy, NMR Spectroscopy and Absorption Spectroscopy.

**SUGGESTED READINGS**

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9thEd., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

## ELEMENTARY CELL BIOLOGY (C2)

L	T	P
4	0	2

**Unit I: Basics of Cell Biology (Structure & Function):** Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells.

**Unit II: Biogenesis of Cellular organelles:** Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

**Unit III: Chromosomes:** Chemical composition, structural organization of chromatids, centromeres, telomeres, chromatin, nucleosome organization, eu- and heterochromatin, special chromosomes (e.g. polytene and lampbrush chromosomes), banding patterns in human chromosomes.

**Unit IV : Membrane Structure & Transport:** Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport; Cell adhesion

**Unit V: Cell Cycle:** An overview of cell cycle; Mitosis and meiosis; Components of cell cycle control system; Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant.

### SUGGESTED READING

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

## FUNDAMENTALS OF COMPUTER APPLICATION (GE1)

L	T	P
4	0	2

### Unit-I

**Fundamental:** H/W and S/W part of computer system, Computer Block Diagram, online processing, time sharing system, real time system, batch system, multiprogramming, multiprocessing, SPOOLING, distributed data processing. Element of computer file, types of files, file processing activities, file design factors, access methods, pros and cons of file organization

### Unit-II

**MS office:** Introduction to MS Office; Introduction to MSWord; Features & area of use. Working with MS Word.; Menus & Commands; Toolbars & Buttons; Shortcut Menus, Wizards & Templates; Creating a New Document; Different Page Views and layouts; Applying various Text Enhancements; Working with – Styles, Text Attributes; Paragraph and Page Formatting; Text Editing using various features ; Bullets, Numbering, Auto formatting, Printing & various print options

### Unit-III

**MS Excel:** Introduction and area of use; Working with MS Excel.; concepts of Workbook & Worksheets; Using Wizards; Various Data Types; Using different features with Data, Cell and Texts; Inserting, Removing & Resizing of Columns & Rows; Working with Data & Ranges; Column Freezing, Labels, Hiding, Splitting etc.; Using different features with Data and Text; Use of Formulas, Calculations & Functions; Cell Formatting including Borders & Shading; Working with Different Chart Types; Printing of Workbook.

## SUGGESTED READINGS

1. Joe Habraken, Microsoft Office 2000, 8 in 1 by, Prentice Hall of India
2. Deitel & Deitel: C How to Program (Prentice Hall), 1996.
3. Yashwant Kanetker, Let us C, BPB Publications.
4. R. B. Patel, Fundamental of Computers and Programming in C, Khanna Book Publishing Company PVT.LTD. Delhi, India, 1st edition, 2008, ISBN: 13: 978-81-906988-7-0, pp. 1-962.
5. Gottfried, Programming with C, Tata McGraw Hill.
6. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, 2nd Ed., Prentice Hall of India.

## ENVIRONMENTAL SCIENCES- EVS (AECC1)

L	T	P
2	0	0

**Unit 1: Natural Resources:** Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people, (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

**Unit 2: Ecosystems:** Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem :- (a) Forest ecosystem, (b) Grassland ecosystem, (c) Desert ecosystem, (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit 3: Biodiversity and its conservation** Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega diversity nation, Hot-spots of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex situ conservation of biodiversity.

**Unit 4: Environmental Pollution:** Definition, Causes, effects and control measures of: (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution (e) Noise pollution, (f) Thermal pollution, (g) Nuclear hazards. Human health risks; Solid waste management: Control measures of urban and industrial waste. Pollution case studies.

**Unit 5: Environmental Policies & Practices:** Sustainability and sustainable development; 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.; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

### SUGGESTED READINGS

1. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
2. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic press, 2011.

## CHEMISTRY-I (GE1)

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>2</b>

### Unit 1:

**Basic Concepts of Inorganic Chemistry:** Introduction: Elements, Classification of Elements (metals, non-metals and metalloids). Periodic table and modern periodic law, classification of periodic table in groups and column. Classification of periodic table into s-block, p-block and d-block elements.

### Unit 2: Atomic Structure:

Schrodinger wave equation; H atom; Radial and angular wave functions: quantum numbers and concept of orbitals; Slater orbitals.

**Unit 3: Bonding:** Molecular orbital theory and molecular energy level diagram of Homo- and Hetero-nuclear molecules. Hybridization, its definition and hybridization involving s, p and d-orbitals. VB and MO approach of H<sub>2</sub> molecule

**Chemical Bonding:** Chemical bonding, types of bonding (ionic, covalent, coordinate, metallic and hydrogen bonding).

### Unit 4: Organic Chemistry-I

**Hydrocarbons:** Alkanes: Chlorination of methane, Alkenes: Addition reactions (Electrophilic and Free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. Alkynes: Reduction, Electrophilic addition, acidity and metal acetylides.

**Unit-5: Stereochemistry:** Fischer, Saw-horse and Newman projection formulae, Chirality-optical activity, enantiomers and diastereoisomerism involving one and two chiral centres. Configuration; D/L, erythrose, threose and R/S nomenclatures. Geometrical isomerism and E/Z nomenclatures. Conformations of n-butane.

### Recommended Books:

1. *Basic Inorganic Chemistry*, F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Concise Inorganic Chemistry*, J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
3. *Organic Chemistry*, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
4. *Organic Chemistry*, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
5. *Organic Chemistry*, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
6. *Organic Chemistry*, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
7. *Organic Chemistry*, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
8. *Organic Chemistry*, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
9. *Organic Chemistry*, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press, Oxford (2001).

## B.Sc Biotechnology 1<sup>st</sup> Year SEMESTER-II

### FUNDAMENTALS OF BIOCHEMISTRY (C3)

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit 1: Classification and Study of macromolecules:** Introduction and classification of Carbohydrate. Lipids, amino acids and Nucleic acid. Interaction between protein-protein, protein-nucleic acid and nucleic acid- nucleic acid. Biochemistry and its scope. Structure, general properties and function of cellular macromolecules.

**Unit 2: Carbohydrate metabolism: Glucose Metabolism:** Glycolysis; fermentation; anaerobic fate of pyruvate; control of glycolysis; metabolism of hexoses other than glucose; pentose phosphate pathway. **Citric Acid Cycle:** Synthesis of acetyl-coenzyme A; enzymes of the citric acid cycle; regulation of the citric acid cycle; glyoxylate pathway; electron transport and oxidative phosphorylation. **Glycogen Metabolism and Gluconeogenesis:** Glycogen breakdown; glycogen synthesis; control of glycogen metabolism. **Starch Metabolism:** Starch synthesis; storage and degradation; abnormal carbohydrate metabolism.

**Unit 3: Lipid Metabolism:** Digestion; absorption and transport; fatty acid oxidation; ketone bodies; regulation of fatty acid metabolism; cholesterol biosynthesis; fatty acid biosynthesis.

**Unit 4: Nitrogen Metabolism:** Amino acid biosynthesis (L-Serine, L-Asparagine, L-Alanine, L-Tyrosine, L-Methionine); Nitrogen fixation in plants and microorganisms; nitrate reduction; inborn errors of L-Phenylalanine and L-Tyrosine metabolism; essential amino acids; glucogenic & ketogenic amino acids.

**Unit 5: Nitrogen Excretion:** The urea cycle; inborn errors involving urea synthesis; catabolism of purine and pyrimidine nucleotides; disorders involving purine metabolism.

### SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

## BASICS OF IMMUNOLOGY (C4)

L	T	P
4	0	2

**Unit 1: Introduction:** Concept of Innate and Adaptive immunity; Immune Cells and Organs.

**Unit 2: Structure, Functions and Properties of: Immune Cells:** Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs: Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

**Unit 3: Antigens and Antibodies: Antigen: Characteristics** of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens, Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. **Antibodies:** Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; immunodiffusion, immunoelectrophoresis, ELISA, RIA, Monoclonal and Chimeric antibodies.

**Unit 4: Major Histocompatibility Complex:** Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways), Complement System: Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement activation.

**Unit 5: Generation of Immune Response:** Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells), Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co-stimulatory signals), Killing Mechanisms by CTL and NK cells, Introduction to tolerance; Vaccines.

### SUGGESTED READINGS

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

## BIOINFORMATICS (GE)

L	T	P
3	0	2

**Unit 1: Introduction to computer:** Classification, characteristics, capabilities and generations, basic components and their functions, hardware(input devices, memory, control units, arithmetic logic units, output devices), software(system software, application software, language low level, high level), interpreter, compiler, data processing, batch, on-line, real time(examples from bio-industries, e.g. application of computers in co-ordination of solute concentrations, pH, temperature etc of a fermenter in operation).

**Unit 2: Internal representation of Data:** Bits and bytes, binary decimals, octal and hexadecimal system, positive and negative numbers, integers and real, characters and codes-BCD, ASCII and EBCDIC coding, algorithms and flow charts.

**Unit 3: Computer Programming:** Introduction and application of programming language, elementary idea of development of computer programs.

**Unit4: Introduction to Bioinformatics:** History, aims of Bioinformatics, Definition and Concepts, Components of Bioinformatics, Basic tools, Scope of Bioinformatics in molecular biology and Computers, Role of internet in Bioinformatics, Applications of Bioinformatics.

**Unit 5: Protein and Nucleic acid databases:** Introduction, Protein and Nucleic acid databases, databases accession, database searching, NCBI based study.

### SUGGESTED READINGS

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International StudentEdition
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell

## B.Sc Biotechnology 2<sup>nd</sup> Year SEMESTER-III

### MICROBIAL GENETICS (C5)

L	T	P
4	0	2

**Unit I: Prokaryotic Genomes** - Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome and Genome of Archaea).

**Unit II: Mechanism of genetic exchange:** Plasmid and bacterial sex, Types of plasmids (F Plasmid: a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu-virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation; Conjugation (Cointegrate Formation and Hfr Cells, Time-of-Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction)- gene mapping.

**Unit III: Molecular Mechanism of gene regulation in prokaryotes** - Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons

**Unit IV: Bacteriophages:** Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli Phage T4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, The lysogenic Cycle.

**Unit V: Bacteriophage Genetics** -: Plaque Formation and Phage Mutants, Genetic recombination in the lytic cycle, (concept of recon, muton, cistron)

### SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, ColdSpring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

## CELL & TISSUE CULTURE TECHNOLOGY (C6)

L	T	P
4	0	2

**Unit 1: Tissue Culture Laboratory:** Planning and organization of a Tissue Culture Laboratory

**Unit 2: Plant and Animal Tissue Culture:** Culture media and culture methods, Basic techniques in plant and animal tissue culture.

**Unit 3: Culture Maintenance and Growth Measurement:** Induction and maintenance of callus and suspension culture, Measurement of growth parameters.

**Unit 4: Introduction to *in-vitro* Methods:** Terms and definitions. Use of growth regulators, Ovary and Ovule culture, Embryo culture, Anther Culture, Embryo rescue after wide hybridization and its applications, Micropropagation- bud, shoot tip and meristem culture, Endosperm culture and production of triploids, *in-vitro* pollination & Fertilization.

**Unit 5: Introduction to Protoplast Isolation:** Principles and applications, Testing of viability of isolated protoplasts, Various steps in the regeneration of protoplasts, Somatic hybridization, Various methods for fusing protoplasts, chemical and electrical. Use of markers for selection of hybrid cells, Practical applications of somatic hybridizations, Cybridization.

### Practical:

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Preparation of stock solutions of MS.
3. Preparation of cotton plugs.
4. Preparation and sterilization of explants and inoculation of explants on culture media.
5. Isolation of protoplasts by mechanical method.
6. Preparation of artificial seeds.
7. Cell suspension culture.
8. Practical record.
9. Viva voice.

## ENVIRONMENTAL BIOTECHNOLOGY (C7)

L	T	P
4	0	2

**Unit 1:** Microorganisms and their Habitats: Structure and function of ecosystems; Terrestrial Environment: Soil profile and soil microflora; Aquatic Environment: Microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersal of microbes; Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

**Unit 2:** Microbial Interactions: Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions

Microbe-animal interaction: Microbes in ruminants, nematophagous fungi and symbiotic luminescent bacteria

**Unit 3:** Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorus cycle: Phosphate immobilization and solubilisation, Sulphur cycle: Microbes involved in sulphur cycle, Other elemental cycles: Iron and manganese

**Unit 4:** Waste Management: Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill), Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary, sewage treatment

**Unit 5:** Microbial Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants,

### SUGGESTED READINGS

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Heidelberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA

## BIOETHICS, BIOSAFETY AND IPR (SEC1)

L	T	P
4	0	2

**Unit 1: Biosafety:** Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms

**Unit 2: Biosafety Guidelines:** Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

**Unit 3: AERB/RSD/RES:** guidelines for using radioisotopes in laboratories and precautions.

**Unit 4: Introduction to Intellectual Property:** Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

**Unit 5: Grant of Patent and Patenting Authorities:** Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner.

**Unit 6: Agreements and Treaties:** GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

### SUGGESTED READINGS

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

**B.Sc Biotechnology 2<sup>nd</sup> Year**  
**SEMESTER-IV**

**MICROBIOLOGY (C8)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit I: Historical developments:** Discovery of microorganisms, Spontaneous Generation Controversy, Germ theory of fermentation, Germ theory of disease.

**Unit II: Classification of Microbes:** Whittaker's five-kingdom concept. Three-domain concept of Carl Woese. Characters used in microbial taxonomy (morphological, physiological, ecological, genetics protein content, nucleic acid sequence and base composition).

**Unit III: Concept of Sterilization:** Definition of sterilization; Physical and Chemical methods of sterilization; disinfection sanitization; antisepsis sterilants and fumigation.

**Unit IV: Microbial Characteristics:** Different groups of Microorganisms and their general characteristics, Prokaryotic vs. Eukaryotic Organization.

**Unit V: Kinetics of Bacterial growth:** Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetics, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure and nutrient concentration per cell.

**Unit VI: Pathogenic Microorganisms:** List of common bacterial, fungal and viral diseases of human.

**SUGGESTED READINGS**

1. Air Microbiology An environment And Health Prospective by Aithal, Wakte & Manwar.
2. Cinnamonteal print and publishing Margao, Goa-403601.
3. Fundamental principles of bacteriology by A.J. Salle.
4. Fundamentals of Microbiology by Martin Frobisher.
5. General Microbiology by Stanier. Ingraham, Wheelis, Painter: Macmillan Press Ltd.

## FOOD TECHNOLOGY & BIOPROCESS TECHNOLOGY (C9)

L	T	P
4	0	2

**Unit 1: Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

**Unit 2: Microbial spoilage of various foods:** Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

**Unit 3: Principles and methods of food preservation:** Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, nitrite and nitrates, ethylene, oxide, antibiotics and bacteriocins.

**Unit 4: Fermented foods:** Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

**Unit 5: Food borne diseases (causative agents, foods involved, symptoms and preventive measures):** Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni. Cultural and rapid detection methods of food borne pathogens in foods.

**Unit 6 Food sanitation and control:** HACCP, Indices of food sanitary quality and sanitizers

### SUGGESTED READINGS

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P)Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CABInternational, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.

## RECOMBINANT DNA TECHNOLOGY (C10)

L	T	P
4	0	2

**Unit 1: Molecular Tools:** Restriction Enzymes: Types I, II and III; Linkers and adaptors; Sites of cleavage (Isoschizomers, neoschizomers; and isocaudomers); DNA modifying enzymes; End-modifying enzymes and their applications.

**Unit 2: Vectors:** properties of vectors; Plasmid vectors; Viral vectors; Cosmids; Fosmids; YAC; PAC; shuttle vectors. Vectors for plants and Animals.

**Unit 3: Recombinant Screening:** Selection of transformed cells; DNA introduction into host cells- bacterial cell (chemical method and electroporation) and plant cell (Direct gene transfer and vector mediated gene transfer); in animals (transduction and transfection).

**Unit 4: Polymerase chain reaction:** Primer designing; Reaction cycles; Modifications to PCR techniques (Asymmetric PCR, RT-PCR, Quantitative Real time PCR, Inverse PCR, RACE, RAPD, AFLP).

**Unit 5: Genetic Engineering in Animals:** Primary and secondary cultures; cell lines; Culture media; Growth patterns. Applications of animal cell culture.

**Unit 6: Genetic Engineering in Plants:** Gene transfer strategies; Ti plasmid; Strategies for production of transgenic plants; Applications; Molecular farming

### SUGGESTED READINGS

1. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
2. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
3. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
4. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

## PLANT PATHOLOGY (SEC2)

L	T	P
4	0	2

**Unit 1: Introduction and History of plant pathology:** Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

**Unit 2: Stages in development of a disease:** Infection, invasion, colonization, dissemination of pathogens and perennation.

**Unit 3: Plant disease epidemiology:** Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

**Unit 4: Host Pathogen Interaction:**A. Microbial Pathogenicity Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

**Unit 5: Control of Plant Diseases:** Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.

**Unit 6 Specific Plant diseases:**Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control. Cucuta, Loranthus, Orobanche and striga.

**Unit 7: Seminar**

### SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.

**B.Sc Biotechnology 3<sup>rd</sup> Year  
SEMESTER-V**

**PRINCIPLE OF GENOMICS AND PROTEOMICS (C11)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit 1: Origin and Evolution of genomics: Study and Scope:** Introduction, definition concepts and approaches of proteomics studies and activities. Origin of genomics, the first DNA genomes, microsatellite and SCOT, DNA based phylogenetic trees, genomes and human evolution, evolution of nuclear and organelle (mitochondrial and Chloroplast genome), Anticipated Benefits of Genome Research

**Unit 2: Molecular maps of genomes and comparative genomics:** Genetic maps, physical maps, EST and transcript maps, functional maps, comparative genomics and collinearity/synteny in maps.

**Unit 3: Whole Genome sequencing:** Whole genome shotgun sequencing, clone-by-clone or 'hiererchical stotgun' sequencing, microbial genomes, plant genomes and animal genomes.

**Unit 4: Annotation of whole genome sequence and functional genomics:** *In silico* methods, insertion mutagenesis (T-DNA and transport insertion), EST contigs and unigene sets, use of DNA chips and microarrays.

**Unit 5: Pharmacogenomics:** Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, pharmacogenomics and industry.

**SUGGESTED READINGS**

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
3. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
4. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

## ELEMENTARY MOLECULAR BIOLOGY (C12)

L	T	P
4	0	2

**Unit 1: Molecular of Life:** an introduction experimental proof of DNA and RNA as genetic Material, Nucleic Acids, Structure and function of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A and Z), Functions of DNA and RNA including ribosome's.

**Unit 2: DNA Replication:** Prokaryotic and Eukaryotic-Enzymes and proteins involved in replication, Theta model and Rolling circle model. Mechanism of DNA replication, replication origin and replication fork, DNA repair

**Unit 3: DNA Repair:** Causes and mechanism –photo reactivation, excision repair, mismatch repair, SOS repair. Recombination in prokaryotes, Transformations, Conjugation and Transduction. Wobble hypothesis.

**Unit 4: Transcription and Translation:** Transcription in Prokaryotes and Eukaryotes, Mechanism, promoters and RNA polymerase, transcription factors, post transcriptional, modifications a eukaryotic mRNA. Translation: Mechanism of translation in Prokaryotes and Eukaryotes. Ribosomes, mechanism of translation, post translational modification, translational inhibitors, Genetic code

**Unit 5: Regulation of Gene expression:** Regulation of Gene expression in Prokaryotes-Person concept (Lac and Trip), Regulation of Gene expression in Eukaryotes –transcriptional activation. Transposable elements in Maize and Drosophila, gene silencing

### SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

## PLANT BIOTECHNOLOGY (DSC1)

L	T	P
4	0	2

**Unit 1: Introduction:** Introduction to Plant Biotechnology and Plant Breeding, Methods used in plant breeding.

**Unit 2: Organogenesis & Embryogenesis:** Micropropagation: bud, shoot tip and meristem culture. Haploids: their production & applications, Somaclonal variations and their applications. Practical applications and examples of tissue and organ culture. Somatic Embryogenesis and its practical applications. Single cell suspension culture and their applications in selection of variants/mutants with or without mutagen treatment.

**Unit 3: Delivery System for Gene Transfer in Plants:** Direct delivery of genes, viz. electroporation, microprojectile transformation, Vector mediated gene transfer in plants. Introduction to *Agrobacterium* Tumour formation on plants using *Agrobacterium tumifaciens*. Root-formation using *Agrobacterium rhizogenes*. Practical application of genetic transformation.

**Unit 4: Production & Practical applications of Transgenic Plants:** production of human therapeutics & edible vaccines, production of herbicides and insecticide resistance, insect resistance, virus resistance, drought and salinity resistance plants, concepts and application of molecular farming.

**Unit 5: Genetic modification in Food industry:** background, history, controversies over risks, future applications.

### Practical:

1. Preparation of competent cells of *E. coli* for harvesting plant transformation vector
2. Preparation of Solid and liquid media (MS, B5, N6) Media.
3. Isolation of plant genomic DNA by modified CTAB method.
4. Preparation and sterilization of explants and inoculation of explants on culture media.
5. Isolation of protoplasts by enzymatic method.
6. Embryo Culture.: To isolate embryos of *Cicer aertinum* and perform *in vitro* culture.
7. Practical record.
8. Viva voice.

## ANIMAL BIOTECHNOLOGY (DSC2)

L	T	P
4	0	2

**Unit 1: Gene transfer methods in Animals:** Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer.

**Unit 2: Transgenic Animals:** Mice, Cow, Pig, Sheep, Goat, Bird, Insects.

**Unit3: Animal diseases need help of Biotechnology:** Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

**Unit 4: Animal propagation:** Artificial insemination, Animal Clones.

**Unit 5: Conservation Biology:** Embryo transfer techniques, Cryopreservation and transport of animal germplasm(i.e. semen, ova and embryos).

**Unit 6: Genetic modification in Medicine:** Gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

### Practical:

1. Differential Count of WBC.
2. Widal Test and VDRL Test.
3. Dot Elisa.
4. ELISA-Demonstration.
5. Isolation of liver parenchyma cells.
6. Separation of Serum from blood & precipitation of immunoglobulin.
7. Practical record.
8. Viva voice.

## BIOPROCESS TECHNOLOGY (SEC)

L	T	P
3	0	2

**Unit 1: History of microbiology of food:** microbial growth pattern, physical and chemical factors influencing structure of micro-organisms - types of micro-organism normally associated with food - mold, yeast and bacteria.

**Unit 2: Micro-organisms in natural food products and their control** - contaminants of foods - stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing - biochemical changes caused by micro-organisms - deterioration of various types of food products - food poisoning and microbial toxins.

**Unit 3: Scope and importance of food processing** - principles and methods of food preservation - freezing, heating, dehydration, canning, additives, fermentation, irradiation, extrusion cooking, hydrostatic pressure coking, dielectric heating, microwave processing.

**Unit 4: Introduction to packaging** - packaging principles and operation - package functions and design - deteriorative changes in foodstuff and packaging methods for prevention - shelf life of packaged foodstuffs - methods to extend shelf life.

**Unit 5: Objectives, importance and functions of quality control** - methods of quality - assessment of food materials - fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products - sampling and specification of raw materials and finished products - statistical quality controls - food regulations, grades and standards - food adulteration, food safety and evaluation.

### SUGGESTED READINGS

1. Neeser JR & German BJ. 2004. Bioprocesses and Biotechnology for Nutraceuticals.
2. Chapman & Hall. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed.
3. Wildman. Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
4. Webb GP. 2006. Dietary Supplements and Functional Foods. Blackwell Publisher.

**B.Sc Biotechnology 3<sup>rd</sup> Year  
SEMESTER-VI**

**NANOTECHNOLOGY (C13)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit 1: Introduction:** The ascale dimension and paradigm. Definitions and historical evolution (colloids etc.) and current practice

**Unit 2:** Types of nanomaterials and their classifications (1D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc)

**Unit 3:** Polymer, Carbon, Inorganic, Organic and Biomaterials –Structures and characteristics

**Unit 4:** Physical, Chemical and Biological Fundamentals of Nanomaterials

**Unit 5:** Overview of synthetic methods Surfactants, polymers, emulsions. Micelles/reverse micelles and colloids Top-down and bottom up approaches Biological Methods Growth and stabilization Self-assembly

**SUGGESTED READINGS**

1. Introduction to Nanoscience and Nanotechnology, Chris Binns, 2010, Wiley, ISBN: 978-0471776475
2. Introduction to Nanoscience, Stuart Lindsay, 2009, Oxford University Press, ISBN: 978-0199544219

## ENTREPRENEURSHIP (C14)

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>2</b>	<b>0</b>

**Unit 1: Introduction:** definition, history and scope of Biotechnology Entrepreneurship

**Unit 2: Biotechnology Marketing & Companies:** Biotechnology in capital market; Initial Public Offering (IPO) in the capital market; examples of success and failure of biotechnology companies and the possible reasons; factors that influence success of company; product selection; failure of the product ; product development ; R&D with expertise ; cost of product development. Mergers and acquisitions of biotechnology companies: Celera Genomica and Axys Pharmaceutical; Monsanto and other companies (use other examples)

**Unit 3: Patenting, licensing and partnership in biotechnology industry:** Patents on biological inventions, licensing revenue, selection of right partner; negotiations of the terms of the terms of the deal.

**Unit 4: Entrepreneurship Skills:** Entrepreneurship Skills of bio-entrepreneur, bio-entrepreneurial training; research experience, creativity, communication skills and other attributes; participation in conferences, training and educational courses; institutes offering entrepreneurship courses.

**Unit 5: Entrepreneurship Seminars.**

### SUGGESTED READINGS

1. Biotech Entrepreneur-to-Entrepreneur: <http://www.bioe2e.org>
2. Startup junkies <http://www.startupjunkies.org/research.html>
3. Biopreneur serves as a focal point for bringing together scientists,
4. Businesspeople and investors [http://www.biopreneur.org/biotech-](http://www.biopreneur.org/biotech-investment.htm)
5. [investment.htm](http://www.biopreneur.org/biotech-investment.htm)
6. Bio Entrepreneur guide :
7. <http://www.bioenterprise.com/assets/entrepreneurguide.pdf>
8. The entrepreneur's guide to a biotech startup By Peter Kolchinsky Ph.D.
9. [www.evelexa.com/resources.cfm](http://www.evelexa.com/resources.cfm)
10. Entrepreneur's Resource Guide by BioEnterprise
11. <http://www.bioenterprise.com/assets/entrepreneurguide.pdf>

## PARASITOLOGY (DSC3)

L	T	P
4	0	2

**Unit I: Introduction:** Parasites, Classification of Parasites, Host, Types of host, Relationships between host and parasites

**Unit II: Protozoa:** (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment)

Entamoeba, Giardia, Plasmodium, Leishmania, Trypanosoma

**Unit III: Platyhelminthes:** (Introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment) Taenia, Echinococcus

**Unit IV: Nematelminthes:** (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment) Ascaris, Ancylostoma, Necator, Enterobius, Wuchereria

**Unit V: Lab Diagnosis:** Different specimens of parasitology, Collection & transportation. Processing of parasitological specimens

### SUGGESTED READINGS

1. 'Textbook of Microbiology' by CP Baveja , 2nd edition, Arya longman Pvt. ltd
2. 'Medical parasitology' by Arora & Arora, 3th edition, CBS publishers & Distributors Pvt. Ltd.
3. 'text book of Medical Laboratory' by Satish Gupta, Edition - latest, J.P. Bros, New Delhi – 1998
4. 'Medical parasitology' by Chatarjee , 3th edition
5. 'Textbook of Medical Lab Technology' by Praful Godkar, Edition latest,
6. 'Medical Microbiology and Immunology' by Warren Levinson, eighth Edition, Lange Medical books/ McGraw-Hill Publication.

## CLINICAL RESEARCH (DSC4)

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

### Unit 1:

**Drug discovery:** Introduction, conventional drug design approaches, irrational Vs Rational, subacute and chronic toxicity studies. Irwin profile test, Drug development process (Preclinical, clinical and toxicological studies).

### Unit 2:

**Clinical Research:** Past, Present and future Importance, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency. Designing clinical trials- History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis.

### Unit-3:

**Ethical Issues in clinical research-** Introduction, codes, declaration and guidelines, informed consent, special issues, Roles and responsibilities of IRBS, issues with ethics review.

### Unit-4:

**ICH-GCP-** History of ICH, Objectives, ICH structure, Guidelines, Future of ICH.

## SUGGESTED READINGS

1. Research in Education- John V. Best, John V. Kahn 7th edition
2. Presentation skills - Michael Hallon- Indian Society for Institute education
3. Practical Introduction of copyright.- Gavin Mcfarlane
4. Thesis projects in Science & Engineering – Richard M. Davi