YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
B.Sc. BIOTECHNOLOGY, CHEMISTRY & GENETICS
THIRD SEMESTER
ACADEMIC YEAR-2021-2022 OF 2020-23 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ week	Duration of Exam (hrs)	Marks			Credits
						Internal	External	Total	
THEORY									
1	I	ES18101	Environmental Studies & Gender Sensitization **(AECC-5)**	3	3	40	60	100	3
2	II	G18BT1T	Medical Lab Technology **(GE-3) (ID)****	2	3	40	60	100	2
3	II	BT20301	Bioanalytical Techniques **(SEC-1)**	4	3	40	60	100	4
4	II	BT20302	Plant Biotechnology **(Core-7)**	4	3	40	60	100	4
5	II	BT20303	Recombinant DNA Technology **(Core-8)**	4	3	40	60	100	4
6	II	BT20304	Chemistry-III **(Core-9)**	5	3	40	60	100	4
PRACTICALS									
7	II	G18BT1P	Medical Lab Technology **(GE-3) (ID)****	2	3	40	60	100	1
8	II	BT20305	Plant Biotechnology **(Core-7)**	2	3	40	60	100	1
9	II	BT20306	Recombinant DNA Technology **(Core-8)**	2	3	40	60	100	1
10	II	BT20307	Chemistry-III **(Core-9)**	2	3	40	60	100	1
TOTAL				**30**		400	600	1000	**25**

*****AECC Ability Enhancement Compulsory Course *Generic Elective (GE)
* SEC Skill Enhancement Course *Inter-Departmental/Inter-Disciplinary

GENERIC ELECTIVE
(INTER-DEPARTMENTAL/INTER-DISCIPLINARY)

UG COURSES

S.No.	Department	Subject
1.	Chemical Technology	Solar Processing Technologies
2.	Agri. Science & Rural Development	Fundamentals of Horticulture
3.	Biotechnology	Medical Lab Technology
4.	Food Technology	Food Processing & Quality Control
5.	Mathematics	Quantitative Aptitude
6.	Statistics	Data Analysis
7.	Multimedia & Animation	Creative Arts
8.	Computer Science & Engg.	Shell Programming
9.	Computer Systems & Engg.	PC Hardware, Installation and Networking
10.	B.Sc. Computer Data Science & Data Analytics Engg.	Python Programming
11.	B.Sc. Electronics Technology	Repair and Maintenance of Home Appliances
12.	Commerce (Honours)	Taxation
13.	Commerce (Advertising, Sales Promotion & and Sales Management)	Marketing Management
14.	Commerce (Business studies)	Banking
15.	Commerce (Computers & IAF)	Accounting
16.	B.B.A.	Principles of Management
17.	Mass Communication	Photography
18.	Mass Communication	Film Appreciation
19.	English	Communication Skills
20.	English	Career Skills
21.	Psychology	Psychology for Living
22	Commerce(Hons)(Strategic Finance)	GST
23	Commerce (Business Process Management)	Financial Markets
24	Food Science & Nutrition	Principles of Food Science,Nutrition & Dietetics

ENVIRONMENTAL STUDIES & GENDER SENSITIZATION

Credits: 3 **Semester: III**
Subject Code : ES18101 **No. of lecture hours: 45**

Objectives:

- To understand the importance of ecological balance for Sustainable Development
- To understand the impacts of developmental activities and mitigation measures
- To understand the environmental policies and regulations.
- To develop students sensibility with regard to issues of gender in contemporary India
- To provide a perspective on the socialization of men and women
- To expose the students to debate on the politics and economic works and on gender violence

Unit Specific Outcomes:

Understand the importance of Environmental education, conservation of natural resources & Understand the importance ofecosystems and biodiversity

Understand the pollution problems and Apply the environmental science knowledge on solid waste management, disaster management

Apply the environmental science knowledge to Improve the resources and Evaluate and understand the sustainable environmentalconditions and control methods

Identify the interactions and intersections of identities (e.g., gender,race, ethnicity, class, sexuality, and so on) and assess the ways in which they contribute to instances of privilege and power dynamicsacross cultures, space, and time. And their problems

Understand the gender problems and ways of addressing them, including interactions across local to global scales in communitiesand overcome inequalities with legislation

UNIT- I **9hrs**

NATURAL RESOURCES, ECOSYSTEMS, & BIODIVERSITY

- Definition, Scope and importance of environmental studies. Need for public awareness.
- Renewable & Non Renewable resources, Brief account on Forests, Water, Minerals and Energy (Solar, Wind, and Geo-thermal & Bio-energy).
- Definition of Ecosystem, Structure and functions—food chains, food webs, ecological pyramids, producers, consumers and decomposers.
- Energy flow and example ecosystems--- Forest, Desert, Aquatic ecosystems.
- Definition of Biodiversity, types (Genetic, Species, Ecosystem), India- mega diversity Nation.
- Hotspots, Threats to biodiversity, Conservation of biodiversity (In-Situ and Ex-Situ).

UNIT-II **9hrs**

ENVIRONMENTAL POLLUTION

- Definition of Environmental pollution
- Brief account of causes, effects, prevention and control measures of
  - (a) Air pollution
  - (b) Water Pollution
  - (c) Soil pollution
  - (d) Noise pollution
  - (e) Marine Pollution
- Solid Waste Management: Causes, Effects & Control measures of urban and industrial wastes
- Disaster Management: floods, Earth quakes, and Cyclones.

UNIT-III **9hrs**

Social Issues and Environment

- Rain-Water Harvesting, Water-shed Management, and From Unsustainable to Sustainable Development.
- Global Warming, Ozone depletion, and Acid rains
- Environmental Legislation: Air Act, Water Act, Environmental Protection Act, Forest Act, Wildlife Act.
- Environmental & Human Health---- HIV/AIDS
- Welfare Programs---- Family, Women & Child Welfare, Population Explosion
- Role of Information Technology in Environmental Studies.

UNIT-IV **9hrs**

Gender Studies

- Why should we study gender issues?
- Socialization- Making women and making men
- Being together as equals-Through the lens of gender
- Missing women: Gender selection and its consequences
- Health issues of Women

UNIT-V **9hrs**

Gender & Labour -Gender Violence & Law

- House work : The invisible labour- my mother doesn't work "share the load"
- Sexual harassment – say no eve teasing – the caste based violence –Nirbhaya Act
- Domestic violence - Is home a safe place? - Blaming the victim.-Domestic violence Act
- Forums of justice-Hindu Inheritance Act(2005)

Field Visit for Environmental Studies:

1. Visit to a local Polluted site- Industrial effluent plant/ Polluted Lake/Agricultural Land
2. Visit to any Ecosystem

ESSENTIAL READING (for Gender Sensitization)

1. A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu. 201. **Towards a World of Equals : A Bilingual Text on Gender**. Hyderabad: Telugu Akademi.

SUGGESTED READING

(for Environmental Studies)

1. Rajagopalan R. 2015. **Environmental Studies-from Crisis to Cure.** Third Edition. Chennai: Oxford University Press.
2. Dr D K Asthana and Dr Meera Asthana. 2014. **A Text Book of Environmental Studies** Revised Edition. New Delhi: S. Chand & Company.
3. Anubha Kaushik and C.P. Kaushik Published. 2016. **Perspectives in Environmental Studies.** Fifth Edition. New Delhi: New Age International.

(for Gender Sensitization)

4. Sen Amartya **More Than One Million Women Are Missing.** New York Review of Books 37.20 (20 December 1990). Print. **We Were Making History...Life Stories of Women in the Telangana People's Struggle**. New Delhi: Kali for Women. 1998.
5. Tripti Lahiri. **By the Numbers: Where Indian Women Work. Women's Studies Journal .** *(*14 November 2012). Available online at: <http://blogs.wsj.com/ India real time/2012/11/14/by – the numbers-where-Indian-women-work/>
6. K. Satyanarayana and Susie Tharu. Ed. **Steel Nibs Are Sprouting : New Dalit Writing From South India, Dossier 2: Telugu and Kanada** Code=3732.
7. Vimala. **Vantillu (The Kitchen)". Women Writing in India: 600 Bc to the Present. Volume II.** The 20th Century. Ed. Suise Tharu and K.Laltitha. Delhi: Oxford University Press, 1995.599-601.
8. Shatrughna, Veena. **Women's Work and its Impact on Child Health and Nutrition.** Hyderabad: National Institute of Nutrition, Indian Council of Medical Research .1993.

MEDICAL LAB TECHNOLOGY

(GE -Inter -Departmental/Inter -Disciplinary)

Credits: 2 **Semester: III**

Subject Code: G18BT1T **No. of Lecture Hours: 30**

Objectives:

- To demonstrate scientific inquiry in course and lab assignments.
- To demonstrate effective verbal and written communication skills appropriate to the scientific community.
- To demonstrate critical thinking skills in examining issues in the biological world.
- To demonstrate effective analysis of biological issues through the use of case studies, laboratory and field research work.
- To be academically prepared for professional training.

Outcome: Student will gain knowledge on the essence of metabolites and its concentrations to retain a homeostatic condition in the body.

Unit Specific Outcomes :

- Explain the biochemical parameters investigated
- Understand about Human Physiology
- Explain about Blood and its constituents
- Understand the concepts of urine composition and Renal calculi
- Identify different types of Blood group

UNIT - I **6Hrs**

Reception, Registration And Biochemical Parameters Investigated

- What is MLT? 1
- Its importance and scope 1
- Reception and Registration 1
- Contents of Laboratory request form 1
- Biochemical parameters investigated 2

UNIT-II **6Hrs**

Introduction to Human Physiology

- What is Physiology
- Definitions of Cell, tissue, organ, system, organism and metabolism. 2
- Different systems of the body – Haemopoietic system, Reticuloendothelial system 2
- Lymphatic system, Skeletal system, Muscular system, Circulatory system, Respiratory system, Digestive system, Excretory system, Endocrine system, Reproductive system Nervous system and Special senses.(Elementary level) 2

UNIT - III **6Hrs**

Blood

- Collection of Blood 1
- Anticoagulants 1
- Blood and its constituents. 1
- Studies on Blood sugar-Diabetes Mellitus 2
- Types of Diabetes. 1

UNIT- IV **6Hrs**

Urine Studies

- Collection and preservation of Urine 2
- Composition of Urine 2
- Abnormal constituents of Urine. 1
- Renal Calculi 1

UNIT -V **6 Hrs**

Blood

- Principles of Blood groups 2
- Antigen- Antibody reactions 2
- ABO-RH blood groups 2

SUGGESTED READING:

1. Lehninger A.L. Nelson D.L. and Cox M.M. 1993. **Principles of Biochemistry.** II Edition. Kalyani Publishers.
2. Voet O, Voet G. 1994. **Biochemistry.** John Willey and Sons.
3. Stryer L. 1994 **Biochemistry** IV Edition
4. Zubay G,William C.Brown. 1997. **Biochemistry.** New York.

BIOANALYTICAL TECHNIQUES

Credits: 4 **Semester: III**

Subject Code: BT20301 **No. of Lecture Hours: 60**

Objectives:

- To provide further understanding of the fundamental physical principles while applying them to biological systems
- To provide basic skills on how to utilize physical principles to solve biological problems
- To develop skills of critical thinking about physical problems as they apply to biology.

Outcome: Student will gain knowledge on the molecular principles based on the core disciplines of biology, chemistry and physics.

Unit Specific Outcomes:

- Understand the operating conditions (mobile phase, temperature, flow rate, program rate, etc.) for the various separation techniques.
- Understand the fundamental thermodynamics behind the various separations methods.
- Understand the instrumentation required for the various estimation techniques and their associated operating principles.
- Learning about the structure and function of important biomolecules and cellular systems. and methods for measuring the effects of radiation on these models and techniques for radiation therapy .
- Understanding the parts of a microscope and its operating principles.

UNIT –I Chromatography	**12Hrs**
• Chromatography - Definition ,basic principle and experimentation	1
• Paper Chromatography - Definition ,basic principle, procedure and applications.	2
• Thin layer Chromatography- Definition ,basic principle, procedure and applications.	1
• Column Chromatography- Definition ,basic principle, procedure and applications.	2
• Gel filtration (molecular sieve) Chromatography- Definition, basic principle, procedure and applications.	1
• Ion exchange Chromatography- Definition, basic principle, procedure and applications.	1

- Affinity Chromatography- Definition, basic principle, procedure and applications 1

- Gas Chromatography- Definition, basic principle, procedure and applications. 1
- HPLC - Definition, basic principle, procedure and applications. 1
- Matrices and support materials used in Chromatography 1

UNIT – II Electrophoresis **12Hrs**

- Electrophoresis- Definition, basic principle and experimentation. 1
- Factors affecting electrophoretic mobility- mass, charge, size, shape, electric field, medium, buffer and ionic strength. 2
- Types of Electrophoresis- free and zone electrophoresis 1
- Free electrophoresis- Microelectrophoresis and Moving Boundary electrophoresis 1
- Zone Electrophoresis-Its features. 1
- Difference between Free Electrophoresis and zone Electrophoresis. 1
- Types of Gels- Starch gel, Agar, Polyacrylamide and Agarose acrylamide. 1
- Solubilizers –Urea, SDS, Mercaptoethanol. 1
- Experimental procedures of Gel Electrophoresis (Principle, procedure, applications) 1
- Experimental procedures of High Voltage Electrophoresis (Principle, procedure, applications) 1
- Experimental procedures of PAGE(Principle, procedure, applications) 2
- Isoelectric focusing (Principle, procedure, applications) 1

UNIT –III Spectrophotometry and Centrifugation **12Hrs**

- UV & Vis absorption Spectra. 1
- Colorimetry – Definition, Principle, Instrumentation and applications. 2
- Spectrophotometry- Definition, Principle, Instrumentation and applications. 2
- Introduction and principle of Centrifugation. 2

- Types of Centrifuges- Desktop centrifuge, High speed centrifuge and Ultracentrifuge . 2
- Preparative and Analytical Ultracentrifuge- its features. 2
- Differential Centrifugation (Principle, procedure, applications) 1

UNIT – IV Radiation Biophysics **12Hrs**

- Radiation Biophysics – Definition, Historical development-Plucker, Geissler, and Hittrof; Gustav Ludwig Hertz; Wilhelm Conrad Röntgen; Antoine Henri Becquerel; Pierre & Marie Curie; Joseph John Thompson; Ernest Rutherford; Hermann Joseph Muller and James Chadwick. 2
- Ionizing radiation- alpha, beta, gamma and X rays- their applications 2
- Sources of Ionizing radiation-Natural and Man made 1
- Radioactivity and Half life – definition
- Radioactive Isotopes- definition and its applications in biology. 2
- Biological effects of radiation- cellular level, Molecular level and Organism level. 2
- Radiation protection and therapy(Hormesis) 2
- Autoradiography(Principle, Protocol and applications) 1

UNIT – V Microscopy **12Hrs**

- Introduction to Optical Microscope 2
- Bright field Microscope. 2
- Dark field microscope 2
- Electron Microscopy- TEM & SEM 2
- Cryo Electron Microscopy 2
- Atomic Force Microscopy 2

SUGGESTED READING:

1. Uphadhyay and Nath 2002 **Biophysical chemistry principles and techniques**, Mumbai: Himalaya Publishing House, III edition,.
2. P. Narayanan 2007 **Essentials of Biophysics** Mumbai: New age International Publishers II edition

PLANT BIOTECHNOLOGY

Credits: 4 **Semester: III**

Subject Code:BT20302 **No. of Lecture Hours: 60**

Objectives:

- To provide core processes involved in the cultivation of plant cells and tissues in vitro thereby enabling student to understand and contribute to the practical application of these techniques
- To provide plant biotechnology processes, breeding of healthy plants, plants with improved characteristics and plants for pharming

Outcome:

- Student will acquire knowledge and technical skills in biotechnological, pharmaceutical, medical and agricultural applications

Unit specific Outcomes:

- Understand the Historical & current perspectives of plant biotechnology, plant tissue culture requirements and media components in plant tissue culture media
- Understand the methods of isolation and fusion of protoplast
- Understand Transformation techniques for production of disease resistant plants
- Understand the scale up strategies for production of secondary metabolites, and cryopreservation
- Understand various transformation techniques employed in plants

UNIT – I BASICS OF PLANT TISSUE CULTURE	12Hrs
• Plant tissue culture - Historical & current perspectives.	2
• Plant tissue culture applications	2
• Plant tissue culture medium- Media components, MS Medium, plant growth regulators.	3
• Plant tissue culture requirements	1
• methods of sterilization – Sterilization of media, maintenance of aseptic conditions, Explant sterilization	2
• Concept of cellular totipotency, differentiation and morphogenesis.	2
UNIT – II TECHNIQUES OF PLANT TISSUE CULTURE & CROP IMPROVEMENT	12Hrs
• Plant regeneration –organogenesis, applications	2
• somatic embryogenesis-application of somatic embryogenesis	2
• Synthetic seeds -production, applications	1
• Micro propagation –stages of micropropagation, applications	1
• Meristem Culture --production of virus free plants, applications	2
• Pollen Culture- production of haploids, applications	3
• Soma clonal variations– mechanisms and applications.	1
	12Hrs

UNIT –III PLANT PROTOPLAST TECHNOLOGY & CROP IMPROVEMENT

- Protoplast –Isolation of plant protoplasts (mechanical method, enzymatic method)3 — 3
- culture of plant protoplasts-agar embedding technique, Droplet culture, co-culture, feeder layer technique, Hanging droplet method — 2
- Protoplast fusion –spontaneous fusion, mechanical fusion, induced fusion — 2
- Somatic hybridization - Selection of somatic hybrids — 2
- Cybridization - methods to produce cybrids — 2
- Applications of protoplast technology to crop improvement — 1

UNIT- IV PLANT CELL TECHNOLOGY & SECONDARY METBOLITE PRODUCTION 12Hrs

- Callus Culture -production and applications — 22
- cell suspension cultures–Batch cultures, continuous cultures
- Plant cell culture strategies for enhanced production – elicitation, applications — 2
- Immobilization of plant cells–entrapment in gel, entrapment in foam, entrapment in hollow fibre membrane system, Two phase system, applications — 2
- Scale up strategies - Plant Bioreactors- types of bioreactor (STR, BCB, ALB) — 2
- Cryopreservation of plant cell line, applications — 2

UNIT – V GENETIC TRANSFORMATION AND TRANSGENIC CROPS 12Hrs

- Gene transfer strategies - Physical methods (microinjection, electroporation) — 2
- Gene transfer strategies -Chemical methods (Polyfection, lipofection) — 2
- Gene transfer strategies - Biological methods –Agrobacterium mediated gene transfer (leaf disc method) — 4
- Plant transformation vectors – co-integrate PTi vectors, binary vectors. — 1
- hairy root cultures-Ri plasmid — 2
- molecular farming — 1

SUGGESTED READING:

1. Kalyan Kumar De. 1997. An Introduction to Plant Tissue Culture. Calcutta: New Central Book Agency.

2. Chawla, H.S. 2008. Introduction to Plant Biotechnology. New Delhi: Oxford & IBH publishing Co.Pvt. Ltd.

3. Ramawat, K.G. 2000. Plant Biotechnology. New Delhi: S. Chand & Co.

4. Kumar H.D. 1991.A text book on Biotechnology. New Delhi: 2nd Edition. Affiliated East West Press Private Ltd.

5. Chrispcel M.J. and Sdava D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers.

6. Reinert J. and Bajaj Y.P.S. 1994. Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture. Narosa Publishing House.

RECOMBINANT DNA TECHNOLOGY

Credits: 4 **Semesters: III**

Subject Code: BT20303 **No of Lecture Hours: 60**

Objectives:

• To study the techniques used in genetic engineering.

• To explore the possible applications and future potentiality of biotechnology.

Outcome: Student will be able to distinguish between different cloning vectors and can apply PCR for different applications.

Unit specific Outcomes:

- Explain basic and advanced concepts of r-DNA technology
- Understand the cloning strategies and screening of Recombinants
- Analyze methodology of PCR and sequencing
- Select appropriate vector used for cloning.
- Apply r-DNA Technology principles for pharmaceutical applications

UNIT – I
Basic Techniques **12hrs**

- What is gene cloning and why do we need the clone of gene 1
- Purification of DNA from bacterial, plant and animal cells. 2
  Cutting and joining DNA
- Cutting – Host controlled restriction and modification, Classification of restriction enzymes 3
- Joining – DNA Ligases, double linkers, adaptors, homopolymer tailing. 2
- Gel Electrophoresis – Agarose gel electrophoresis 2
  --PAGE
- Principles involved in Blotting - Southern , Northern , Western blotting 2

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UNIT – II
Cloning Vechicles **12hrs**

- **Plasmids** :Basic and desirable properties of plasmid,Example: pBR322. 2
- Short note--Direct selection vectors, Low- copy- number plasmid ,Runaway plasmid vectors, bacteriophage and cosmid 2
- Cloning strategies-cDNAlibrary. 2
- Introduction of DNA into living cells:Transformation, transfection, electroporation, microinjection, lipofection. 3
- Recombinant selection and screening: 3
  Genetic method-immunochemical method , nucleic acid hybridization, recombinal probe method – HRT and HART.

UNIT – III
Gene Amplification and Sequencing **12Hrs**

- Gene amplification – Polymerase chain reaction (PCR) introduction, 1
- PCRconcept and technology, properties of primers,Taq DNA polymerase & its significance 4
- Modification of PCR: degenerate PCR, Nested PCR,Amplification of cDNA (RTPCR) 3
- Methods of gene sequencing: Maxam and Gilberts method, Sangers dideoxy chain termination method. 4

UNIT- IV
Cloning Vectors for Organisms other than E-Coli **12Hrs**

- **Yeast vectors:**Yeastintegratedplasmid(YIp),Yeast episomal plasmid (YEp),Yeast replicating plasmid (YRp),Yeast centromere plasmid (YCp) and Yeast artifical plasmid (YAp) 4
- **Plant – agrobacterium:** Ti plasmid 1

- **Plant viruses vectors:** Cauliflower mosaic virus (CaMv) ,Agro infection with Gemini virus, Tobacco mosaic virus 3
- **Animal viruses vectors:** SV40,Recombinant vaccinia virus , Baculovirus vector for insect cells and insect and Retrovirus 3
- Safety measure and regulations for recombinant DNA work (short note) 1

UNIT – V
Applications of rDNA Technology **12Hrs**

- Gene cloning and expression of foreign gene in research and biotechnology. 1
- Production of protein from cloned gene 1
- Gene cloning in medicine 1
- Pharmaceutical compounds -hGH,tPA,Epo, 3
- Artificial Insulin gene 2
- Recombinant Vaccine (Hep B) 3
- Diagnostic Reagents 1

SUGGESTED READING:

1. Old R.W. and Primrose. S.B. 1989.**Principles of Gene Manipulation**. London. Blackwell Scientific Publication.
2. Primrose. S.B. 1989. **Animal Biotechnology**. London.Blackwell Scientific Publication.
3. Watson, J.D. et al. 1987**. Celland Molecular Biology**. NY. John Wiley Publications.
4. Freifelder, D. 1993. **Molecular Biology;** Jones and Bartlett Publishers, London.
5. Brown T.A. 1995. **Gene Cloning – An Introduction.** 3rd Edition. Chapman & Hall.

CHEMISTRY - III

Credits: 4 **Semester: III**
Subject Code: BT20304 **No. of Lecture Hours: 75**

Objective:
To complete a Major Study in Organic / Inorganic Chemistry.
Outcome:
Students will develop the skills for multistep synthesis of organic compounds and can predict the reactivity from its structure.

Unit Specific Outcomes:

- Explain synthesis and properties of alcohols, phenols and ethers.
- Compare synthesis and properties of aldehydes and ketones.
- Explain synthesis and properties of carboxylic acids, illustrate applications of carbanions.
- Analyze the three dimensional view of a organic molecule, optical isomerism.
- Explain the properties of d- and f-block elements

UNIT-I **15Hrs**
Alcohols, Phenols & Ethers

- Classification – Monohydric, Dihydric, Tri hydric & Polyhydric alcohols – examples. **Monohydric Alcohols** – Nomenclature, classification (1^0,2^0& 3^0), Isomerism (chain, position &functional). Preparation methods - (i) Reduction of Carbonyl compounds, carboxylic acid & esters (iii)Hydrolysis of RX, (iv)from GR. 3
- Properties – Physical – Inter molecular hydrogen bonding (solubility in water, BP). Chemical Properties (A) Na, (B) HX & $ZnCl_2$,
- (C) Esterification (D) Oxidation using PCC & Oppenauer oxidation 2

  Dehydration of Alcohols (1^0, 2^0&3^0)-Using Conc.H_2SO_4 – (Mechanism)-Saytzeff's Rule. Oxidation of alcohols. 2
  Identification of Alcohols (i)Na, (ii)PCl_5, (iii)CH_3MgBr; Distinguishing Tests of 1^0,2^0& 3^0 Alcohols (i)Lucas Test (ii)Oxidation using $Na_2Cr_2O_4/H_2SO_4$ (iii)Cu/300^0C (iv) Victor Meyer Test. 2
- **PHENOLS** – Nomenclature, Preparation methods (i)from $C_6H_5N_2^+$, (ii)from $C_6H_5SO_3H$, (iii)from Cumene.
  Physical Properties – (a)intermolecular, (b) intramolecular hydrogen bonding (solubility in water & BP),
  - Examples as o-nitro phenol & p-nitro phenol. 1
- Chemical Properties – (i)Acidity (comparison with alcohol), effect of
  - substituents on acidity, (ii)Na, (iii)Williamson's synthesis-formation of Anisole. 1

- Special Reactions of Phenol :(i) Bromination, (ii)Nitration, (iii)Acylation Benzoylation, (iv)Kolbe-Schmidt reaction (Mechanism),
  (v)Reimer Teimann reaction (Mechanism), (vi)Azo Coupling reaction,
  (vii)HCHO, (viii)Condensation with Pthalic anhydride, (ix)Neutral $FeCl_3$,
  (x) Libermann's Test. 2

- Polyhydric Aocohols – Pinacol– Pinacolone Rearrangement (Mechanism).

- **ETHERS** – Nomenclature, Isomerism & Preparation (i)Williamson's Synthesis (Mechanism), (ii)Dehydration of Alcohols; Physical Proprties, Chemical Properties – (i)Inert nature, (ii)Conc.H_2SO_4, (iii)Conc.HI (Cold & Hot)- Zeisel's method. 2

UNIT - II **15Hrs**

Aldehydes & Ketones

- Nomenclature, Isomerism (chain, position, functional), Prepation(aliphatic aldehydes & ketones) – (i) from acid halides, (ii) from Dithianes, (iii)from nitriles, (iv)from carboxylic acids, (v)from gem dihalides; 2
- Preparation of (a)Aromatic aldehyde ex. Benzaldehyde – (i)Oxidation of Arene, (ii)Rosenmund reduction, (iii)GattermannKotch reaction,
  - (iv)from gem dihalide, 1
- (v)distillation of Calcium benzoate+Calciumformate.(b)Aromatic Ketones – (A)Benzophenone- (i)Friedel Craft's Acylation, (ii)distillation of Calcium benzoate, (iii)from gem dihalides. (B)AcetoPhenone- (i)Friedel Craft's Acylation, (ii)distillation of Calcium benzoate + Calcium acetate,
  - (iii)from gem dihalides. 1
- Physical Properties, Ketoenol Tautomerism(acid & base catalyzed), relative reactivity of aldehydes & ketones towards Nucleophilic addition reactions.
  - Acidity of α hydrogens. 2
- Nucleophilic Addition reactions : (i)$NaHSO_3$, (ii)HCN, (iii)RMgX, (iv)NH_3, (v)Amine.(vi)Reactions involving addition followed by elimination of water (a)NH_2OH, (b)N_2H_4, (c)$C_6H_5NHNH_2$,(d)2,4-DNP, (e)Schiff's base. 2
- (vii)Reactions of >C=O (a)Halogenation, (b)Reformatsky reaction, (c)Oxidation, (d)Reaction with alcohol;(viii)Reaction with Cl_2, (ix)Polymerization, (x)Reduction (a)Catalytic reduction – Pt/H_2 (or) Pd/H_2 (or)$LiAlH_4$, (b)MPV reduction, (c)reduction to alkanes (i)Clemmensen reduction,
  - (ii)Wolff Kishner reduction. 2
- Distinguishing Tests for Aldehydes & Ketones 2
- Base Catalyzed Reactions – (Mechanisms) (i)Aldol Condensation, (ii)Cannizaro reaction, (iii)Benzoin Condensation, (iv)Perkin Reaction, (v)Haloform reaction, (vi)Knoevenagel Reaction. 3

UNIT-III **15Hrs**

Carboxylic Acids & Its Derivatives / Carbanion Synthesis

- **CARBOXYLIC ACIDS** : Mono Carboxylic Acids – Nomenclature, Isomerism. Preparation – (i)Hydrolysis of (a)Nitriles, (b)Amides, (c)Esters, (ii)Carbonation of GR, (iii)Oxidation of alcohols & aldehydes. Preparation of aromatic Carboxylic acid ex. Benzoic Acid – (i)Oxidation of side chain of Benzene (ii)Hydrolysis ofC_6H_5CN, (iii)Hydrolysis of benzotrichloride, (iv)C_6H_6+$COCl_2$ (FriedelCraft'sreaction.) 1
- Physical Properies – Intermolecular hydrogen bonding (Solubility in water, BP), Chemical Properties-(A)Acidity-Effect of substituents, (B) Reaction involving –H of -COOH (i)NaOH, (ii)Na, (iii)Na_2CO_3 (or) $NaHCO_3$, (C)Reactions involving >CO of -COOH (i)Esterification-(Mechanism), (ii)PCl_5 (or) PCl_3 (or) $SOCl_2$, (iii)Dehydration, (iv)NH_3, (v)Huns Diecker reaction, (vi)Arndt Eistert synthesis. (D)Halogenation-HVZ Reaction(E)Schmidt Reaction. 2

- Ester Hydrolysis – (i)Acid catalyzed, (ii)Base catalyzed examples as (a) ethyl acetate, (b)ethyl Benzoate.(MECHANISMS) 2
- **Acid Amides** – Preparation (i)from CH3COONH4, (ii)Partial hydrolysis of CH_3CN, (iii)NH3+CH3COCl/CH3COOC2H5/(CH3CO)2O. Properties – (i)Basic Character, (ii)Hydrolysis, (iii)HNO2,(iv)Hoffmann Degradation. Comparison of basic strength of amine, Urea & amide. 2

Active Methylene Compounds

- Examples, sources & generation of Carbanions, Comparison of stability – (i) EAA (ii)Malonic Ester (iii)Acetyl Acetone. Keto-Enol Tautomerism (acid & base catalyzed) – Evidences supporting keto &enol forms. 2
- EAA – Preparation – Claisen Condensation (Mechanism), Properties of Keto ($Na-Hg/H_2O$, $LiAlH_4$, $NaHSO_3$, HCN, NH_2OH & $PhNHNH_2$)
- Enol (NaOH, CH_3COCl, Br_2). 2
- EAA Synthetic Applications – (i)Formation of Mono carboxylic acid-Alkyl & Dialkyl carboxylic acids, (ii)Di carboxylic acids-Succinic acid, Glutaric acid, Adipic acid, (iii)Unsaturated carboxylic acids-Crotonic acid, Cinnamic aid, (iv)Ketones-methyl ketones-2,4-di ketones, 2,5-diketones, (v)4-methyl Uracil. 2
- Diethyl Malonate: Preparation from acetic acid. Synthetic Applications- (i)Mono Carboxylic acids, Di carboxylic acid, Unsaturated acid-crotonic acid, (iv)amino acid-Glycine, (v)Ketones-Acetone, (vi)Barbituric acid. 2

UNIT : IV **15Hrs**

Stereo Chemistry

- Projection of organic compounds (Wedge, Fischer, Newmann projections & Sawhorse formulae). 2
- Definitions of Conformational, Configurational isomerism. 2
- OPTICAL ISOMERISM – Cause of optical activity –Asymmetric carbon, examples – lactic acid, glyceraldehyde, alanine 1
- Dissymmetric molecules - Definition & example – trans 1,2-dichloro cyclo propane. Enantiomers – Definition, examples & characteristics. 1
- Optical activity of compounds containing dissimilar chiral centers –example – 2,3-dibromopntane, Diastereomers – Definition & characteristics. 2
- Molecules with similar chiral centers – Mesomers – Definition,
  - example – Tartaric acid 2
  - Racemization and resolution methods. 2
- D-L & R-S Notation-Cahn-Ingold-Prelog rules-examples.
  - E-Z Notation-Geometrical Isomerism-in alkenes – examples. 2
- Conformational analysis of n-butane – Newmann projections-explanation of stability. cyclohexane-Bayer's Strain theory-stability of chair, twist boat, boat & half chair Conformations. 1

UNIT – V **15Hrs**

Transition Elements & Inner Transition Elements

- Definition, Electronic Configuration, General Properties-Comparative study of 3d-block elements (i)Atomic radii, (ii)IP, (iii)Metallic character, (iv)MP &BP, (v)SOP 3
- (vi)Complex formation, (vii)Magnetic Properties, (viii)Color,
- (ix)Variable oxidation states (x)Catalytic Properties. 3

Inner Transition Elements

- Definition; Lanthanides – Definition, position in periodic table, Electronic configuration. Lanthanide Contraction-Cause, Consequences. 2
  Oxidation states, Color, Magnetic properties, Complex formation. 3
- Methods of Separation of 4f-block elements-(i) Fractional Crystallization, (ii) Fractional Preparation, (iii)Ion Exchange method. 2
- Actinides-Definition, electronic configuration, oxidation states; Comparison with lanthanides 2

ESSENTIAL READING:

1.Agarwal O.P. -**Unified Course in Chemistry**- (Vol.II).

SUGGESTED READING:

1. Jerry March- **Advanced Organic Chemistry** 4th edition-Replika Press (P) Ltd.
1. ArunBHal&Bhal-**Advanced Organic Chemistry**
2. Finar I.L -**Organic chemistry**
3. Bansal R.K -**Organic chemistry**
4. Morrison R.T. & Boyd R.N - **Organic chemistry** (2003)-6th edition-Replika Press (P) Ltd.
5. Lee J.D.- **Concise inorganic chemistry** 5th edition-(Reprint-2010)
6. Madan Malik and Tuli- **Selected Topics in inorganic chemistry**(2010) S.Chand Company Ltd.
7. Kalsi P.S.- **Organic reactions their Mechanisms** 2nd edition New Age International Publishers(2005).
8. Nasipuri D.- **Stereo Chemistry of Organic Compounds** 2009 edition.New Age International Publishers.
9. Agarwal O.P.- **Organic Reactions & Reagents** Krishna Prakash Media (P)Ltd-Goel Publishers.

Kalsi P.S.- **Stereo Chemistry conformations& Mechanisms** (2010 edition)New Age International

MEDICAL LAB TECHNOLOGY PRACTICALS
(GENERAL ELECTIVE)

Credits: 1 **Semester: III**
Subject Code: G18BT1P **No. of Practical Hours: 30**

Objectives:

- To demonstrate scientific inquiry in course and lab assignments.
- To demonstrate effective verbal and written communication skills appropriate to the scientific community.
- To demonstrate critical thinking skills in examining issues in the biological world.
- To demonstrate effective analysis of biological issues through the use of case studies, laboratory and field research work.
- To be academically prepared for professional training.

Outcome: Student can analyze and interpret data to evaluate the various parameters involved in functions of a healthy human body.

1. Lab instruction for personal safety precaution. 1
2. Collection of clinical samples like blood and urine. 2
3. Qualitative analysis of sugars by Benedict's test. 1
4. Handling and care of Microscope. 2
5. Interpretation of a clinical lab report. . 2
6. Methods of disposal of Hospital waste 2
7. Uses, Care and Maintenance of Centrifuge, Autoclave, Hot air oven and Autoanalyser in the laboratory. 3

8.Antibiotic sensitivity test 2

SUGGESTED READING:

1. Sawhney S.K, Randhir Singh. 1992**. Introductory Practical Biochemistry.**
2. Thimmaiah S.R. 1991. **Standard Methods of Biochemical Analysis.**
3. Sadasivam S.Manickam A. **Biochemical Methods.** II Edition.

PLANT BIOTECHNOLOGY PRACTICALS

Credits: 1 **Semester: III**

Subject code: BT20305 **No of Practical Hours: 30**

Objective: To demonstrate and train in tissue culture techniques.

Outcome: Student will be able to gain knowledge on the advantages of invitro propagation in various areas.

1.	Preparation of Plant Tissue culture medium	2
2.	Sterilization methods in Plant Tissue culture	2
3.	Seed culture	2
4.	Pollen culture	2
5.	Establishment of callus cultures	2
6.	Preparations of Cell suspension cultures.	2
7.	Protoplast isolation and viability testing.	3

SUGGESTED READING:

1. Kalyan kumar De. 1997. An Introduction to Plant Tissue Culture. Calcutta: New Central Book Agency.

2. Chawla, H.S. 2008. Introduction to Plant Biotechnology. New Delhi: Oxford & IBH publishing Co.Pvt. Ltd.

3. Ramawat, K.G. 2000. Plant Biotechnology. New Delhi: S. Chand& Co.

4. Kumar H.D. 1991.A text book on Biotechnology. New Delhi: 2nd Edition. Affiliated East West Press Priva Ltd.

5. Chrispcel M.J. and Sdava D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers.

6. Reinert J. and Bajaj Y.P.S. 1994. Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture. Narosa Publishing House.

RECOMBINANT DNA TECHNOLOGY PRACTICALS

Credits: 1 **Semester: III**
Subject Code: BT20306 **No. of Practical Hours: 30**

Objectives:

- To provide further understanding of the fundamental physical principles while applying them to biological systems
- To provide basic skills on how to utilize physical principles to solve biological problems
- To develop skills of critical thinking about physical problems as they apply to biology.

Outcome: Student can analyze and interpret data related to Biochemical technique employed.

- Paper Chromatography- Separation of Ink 1
- Paper Chromatography – Separation of amino acids by ascending paper chromatography 2
- TLC- Separation of plant pigment 1
- Column Chromatography- Demonstration 2
- Agarose Gel Electrophoresis. 2
- Restriction Digestion 2
- Polymerase Chain Reaction 2
- HPLC Demonstration 3

SUGGESTED READING:

1. S.K Sawhney, Randhir Singh, 2007. **Introductory practical Biochemistry**, New Delhi: Narosa: Publishing House,
2. D.T. Plummer, 1988 **An Introduction To Practical Biochemistry** New Delhi: III Edition Tata McGraw Hill.
3. J.Jayaraman , 1981 **Laboratory Manual In Biochemistry**, New Delhi: I Edition Wiley, Eastern Limited.
4. B.Sashidhar Rao and Vijay Deshpande 2007 **Experimental Biochemistry – A Student Companion** IK: International pvt Ltd.

CHEMISTRY –III PRACTICALS

[QUANTITATIVE ANALYSIS]

Credits: 1 **Semester: III**
Subject Code: BT20307 **No. of Practical Hours: 30**
Objective :
To estimate the substances / ions present in given unknown samples.
Out Come:
Students will be able to estimate amount of unknown substances in a given sample using classical techniques as quantitative analysis.

VOLUMETRIC ANALYSIS:
Laboratory Safety Rules and Regulations:
Calibration of fractional weights,Calibration glass ware–burette, pipette, standard flask. Normality or Molarity and specific gravity of concentrated acids. Preparation of dilute acids and bases. Preparation of standard solutions. 1

Preparation of Lab Reagents:

Preparation of indicators and usage of indicators in Volumetric analysis, Role of indicator in detecting end point (Phenolphthalein, Methyl orange, Methyl-red, Potassium Chromate, EBT, Murexide). Preparation of buffer P^H- 10, acetate buffer, DMG, Mohr's salt solution, Iodine solution, Starch solution [Minor Experiment] 1

ACIDIMETRY& ALKALIMETRY

1. Estimation of Na_2CO_3 & $NaHCO_3$ Using Standard HCl solution (HCl standardized by standard Na_2CO_3 solution). 2
2. Estimating the amount of acetic acid present in Commercial Vaniger using Standard NaOH. 1

PERMANGANO METRY :

3. Preparation standard oxalic acid solution. Standardization of $KMnO_4$. Estimation of Calcium present in Chalk. 2

DICHROMETRY:

4. Preparation of a standard solution potassium dichromate, Estimation of ferrous and ferric. 1

IODOMETRY

5. Preparation of a standard solution of Potassium dichromate, standardization of Hypo. 1
6. Estimation of Copper in Copper Sulphate. 1

COMPLEXOMETRY

7. EDTA Titrations:
   (i)Estimation of Ni^{+2} 1
   (ii)Estimation of $Mg^{+}2$ 1

PRECIPITATION TITRATIONS:

8. Estimation of Zn^{+2} Using Potassium ferrocyanide.	1
VIVA QUESTIONS.	2

ESSENTIAL READING:

1. Mendham.J, Denney, Barnes.J and M.J.K. Thomas. **VOGEL'S Text Book of Quantitative Analysis.** 6th Edition. Pearson.

SEMESTER-IV

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
B.Sc. BIOTECHNOLOGY, CHEMISTRY & GENETICS
FOURTH SEMESTER
ACADEMIC YEAR-2021-2022 OF 2020-23 BATCH

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of Exam (hrs)	Marks			Credits
						Internal	External	Total	
THEORY									
1	II	BT20401	Biodiversity **(GE-4)**	3	3	40	60	100	3
2	II	BT20402	Biostatistics **(SEC-2)**	3	3	40	60	100	3
3	II	BT20403	Agriculture Biotechnology **(Core-10)**	4	3	40	60	100	4
4	II	BT20404	Human Genetics **(Core-11)**	4	3	40	60	100	4
5	II	BT20405	Medical Biotechnology **(Core-12)**	3	3	40	60	100	3
6	II	BT20406	Chemistry-IV **(Core-13)**	4	3	40	60	100	4
PRACTICALS									
7	II	BT20407	Biostatistics **(SEC-2)**	2	3	40	60	100	1
8	II	BT20408	Agriculture Biotechnology **(Core-10)**	2	3	40	60	100	1
9	II	BT20409	Human Genetics **(Core-11)**	2	3	40	60	100	1
10	II	BT20410	Chemistry IV **Core-13)**	2	3	40	60	100	1
TOTAL				**29**		**400**	**600**	**1000**	**25**

*****SEC Skill Enhancement Course
*GE Generic Elective

BIODIVERSITY

Credits: 3 **Semester: IV**

Subject Code: BT20401 **No. of Lecture Hours: 45**

Objective: To understand the diversity in nature.

Outcome: Students will be able to gain fundamental knowledge of the range auto ecological, population and community processes that are responsible for the variation and maintenance of patterns of the Biodiversity across different spacial & temporary scales.

Unit specific outcomes:

- students will gain an in depth understanding on biodiversity and its importance
- students will acquire basic knowledge on values of biodiversity and microbial taxonomy and toxins
- students will be able to gain basic knowledge on different types of diversity and ways to conserve wild life
- students will be able to gain knowledge on extinct threatened and endangered species,
- Biodiversity Hotspots & their protection
- students will be able to gain knowledge on importance of biodiversity conservation

UNIT- I **9Hrs**

- Introduction to Biodiversity 1
- Types of Biodiversity. 3
- Importance of Biodiversity. 2
- Biodiversity at Global ,National Levels 2
- Biodiversity as a natural resource. 1

UNIT- II **9Hrs**

- Value of Biodiversity. 1
- Consuptive use. 1
- Productive use. 1
- social value 1
- Ethical Value 1
- Aesthetic Value. 1
- Micro-organism: main taxonomic groups of micro-organism. (General concepts). 1
- Microbial toxins in environment. 2

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UNIT- III **9Hrs**

- Species diversity, Biological and phylogenetic species concept. 2
- Basic concepts of speciation, species extinction. 1
- Concept of genetic diversity. 2

- Ecosystem Diversity. 2
- Wild life conservation. 2

UNIT – IV **9Hrs**

- Hot Spots of Biodiversity. 2
- Threats to Biodiversity 2
- Concept of threatened species 1
- Threatened and endangered animals of India. 2
- Protection of wild flora, fauna and natural habitats . 2

UNIT- V **9Hrs**

- Reduction in biological diversity. 1
- Major causes of reduction in Biological diversity 2
- Approaches for conservation of biological diversity 4
  Ex-Situ Conservation
  In-Situ Conservation
- Biotechnological needs for biodiversity conservation. 2

SUGGESTED READING:

1. Asthana D.K & Meera Asthana. 2003 **Environment Problems & Solutions**. S.CHAND.

2. Anjaneyulu.Y **Introduction to Environmental Science.** B S Publications.

3. Krishnamurthy K.V. **Textbook of Biodiversity.**

BIOSTATISTICS

Credits: 3 **Semester: IV**
Subject code: BT20402 **No. of lecture Hours: 45**

Objective: To provide knowledge on basics in Biostatistics

Outcome: Students will be able to develop various forms of representations of data and its analysis by using statistical methods with maximum effectiveness.

Unit specific Outcomes:

- Students will be able to gain concepts of data and its collection
- Students will be able to represent the data in different forms
- Students will be able to gain knowledge on measures of central tendancy
- Students will be able to gain basic knowledge on measures of central dispersion
- Students will gain a basic understanding on sampling

UNIT-I **9Hrs**
Introduction to Biostatistics

- Definition of statistics 1
- Limitations of biostatistics 1
- Role of applied statistics 2
- Data and its collection: Sources of Primary Data, Secondary Data 2
- Types of Classification of data- Simple problems 2
- Simple and Complex Tables 1

UNIT-II **9Hrs**
Diagrams and Graphs

- Diagrams and graphs-Simple bar diagram 2
- Subdivided bar diagram 2
- Multiple bar diagram 1
- Pie diagram 1
- Histogram 1
- Frequency polygon 1
- Frequency curve 1

UNIT-III **9Hrs**

Measures of Central Tendency

- Mean-Merits and demerits-Individual, Discrete & Continues series (Simple Problems by Direct method) 2
- Median- Merits and demerits -Individual, Discrete & Continues series (Simple Problems by Direct method) 2
- Mode- Merits and demerits -Individual, Discrete & Continues series (Simple Problems by Direct method) 2
- Geometric Mean- Merits and demerits-(Simple Problems) 2
- Harmonic Mean -Merits and demerits – (Simple Problems) 1

UNIT-IV **9Hrs**

Measures of Dispersion

- Measures of variability –variability of Range-Merits and demerits-(Simple Problems) 2
- Quartile Deviation- Merits and demerits-(Simple Problems) 2
- Mean deviation- Merits and demerits-(Simple Problems) 2
- Standard Deviation- Merits and demerits-(Simple Problems) 2
- Calculation of Coefficient of Variance 1

UNIT-V **9Hrs**

Sampling

- Types of sampling-purposive sampling, random sampling, simple random sampling and stratified sampling 2
- Definition of Null hypothesis, Alternative Hypothesis, Types of errors; 2
- Level of significance 1

Small Sample test

- CHI-SQARE TEST
- Chi square test for goodness of fit 2
- Chi Square test for independence of attributes-Yates correction 2

SUGGESTED READING:

1. Vishweswara Rao K. **Biostatistics.** New Delhi: Jaysree Publishers.
2. Khan and Khanum. **Fundamentals of Biostatistics.** India: Ukaaz Publications.
3. Arora,P.N & Mashan P.K. **Biostatistics.** Meerut**:** Himalaya Publishing House.

AGRICULTURAL BIOTECHNOLOGY

Credits: 4 **Semester: IV**

Subject Code: BT20403 **No. of Lecture Hours: 60**

Objective: enables students to gain information on role of biotechnology in the field of agriculture and applications of transformation techniques

Outcome: The student will acquire knowledge about the range of approaches to manipulate and improve plants.

Students will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation in field of agriculture.

Unit specific Outcomes:

- Understand the Plant breeding methods and limitations of conventional breeding
- Understand the Concept of plant pathology, classification of plant diseases based on symptoms, Plant diseases
- Understand Transformation techniques for production of disease resistant plants
- Understand the Genetic Engineering techniques to improve quality of plants
- Understand Environmental issues, legal aspects of agriculture biotechnology

UNIT I PLANT BREEDING **12 Hrs**

- Introduction to Agricultural biotechnology. 1
- Conventional methods for crop improvement: Principles of plant breeding 3
- Breeding methods for self and cross pollinated crops 3
- Heterosis breeding, Mutation breeding 2
- Limitations of conventional breeding 1
- Crop improvement hybridization 2

UNIT-II PLANT PATHOLOGY **12 Hrs**

- Concept of Plant Pathology. 1
- Host Pathogen Relationship. 1
- Classification of Plant Diseases based on Symptoms. 4
- Control Measures (Chemical and Biological) 2
- Plant Diseases: Causative agent, Symptoms 3
- Powdery Mildew of Wheat. 1

UNIT-III PLANT TRANSFORMATION **12 Hrs**

- Insect resistance –endotoxin gene of Bacillus thuringensis 3
- Virus resistance – coat protein mediated, nucleocapsid gene 2
- Fungal resistance – PR proteins-1- chitinase, -3 beta glucanases. 3
- Herbicide resistance – phosphinothricin 2
- Nematode resistance - Nematode infestation 1
- Abiotic stress- drought resistance, salinity resistance 1

UNIT IV TRANSGENIC PLANTS IN QUALITY MODIFICATIONS 12 Hrs

- Genetic engineering of plant oils 2
- Genetic engineering for extended shelf-life of fruits 3
- Genetic manipulation of flower Pigmentation 2
- Manipulation of starch biosynthesis 1
- Seed storage proteins and their genetic improvement 3
- post-harvest biotechnology 1

UNIT V SAFETY REGULATIONS FOR TRANSGENIC PLANTS 12 Hrs

- Environmental issues associated with transgenic crops 3
- Food safety issues of transgenic food crops. 3
- risk assessment of transgenic food crops. 2
- Plant patents 1
- plant variety certificates 1
- Plant breeders rights 2

SUGGESTED READING:

1. Singh B.D. 1983.Principles of Plant Breeding. New Delhi: Kalyani Publishers.
2. Ram Kumar, 2008. Intellectual Property Rights-Demystified, New Delhi. New India Publishing House.
3. Kalyan kumar De. 1997. An Introduction to Plant Tissue Culture. Calcutta: New Central Book Agency.
4. Chawla, H.S. 2008. Introduction to Plant Biotechnology. New Delhi: Oxford & IBH publishing Co.Pvt. Ltd.
5. Chrispcel M.J. and Sdava D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers.
6. Reinert J. and Bajaj Y.P.S. 1994. Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture. Narosa Publishing House.

HUMAN GENETICS

Credits: 4 **Semester: IV**

Subject Code: BT20404 **No. of Lecture Hours: 60**

Objective: To prepares students for careers as independent laboratory researcher with a firm grasp of the developments in biological and medical research.

Outcome: Students will be able to gain knowledge on genetic disorders and their inheritance patterns and also gain comprehensive knowledge on blood, cancer and prenatal diagnosis.

Unit specific Outcomes:

- Students will be able to gain concepts of different types of inheritance pattern
- Students will be able to evaluate and analyse different blood related genetic diseases
- Students will be able to gain knowledge on cancer
- Students will be able to gain basic knowledge on genetherapy used in treating disease
- Students will gain a basic understanding on prenatal diagnosis and genes in population

UNIT- I **12Hrs**

Genetics of Human diseases

- Pedigree Construction - Symbols used
- Patterns of Single Gene Inheritance – Autosomal dominant, Autosomal recessive, X linked dominant and X linked recessive Inheritance patterns – factors effecting pedigree patterns 3
- Patterns of Autosomal dominant disorders – Huntington's disease 1
  Neurofibromatosis 1
  Familial hyper cholesterolemia 1
- Patterns of Autosomal Recessive disorders – Cystic fibrosis 2
  Tay sach's disease 1
- X linked dominant and recessive inheritance
  – fragile X syndrome, DMD 2
- Mitochondrial inheritance – short note 1

UNIT - II **12Hrs**

Disorders of blood

- Structure of Haemoglobin – Haemoglobin variants 2
- Development of Haemoglobin 2
- Globin chain structure 3
- Disorders of Haemoglobin structure – sickle cell disease 2
- Disorder of Haemoglobin Synthesis
  – Thalassaemias - α & β Thalassaemias , 3

UNIT- III **12Hrs**

Genetic basis of Cancer

- The Oncogenes : growth promoters 2
- Origin of Retroviral Oncogenes 2
- Retroviruses and their oncogenes – Mechanisms of Oncogene activation like DNA rearrangements, Insertional Mutagenesis, Chromosomal Translocations, Autocrine stimulation 3
- Cellular Oncogenes 1
- Tumor Suppressor genes - Retinoblastoma 2
- Functions of proto oncogenes and oncogenes 2

UNIT- IV **12Hrs**

Gene Therapy and genetic counseling

- Treatment of genetic diseases 2
- Gene Therapy protocol, vectors used in gene therapy – mammalian viral vectors used like adenoviral vectors, adeno associated viral vectors, herpes simplex viral vectors etc 2
- Non Mammalian viral vectors – Direct injection or partical bombardment, receptor mediated endocytosis, liposomes. 2
- Methods of Gene Therapy – Invivo Gene Therapy and Exvivo Gene Therapy Techniques – Gene Augmentation therapy, targeted inhibition of gene expression. Targeted mutation correction etc. 2
- Diseases amenable to gene therapy – Adenosine deaminase deficiency, Cystic fibrosis, familial hyper cholesterolemia, DMD 2
- Genetic counseling – Steps involved in genetic counseling and risk estimation - Bayes theorm ,optional, support-outcomes in genetic counseling 2

UNIT -V **12Hrs**

Prenatal Diagnosis & Introduction to Population Genetics

- Methods of Prenatal diagnosis
- Invasive methods – Amniocentesis, Chorionic villus sampling, Fetoscopy, Cordocentesis 4
- Non Invasive methods - Ultra Sonography,Maternal Serum AFP Radiography, NST etc (merits & 2 demerits) 4

- Introduction to population genetics: Random mating and genetic equillibriun 2

- Estimation of gene frequencies and testing Hardy Weinberg equilibrium for two allels 2

SUGGESTED READINGS

1. Edwin H. McConkey. **Human Genetics – The Molecular Revolution;** Jones and Bartlett publishers ,Sudbury, Massachusetts.

2. Robert F. Mullar, Lan D Young. **Emery's Elements of Medical Genetics** ; Churchill Livingston, Edinburgh.

3. Tomstrachn and Andrew P. Read . **Human Molecular Genetics**;Bios Scientific Publishers.

4. Fairbanks,Daniel J. **Genetics: the continuity of life**. 1999**.** Brooks/Cole Publishing Company.

5. Daniel L.Hartl ,Elizabeth W. Jones .**Genetics:Principles & Analysis**. 1998. Jones & Bartlett Publishers Inc.

MEDICAL BIOTECHNOLOGY

Credits : 3 **Semester : IV**

Subject Code : BT20405 **No. of Lecture Hours:45**

Objective:

To equip students with knowledge, skills, competencies and awareness in preparation for careers in biomedical research, biotechnology and related areas.

Outcome:

Students will be able to gain knowledge and skills associated with medical, cell or molecular biology that can be applied in a professional context.

Unit specific outcomes:

- students will be able to gain concepts on vaccines,different types of vaccines and their production
- students will be able to evaluate and analyse different markers and methods used for diagnosing diseases
- Students will be able to gain knowledge on different therapeutic agents used for treating disease
- Students will be able to gain basic knowledge on advanced techniques & strategies used in treating disease
- students will gain a basic understanding on drug discovery, designing, targets,properties& delivery

UNIT- I: **9Hrs**

Vaccine Technology

- Role of biotechnology in health care 2
- Vaccines-Definition, Properties ,Advantages & Disadvantages of vaccines 1
- production of vaccines 1
- Subunit vaccines (HSV) , Recombinant attenuated vaccines (vaccina virus) 2
- Anti-idiotypic vaccines 1
- DNA vaccines (Genetic immunization) 2

UNIT - II **9Hrs**

Diagnosis:

Enzymes in diagnosis: 2

- Enzymes to detect and quantify substances
    1. Assay of blood glucose
    2. Assay of blood cholesterol and triglyceride
- DNA Markers for Diagnosis: Use of DNA probes its features & applications ,RFLP(Restriction fragment length polymorphism), ARMS (Amplification refractory mutation system) 2
- RNA Marker for Diagnosis:Use of RNA, cDNA &oligonucleotide probes for diagnosis 2
- Monoclonal antibodies for Diagnosis: monoclonal antibody production.& its Application in Diagnosis of infectious diseases and cancer 2
- Biosensors &Biodevices in analysis of disease (Elementary level) 1

UNIT – III **9Hrs**

Biomolecules for Therapy

- Enzymes in therapy:
  Examples of the Therapeutic enzymes, Dnase, Asparaginase, superoxide dismutase, rennin, streptokinase, urokinase, lipase and adenosine deaminase. 2
- Blood products-Blood coagulation factors,Anticoagulants,Fibrinolytic agents 2
- Hormone Therapy: 2

  Example of hormones used in therapy: insulin, human growth hormone, erythropoietin , calcitonin, adenocorticotropic hormone and somatostation.
- Therapeutic proteins: 2
    - Cytokines – interferon's and interleukins
    - Formulation of protein drugs
- Biosensors for therapeutic drug response (Elementary level) 1

UNIT – IV

Advanced Therapeutic strategies **9Hrs**

- Antisense technology: 3
  - Principle , delivery, stability, Bioavailability , target specificity and advantages.
  - Application to cancer, antiviral drug
- Immunomodualtion as Therapy: 3
  - Immune suppressive agents
  - Specific immune modulation
  - Non specific immune modulation
- Monoclonal Antibodies for Immunotherapy : 2
  - Monoclonal antibodies in therapy for infectious disease
  - Monoclonal antibodies in cancer therapy
- Epigenetic/Chromatin modulators (Elementary level) 1

UNIT – V **9Hrs**

Molecular drug targets and nanomedicine

- Pharmacogenetics (Elementary level) 1
  Basic concept of molecular targeting 1
- Basics of drug discovery and development 2
- ADME properties of drug 2
- Tissue specific drug delivery 2
- Basic concept on Biosensors and Nanosensors in Therapeutic drug monitoring (Elementary level) 1

SUGGESTED READING:

1. S.N. Jogdand. 2000. **Medical Biotechnology**. Hyderabad. Himalaya Publishing House.
2. Robert F. Mullar, Lan D Young. 2012. **Emery's Elements of Medical Genetics**. Philadelphia. Elsevier Ltd.
3. Glick.B.R & Pasternak.J.J. 2002. **Molecular Biotechnology.** New Delhi. Panima Publishing Corporation.

CHEMISTRY IV

Credits: 4 **Semester: IV**
Subject Code: BT20406 **No. of Lecture Hours: 60**

Objective: To develop an understanding of breadth & Concepts of Physical / Organic / Inorganic Chemistry which can be useful for further Studies.

Outcome: Students will be able apply chemistry proficiency in all three displines of chemistry and also to develop critical thinking and analytical reasoning.

Unit Specific Outcomes:

- Evaluate the concept of critical phenomenon, real gas.
- Apply the concept of colligative property and determine molar mass of unknown compound.
- Analyze the structures of various complexes.
- Compare the aromaticity and synthesis of heterocyclic compounds.
- Explain synthesis and structures of carbohydrates and amino acids.

UNIT- I **12hrs**
Gaseous State

- PV=nRT Ideal gas, Real gas – Deviation of real gas from ideal behavior & derivation of Vander Wall's equation. Problems. 2
- Andrews PV-Isotherm of CO_2, Critical Phenomenon, 2
- Vader Walls PV-Isotherm- Critical state – Relationship between a, b & P_c , T_c, V_c. Problems. 3
- Principle of Continuity of state, Reduced equation of State (Law of corresponding states). Problems. 3
- Joule Thomson Effect – Liquefaction of gases: Claude's Method-Adiabatic Expansion 2

UNIT -II **12hrs**
Dilute Solutions & Colligative Properties
Definition of solution – expressions of concentration (M , N , m , & x). Dilute solution – Colligative property . Lowering of Vapor pressure – Raoult's Law – Experimental determination of molar mass of non volatile solute using lowering of VP (Ostwald Walker Dynamic method) Problems. 2

- Osmosis – Semi permeable membrane, Van't Hoff laws of Osmatic Pressure. Relation between osmotic pressure of solution containing non volatile solute and $(P^0 - P)$. 1
- Experimental determination of 'm' of non volatile solute using osmatic pressure of solution Berkley Hartley method. Problems. 2

- Elevation in boiling point – VP – Curves determination of 'm' of non volatile solute from elevation in BP, Relation between elevation in BP & (i) $(P^0 - P)$ (ii) π 1
- Experimental determination of 'm' of non volatile solute using elevation in BP of solution Cottrell's method. Problems. 2

- Depression in FP – VP – Curves – determination of 'm' of nonvolatile solute. Relation between depression in FP & (i) $(P^0 - P)$ (ii) π. 1

- Experimental determination of 'm' of non volatile solute using depression in FP of solution Rast Camphor method. Problems . 2
- Abnormal behavior of solutions – Van't Hoff factor – degree of association & degree of dissociation. Problems. 1

UNIT-III **12hrs**

Coordination Chemistry

- Simple salt, double salt & coordination complex – definitions and examples. 1
- Review of Werner's Theory& Sedgwick's concept of coordination ; EAN –Rule. 2
- Valence Bond Theory – Postulates, geometries of (i) Tetrahedral (ii) Square Planar (iii)Octahedral Complexes, its limitations. 2
- Crystal Field Theory – Postulates – Splitting of d-orbitals (i)Td (ii)Sq Pl (iii)Oh - complexes. 2
- Isomerism – Structural & Stereo – Geometrical and Optical for Coordination no.4 &6. 2
- Composition of a complex - Job's method. Detection of formation of a complex. 1
- Factors affecting the formation of a complex. Applications of complex formation in Qualitative & Quantitative Analysis. 2

UNIT-IV **12hrs**

Heterocyclic Compounds

- Definition - Preparation of Pyrrole (Paal Knorr Synthesis, from $C_2H_2 + NH_3$, from Ammonium mucate, from Succinic dialdehyde + NH_3) Furan (Paal Knorr synthesis, from Mucic acid, from succinic dialdehyde , from pentose sugar) &Thiophene (Paal Knorr synthesis, from $C_2H_2+H_2S$, from furoicacid+BaS, isolation from Light oil). 2
- Aromatic nature of (i) Pyrrole (ii) Furan (iii) Thiophene. 2

- Reactivity of pyrrole, furan & thiophene - Comparison with benzene towards ESR.1

- Pyrrole – (i) Basic character, (ii) Acidic character, (iii)ESR – (a)Nitration (b)Sulphonation (c)Halogenation (d)Friedel Craft's Acylation (e)Kolbe-Schmidt reaction (f)Reimer Tiemann Formylation (g)Diazo Coupling (h) Michel addition, (iv)Oxidation (v)Reduction (vi) Ring opening. 1
- Furan - (i)Basic character, (ii)ESR- (a)Nitration (b)Sulphonation (c)Halogenation (d)Fredel Craft's Acylation (e)n-buLi, (iii)Reduction, (iv)Ring opening reaction, (v)Diels Alder raction. 1
- Thiophene – ESR- (i) Nitration (ii)Halogenation (iii)Friedel Craft's Acylation (iv)n-buLi (v)Reduction 1
- Structure & aromatic nature of Pyridine (based on MOT).
    - Preparation – (i) C_2H_2+HCN, (ii)from Piperidine, (iii)from Pyrrole,
    - (iv)from β-Picoline. 1

- Comparison of basisity of pyrrole, Piperidine, pyridine
    - with $(CH_3)_3N$. 1
- Pyridine Properties – (i)Basic character (ii)ESR (Mechanism–General)- (a)Nitration, (b)Sulphonation, (c) Bromination (d)Friedel Craft's Acylation. (iii)Nucleophilic substitution reactions of Pyridine(Mechanism-General)- (a) Chichibabin reaction (b)NaOH (c)n-buLi (iv)Oxidation (v)Reduction 2

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UNIT -V **12hrs**

Carbohydrates & Amino Acids

- **Carbohydrates**: Definition & classification; Structural Elucidation of glucose-Evidences for straight chain pentahydroxy aldehyde structure (Acylation, reduction to n-hexane, cyanohydrin formation, reduction of TR & FR; oxidation to gluconic acid and glucaric acid). Absolute Configuration (proof not required) Cyclic structure of D(+)glucose-ring size determination (methylation, hydrolysis & oxidation Reactions) 2
- Structural elucidation of fructose-ring structure-Haworth form(formation of penta acetate, cyanohydrin &its hydrolysis oxidation). 1

- Chemical Properties of glucose & fructose - (i)Acetylation (ii) reaction with $Ca(OH)_2$ (iii)CH_3OH(iv)Reduction (v) Oxidation (a)Br_2/H_2O (b) HNO_3 (vi)NH_2OH (vii) $PhNHNH_2$ (viii)HCN, Hydrolysis reduction (ix) alkali. 2
- Typical Inter conversions – (i)Glucose to Fructose (ii) Fructose to Glucose (iii)Glucose to Mannose(Epimerization) (iv) Arabinose to Glucose (Kiliani's synthesis) (v) Glucose to Arabinose (a) Wohl's Synthesis (b) Ruff degradation . 2

- **Amino Acids** : Definition, classification & preparation methods for alpha amino acids (Glycine, Alanine, Valine &Leucine (i) Halogenated carboxylic acids (ii)Malonic ester synthesis (iii)Strecker's Synthesis. 2
- Physical Properties - Zwitter ion, characteristics , Iso electric point. 1
- Chemical Properties (A) Reactions of -COOH : (i)NaOH (ii) Esterification (iii)Decarboxylation (iv) $LiAlH_4$. (B) Reactions of $-NH_2$: (i)HCl (ii)Acylation (iii)Benzoylation (iv) HNO_2 (v)HCHO (vi)2,4-DNB(C) Reactions of both –COOH & $-NH_2$: (i) Action of heat (ii)Methylation (iii) reaction with Ninhydrin(iv) formation of Sydnone (v) Cu_2O. 2

SUGGESTED READING:

1. Jerry March- **Advanced organic chemistry** 4th edition-Replika Press (P) Ltd.
2. ArunBahl&Bahl- **Advanced organic chemistry**
3. Cotton F.A, G.Wilkinson G -**Advanced Inorganic chemistry** (6th edition)Carlos A Marillo Manfred Bochmann-Wiley India Education
4. Madanmalik&Tuli- **Selected topics in inorganic chemistry** (Reprint-2010) S.Chand Company Ltd
5. Gopalan R, Ramalingam V - **Concise coordinate chemistry** Vikas Publishing House (P)Ltd
6. Banerjea D.-**Coordination Chemitry** (3rd edition)Asian Books (P) Ltd
7. ArunBhal&Bhal- **Essentials of physical chemistry**
8. Puri ,sharma& Pathania **Principles of physical chemistry** -41st edition-Vishal Publishing Co.

BIOSTATSTICS PRACTICALS

Credits: 1 **Semester: IV**
Subject code: BT20407 **No. of Practical Hours: 30**

Objective:
To provide students with basic knowledge and applicable skills in Biostatistics
Outcome: Students will be able to apply the relevant experiments and problems with maximum flexibility and effectiveness.

1) Graphical representation of Data 2
2) Measures f central tendency: Mean, Mode , Median 3
3) Measures of Dispersion- Mean Deviation, Standard Deviation 3
4) Calculation of coefficient of Varience 2
5) Chi square test for goodness of fit 3
6) Chi Square test for independence of attributes-Yates correction 2

SUGGESTED READINGS

1. Vishweswara Rao K.**Biostatistics.** New Delhi: Jaysree Publishers.
2. Khan and Khanum .**Fundamentals of Biostatistics**. India: Ukaaz Publications.
3. Arora,P.N & Mashan P.K. **Biostatistics.** Himalaya Publishing House.

AGRICULTURAL BIOTECHNOLOGY PRACTICALS

Credits: 1 **Semester: IV**

Subject Code: BT20408 **No. of Lecture Hours: 30**

Objective: To demonstrate the role of biotechnology in the field of agriculture

Outcome: Students will be able to develop knowledge in field of agriculture biotechnology.

1.	Optimization of tissue culture media	2
2.	Surface sterilization of explants	2
3.	Meristem culture for virus free plants	2
4.	Regeneration studies in cereals	2
5.	Hardening /Acclimatization of regenerated plants	2
6.	Study of disease symptoms and host parasite relationship.	3
7.	Identification of different stages of nematode infestation	2

SUGGESTED READING:

1. Singh B.D. 1983.Principles of Plant Breeding. New Delhi: Kalyani Publishers.
2. Ram Kumar, 2008. Intellectual Property Rights-Demystified, New Delhi. New India Publishing House.
3. Kalyan kumar De. 1997. An Introduction to Plant Tissue Culture. Calcutta: New Central Book Agency.
4. Chawla, H.S. 2008. Introduction to Plant Biotechnology. New Delhi: Oxford & IBH publishing Co.Pvt. Ltd.
5. Chrispcel M.J. and Sdava D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers.
6. Reinert J. and Bajaj Y.P.S. 1994. Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture. Narosa Publishing House.

HUMAN GENETICS PRACTICALS

Credits: 1 **Semester: IV**

Subject Code: BT20409 **No. of Practical Hours: 30**

Objective: To train in the application of the various diagnosis techniques in genetic diseases and prenatal diagnosis to overcome/avoid birth defects.

Outcome: Students will be able to develop a comprehensive and practical understanding of chromosomal identification and techniques involved diagnosis of genetic diseases.

1.	Estimation of haemoglobin	2
2.	Karyotyping of human chromosomes	2
3.	Pedigree analysis	2
4.	Genetic counseling and risk management	2
5.	Gene mapping using clonal assay	1
6.	DNA Extraction from Human blood sample by using salting out method.	2
7.	Techniques for Amniotic Fluid cell culture, chorionic villus culture and fibroblast culture (solid tissue specimen)	1
8.	Preparation of at least ten karyotypes from metaphase spreads of normal and abnormal chromosome complements.	2
9.	Problems on Hardy Weinberg Law of Equilibrium for two allels.	1

SUGGESTED READING:

1. Edwin H. McConkey. **Human Genetics – The Molecular Revolution.** Jones and Bartlett publishers ,Sudbury, Massachusetts.
2. Robert, F. M., Lan, D. Y. **Emery's Elements of Medical Genetics** ; Churchill Livingston, Edinburgh
3. Fairbanks, D. J. **Genetics: The continuity of life**. 1999. Brooks/Cole Publishing Company.
4. Daniel, L., Hartl, Elizabeth, W. J. **Genetics: Principles & Analysis**. 1998. Jones & Bartlett Publishers.

CHEMISTRY-IV PRACTICALS

[QUALITATIVE ANALYSIS OF ORGANIC COMPOUND]

Credits : 1 **Semester: IV**
Subject Code :BT20410 **No. of Practical Hours:30**

Objective: To detect the given unknown organic compound.
Outcome: Students can recognize given unknown organic compound in a sample along with physical constant by qualitative organic analysis.
Preparation of Lab Reagents:

Bayer's reagent, Bromine water, Benedict's reagent, 2,4-DNP, Fehling's solution, Molisch's reagent, Schiff's reagent, Tollen's reagent.

1

Functional group Reactions, solubilities, Lassigne's test (detection of nitrogen) 1

Demonstration of Lassigne's test. 1

Solubility of organic compounds in various solvents 1

1. Aromatic amine 1
2. Carbohydrate-Polyhydroxy aldehyde 1
3. Phenol 1
4. Aromatic amide 1
5. Aromatic Carboxylic acid 1
6. Aromatic Nitro compound 1
7. Aromatic Aldehyde 1
8. Aromatic Simple Ketone 1
9. Aromatic Methyl Ketone 1
10. Aromatic Hydro carbon 1
11. Discussion of Viva Questions, MP's & BP's determination. 1

ESSENTIAL READING:

Mann.F.G. and Sauders.B.C. 1999. **Practical Organic Chemistry.** 4th Edition. U.S.A: Pearson.

BIOTECHNOLOGY AND HUMAN WELFARE

(SELF STUDY COURSE)

UNIT- I Introduction to Biotechnology

- Biotechnology-definition, importance, history and scope of biotechnology
- Basics of Biotechnology- Biochemistry, Microbiology, cell biology and Molecular biology.
- Areas of Biotechnology - Genetic engineering, Protein engineering, Bioinformatics,
    - Immunology, Plant Biotechnology, Animal Biotechnology, Cancer Biology, Environmental Biotechnology, Marine Biotechnology, Nano Biotechnology and Pharmacology.
- UNIT - Il Food Biotechnology
- Single Cell Proteins- definition,history, production,applications, merits and demerits ● Neutraceuticals- definition, classification, difference between nutraceutical and functional foods.
- Probiotics- definition, history, importance, characteristics, mode of action, merits and demerits.
- Prebiotics- definition, characteristics, tnes and mechanism of action.
- UNIT Ill Forensic Biotechnology
- Forensic science- definition
- DNA Fingerprinting-definition, principle, ,STR,VNTR. ● Merits and demerits of DNA fingerprinting ● Applications of DNA fingerprinting.
- Uses of DNA fingerprinting in forensic science.
- UNIT - IV Environmental Biotechnology:
- Environmental Biotechnology- definition
- Waste water treatment
- Bioremediation: Intrinsic bioremediation, Biostimulation and Bioaugmentation. In situ and ex situ bioremediation technologies
- Microbial Insecticides: Bacterial, fungal and viral insecticides in pest management.

- **UNIT ¯ V**
- Applications in Biotechnology

- Human genome project.
- Biotechnologies: development, applications and their benefits:
- Basic principles of ethics concerning new technologies in agriculture, medicine, health care, diagnostics, food technology and environment.

SUGGESTED READING:

l. InduShekarThakur. 2011. Environmental Biotechnology Basic Concepts and Applications. New Delhi. 1K international publishing house pvt Ltd.

2. Dr.Das.H.K. 2010. Text OfBi0techn010gy. Hyderabad. Wiley Publishers

3. Singh B.D. 2010. Applications Of Biotechnology. Hyderabad. Kalyani Publishers.

Nano Biotechnology
Add-on Course

Unit 1: Principles of Nano biotechnology

- Functional Principles of Nano biotechnology- Fundamentals-
- Physicochemical Principles of Nanosized Drug Delivery Systems-Nanotubes, Nanorods, Nanofibers, and Fullerenes for Nanoscale
- Drug Delivery, Carbon nanotubes biocompatibility and drug delivery

Unit 2: Molecular Assembly

- Self assembling nanostructures- Self-Assembled Artificial Transmembrane
- Ion Channels-types, Methods, Self-Assembling
- Nanostructures from Coiled-Coil Peptides, Synthesis and Assembly using Bio-Derived Templates- Self-Assembling for Patterned Molecular Assembly.

Unit 3: Nanostructures

- Protein and Peptide based Nanostructures- S-layers-Chemistry and structure, Assembly, recrystalisation, diagnosis-
- Engineered Nanopores- Methods of production Supported bilayers and membrane arrays- Genetic Approaches-
- Microbial nanoparticles production- Magnetosomes- Bacteriorhodopsins-Nanoproteomics.

Unit 4: Nucleic acid Nanoparticles

- DNA based Nanostructures- DNA-protein nanostructures-
- Methods- Self assembled DNA nanotubes—
- Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties.

Unit 5: Drug Nanoparticles

- Pharmaceutically important nanomaterials
- Drug Nanoparticles- Structure and Preparation, Liposomes, Cubosomes and Hexosomes, Lipid based Nanoparticles-Liquid nanodispersions-
- Solid Lipid Nanoparticles (SLP)- Biofunctionalsiation of SLP, Charatcterisation-Nanoparticles for crossing biological membranes.

References:

1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.
2. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag Gmb H&Co, 2004.
3. S. David Goodsell, Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc, 2004.
4. Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press 2009.
5. Robert A. Freitas Jr. Nanomedicine, Volume I:Basic Capabilities, Landes Bioscience,1999

SEMESTER - V