OVERVIEW OF THE SYLLABUS

- **Semester I :**
  - **Core Course :-** Biochemistry and Metabolism (UBTTC-101)

- **Semester II :**
  - **Core Course :-** General and Applied Microbiology (UBTTC-201)

- **Semester III :**
  - **Core Course :-** Cell and Molecular Biology (UBTTC-301)
  - **Skill Enhancement course (SEC-I) :-** Environmental Biotechnology (UBTTS-301)

- **Semester IV :**
  - **Core Course :-** Enzymology and Bioprocess Technology (UBTTC-401)
  - **Skill Enhancement course (SEC-II):-** Food Biotechnology (UBTTS-401)

- **Semester V :**
  - **Discipline Specific Elective I (DSE-I):-** Plant Biotechnology and Genetic Engineering (UBTTDSE-501)
  - **Discipline Specific Elective II (DSE-II):-** Biotechnology for Human Welfare (UBTTDSE-502)
  - **Skill Enhancement course (SEC-III) :-** Intellectual Property Rights (UBTTS-501)

- **Semester VI :**
  - **Discipline Specific Elective III (DSE-III):-** Immunology and Animal Biotechnology (UBTTDSE-601)
  - **Discipline Specific Elective IV (DSE-IV) :-** Industrial Fermentations (UBTTDSE-602)
  - **Skill Enhancement course (SEC-IV) :-** Clinical Biochemistry (UBTTS-601)

Pattern for Examination

- Each theory paper /course shall be of 100 marks.
- 20% of which shall be reserved for internal assessment.
- 80% of which shall be reserved for external examinations to be conducted by the University/Colleges.
- The External examination in theory shall consist of the following :
  1. **Five (5) short answers** to the questions representing all units/syllabi i.e. at least one from each unit (without detail explanation having 70 to 80 words in approximately 6 minutes and having **3 marks** for each answer to the question **(All Compulsory).**
  2. **Five (5) medium answers** to the questions representing all units/syllabi i.e. at least one from each unit (with explanation having 250 to 300 words in approximately 12 minutes and having **7 marks** for each answer to the question **(All Compulsory).**
  3. **Five (5) long answers** to the questions **(two to be attempted)** representing whole of the syllabi with detailed analysis/explanation/critical evaluation/solution to the stated problem within 500 to 600 words in approximately 30 minutes and having **15 marks** for each answer to the question.

SEMESTER-I

Core Course

Course Title : Biochemistry and Metabolism
Course Code : UBTTC-101
Course Credits: 06

Learning outcomes

- The Course aims to make students familiar with the basics of Biochemistry and various biochemical processes with a special emphasis on metabolism of various biomolecules like carbohydrates, Proteins, Lipids and Nucleic acids.
- The students get an overview of various metabolic pathways and cycles involved in cellular metabolism and how an imbalance or anomaly in functioning of these pathways can prove to be of clinical significance.
- The course aims at priming the students towards understanding deeper concepts of cellular functioning in the coming semesters.

UNIT – I

Water and its properties; physicochemical properties of water; Dissociation and association constants, pH, buffers, pI, pKa, solutions, solubility, criteria for solubility, hydrophobicity and hydrophilicity; Dielectric constant; Thermodynamics; free energy, enthalpy, entropy and redox potential.

UNIT – II

Carbohydrates, structure of mono-, di- and polysaccharides, cellulose, glycogen, starch, Glycoproteins, peptidoglycans, lipolysaccharides; Carbohydrate metabolism- glycolysis, Fate of pyruvate under aerobic and anaerobic conditions, Entry of fructose and galactose in glycolysis, TCA cycle, Amphibolic and anaplerotic nature of TCA cycle, gluconeogenesis; Electron transport chain, oxidative phosphorylation, pentose phosphate pathway: Oxidative and non oxidative phase, glyoxylate cycle.

UNIT – III

Structure of amino acids: acidic, basic and neutral amino acids, essential amino acids, Chemical reactions; Structural organization of proteins, primary, secondary: The alpha- helix, beta-pleated sheet structures, tertiary and quaternary structure of proteins and the Forces that stabilize the structure, Protein classification, fibrous and globular proteins and functions; Biosynthesis and degradation of amino acids; Reduction and assimilation of atmospheric nitrogen, nitrogen cycle.

UNIT – IV

Lipids and fats, classification of lipids and fatty acids, saturated and unsaturated fatty acids, general structure and functions of major subclasses of lipids-acylglycerol, phosphoglycerides, sphingolipids, glycosphingolipids, terpenes, sterols, cholesterol and steroids; prostaglandins; biosynthesis and degradation of fatty acids.

UNIT – V

Nucleic acid, DNA :A, B & Z- DNA , RNA: Structure of m-RNA, r-RNA & t-RNA, structure and type of nucleosides and nucleotides, biologically important nucleotides and their functions. Biosynthesis and degradation of nucleic acids.Vitamins and hormones; types of vitamins and their deficiency symptoms, steroid and peptide hormones.

Books recommended

1. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2003). Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
2. Stryer, L. (2001) Biochemistry : 5th Edition, W.H. Freeman and Company, New York.
3. Zubay, G.L., Parson. W.W. and Vance, D.E. (2006). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.
4. Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd ed., John Wiley and Sons Inc., New York.

Practicals

1. Preparation of physiological buffers.
2. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
3. Determination of pKa value of P-nitrophenol.
4. The colorimetric estimation of inorganic phosphate.
5. Estimation of carbohydrate in given solution by anthrone method.
6. Estimation of sugar in biological samples by Dubois method.
7. Protein estimation by Lowry's/ Bradford method.
8. Analysis of urine for urea, glucose, uric acid and choride
9. Determination of acid value of a fat.
10. Determination of saponification value of a fat.

Books recommended

1. Plummer, D.T. (1990) An Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Singh, R. and Sawhney, S.K. (2002) Introduction to Practical Biochemistry. Narosa Publications, New Delhi.

SEMESTER II

Core Course

Course Title : General and Applied Microbiology
Course Code : UBTTC-201
Course Credits: 06

Learning Outcomes

- General and Applied Microbiology course is designed to provide the student with strong theoretical base of microbiology.
- The course is designed to introduce the student with the principles and practical considerations of microbiology.
- It also includes the concept, principles and methods used in microbial biotechnology and the possibilities of production of various products from microbial source.

UNIT – I

History, development and scope of Microbiology, Principles and applications of microscopy (bright field, darkfield, phase contrast, fluorescence and immunofluorescence, confocal microscopy, electron microscopy). Methods in Microbiology, pure culture techniques, microbial culture media, sterilization, culture collection and maintenance of cultures

UNIT – II

Prokaryotic cell structure and function, Flagella and motility, Cell inclusions. Bacterial staining. Microbial growth: batch and continuous culture; Factors affecting growth;Viruses: Discovery, Classification and structure of viruses (Plant, animal and bacterial viruses), Retroviruses. Metabolic diversity among microorganisms.

UNIT – III

Distribution and classification of algae (Fristch) and fungi (Ainsworth).Reproduction and nutrition in algae and fungi. Fungi and ecosystem. Algal ecology and algal biotechnology, Morphology, motility and reproduction in protozoa.

UNIT – IV

Industrial products derived from microbes, industrial enzymes, production of antibiotics, vitamins and vaccines; Single cell proteins, biofertilizers, nitrogen fixation, vermiculture, composting, herbicides and biopesticide production, Biotransformation, bioremediation of

contaminated soils, biodegradation of organic pollutants and xenobiotics; bioplastics and biomining.

UNIT – V

Air borne disease transmission, respiratory diseases caused by bacteria and viruses, Direct contact disease transmission, tuberculosis, sexually transmitted disease including AIDS, diseases transmitted by animals (rabies, plague),Arthropod transmitted disease (rickettsias, malaria, lyme disease), food and waterborne diseases (Cholera, Giardiasis , Typhoid), pathogenic fungi.

Books recommended

1. Stainer, R.Y., Ingraham, J.L., Wheelis, M. and Painter, P.R. (2003) General Microbiology.The Mac Millan Press Ltd. London.
2. Pelczar, M.J.J., Chan, E.C.S. and Kreig, N.R (2005) Microbiology. Tata McGraw Hill, New Delhi.
3. Prescott, L.M., Harley, J.P. and Klein, D.A. (2005) Microbiology. McGraw Hill, USA.
4. Mackie and McCartney. (1996) Medical Microbiology.Vol. 1. Microbial Infection. Churchill Livingstone.
5. Cappuccino, J.G. and Sherman, N. (1996) Microbiology – A Laboratory Manual.

Practicals

1. To study different components, use and care of the compound bright field microscope.
2. Culture characteristics of different microorganisms.
3. Different sterilization techniques. Preparation of media for cultivation of bacteria and fungi.
4. Isolation of microorganisms from soil, air and water. Colony purification.
5. Enumeration of microorganisms; total vs viable count.
6. Study morphology of molds and yeast by methylene blue staining.
7. Bacterial staining: simple staining, Negative staining and Gram's staining.
8. Biochemical activities of microorganisms.
9. Standard qualitative analysis of water.
10. Antibiotic sensitivity of microbes.
11. Microbial flora of mouth, teeth and throat.

Books recommended

1. Cappuccino, J.G. and Sherman, N. (1996) Microbiology – A Laboratory Manual. Addison – Wesley.
2. Aneja K.R. (2005). Experiments in Microbiology, Plant Pathology and Biotechnology (4th edition). New Age International (P) Limited, New Delhi.

SEMESTER III

Core Course

Course Title : Cell and Molecular Biology
Course Code : UBTTC-301
Course Credits: 06

Learning Outcomes

- The course aims to make students well versed with structural and functional information about the cell.
- The students will be educated about various concepts of genetics and important cellular processes like replication, transcription and translation.
- Various aspects of the course like gene regulatory mechanisms and applied genetics are of importance for the students.

UNIT – I

Cell theory, Structure of pro-and eukaryotic cells; cell wall in plants and microbes; structure and function, Plasma membrane; transport through membrane, Cell organelles; Nucleus, Mitochondria, Chloroplast and endoplasmic reticulum. Basic concept of cell signaling. Chromosome structure and function.

UNIT – II

Mendelian Genetics, interaction of genes, Recombination, Bacterial genetic system; transformation, transduction and conjugation, Mutations; molecular basis, Overview of transposable elements in bacteria and plants. Structural and numerical alterations of chromosomes.

UNIT – III

Central dogma , Model organisms to study Molecular biology. Nucleic acids ; DNA and RNA as a genetic material, experimental basis. DNA structure: Direct and indirect methods for analysis of DNA . Direct method; X-ray crystallography, autoradiography and electron microscopy to study DNA. Indirect methods Spectroscopy and Agarose gel electrophoresis . Factors determining structure of DNA, Hydrogen bonding in DNA, Hydrophobic interactions in DNA, base stacking, different forms of DNA: A, B, Z, Satellite DNA, Shapes of DNA; Linear and Circular DNA.

UNIT – IV

General features of DNA replication and basic rules of replication. Semiconserative mode of DNA replication Experimental basis , Replication in prokaryotes, initiation,elongation and termination. Replication in eukaryotes Initiation ,elongation and termination Transcription in prokaryotes , Initiation, elongation and termination. Transcription in eukaryotes initiation, elongation and termination

UNIT – V

Regulation of gene expression in prokaryotes operon concept , inducible and repressible operons., Translation: structure and function of ribosomes, mRNA, tRNA, rRNA; Protein synthesis in prokaryotes initiation ,elongation and termination Translation in eukarotes initiation elongation and termination.

Books recommended

1. Alberts, B. Bray, D. Lewis, J. Raff, M., Roberts K. and Watson J.D (2002). Molecular Biology of Cell (2nd edition), Garland Publishing Inc., New York.
2. Dranell, J. Lodish, H and Baltimore D (1999). Molecular Cell Biology (4th edition), WH Freeman and Co. New York, NY.
3. Das, H.K (2007.). Textbook of Biotechnology (2nd edition), Wiley Dreamteck India Pvt. Ltd, India.
4. Wilson, K. and Walker, J. (2004) Practical Biochemistry, John Wiley.
5. Singh, B. D. (1999) Biotechnology, Kalyani Publishers, India.
6. Karp, Gerald, and Nancy L. Pruitt. *Cell and molecular biology: concepts and experiments*. New York: John Wiley & Sons, 1996.

Practicals

1. Introduction to Spectrophotometry, (UV/Vis) Spectrophotometer: Principle, Working and Result Interpretation
2. Estimation of unknown concentration of copper (II) ions in a $CuSO_4$ solution using Vis spectrophotometer.
3. Determination of the λ max (maximum absorbance) of a given sample solution using spectrophotometer.
4. Demonstration of DNA isolation from plants using plant DNA isolation Kit
5. Agarose gel electrophoresis as separation technique for DNA analysis.
6. Quantification of DNA by UV spectrophotometer.
7. Estimation of purity of DNA by UV spectrophotometer
8. To separate and study plant pigments by paper chromatography and calculation of Rf values.

9. Quantification of DNA using agarose gel by normalization
10. Demonstration for quantification of DNA using PCR (Thermocycler) machine.

Books recommended

1. Sambrook J, Fritsch, E.F. and Maniatis, T. (2001). Molecular cloning. A Laboratory Manual 3rd ed., Cold Spring Harbor Laboratory Press.
2. Dabre P.D. (1998) Introduction to Practical Molecular Biology, John Wiley & Sons Ltd., New York.
3. Plummer D.T. (1990) An Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
4. Singh R. and Sawhney, S.K. (2002) Introduction to Practical Biochemistry. Narosa Publications, New Delhi.

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Skill Enhancement Course (SEC) –I

Course Title: Environmental Biotechnology
Course Code: UBTTS-301
Course Credits: 04

Learning Outcomes

- Environment Biotechnology aims at providing the students with an understanding of various issues related to environment.
- The focus is on the scope and importance of environmental biotechnology and recent biotechnological advances.
- Additionally, the focus is also on the adverse health effect of Xenobiotics which plays an important role in addressing public health challenge.

UNIT -I

Components of Environment: Abiotic (Hydrosphere, Lithosphere, Atmosphere) and Biotic (Biosphere), Environmental Problems: Global Warming, Acid rain, Ozone depletion, deforestation. Scope & importance of environmental biotechnology.

UNIT -II

Pollution- Air, water and land pollution: Causes and control strategies. Conventional waste water treatment methods, Biotechnological interventions for air pollution abatement. Solid waste management strategies.

UNIT - III

Use of microbial biodiversity in improving soil fertility, Bio-fertilizers, bioinsecticide, biofungicide and bioherbicides. Vermitechnology.

UNIT -IV

Xenobiotic compounds, Biomagnification, health hazards due to pesticides and metal pollution and xenobiotics.

UNIT -V

Recent Biotechnological advances, Bioplastics, biofuels, biosensors and bioindicators. Bioremediation, Bioaugmentation, phytoremediation..

Books recommended

1. Introduction to Environmental Biotechnology- A K Chatterjii
2. Biotechnology - B.D. Singh, Kalyani Publications
3. Environmental biotechnology, 1995 S.N.Jogdand. Himalaya Publishing House,
4. Bioremediation 1994 Baker, K.H.and Herson, D.S. McGraw Hill, Inc.New York.
5. Biotechnology biology 1997 P.K.Gupta, Rastogi Publications, Meerut

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SEMESTER IV

Core Course

Course Title : Enzymology and Bioprocess Technology
Course Code : UBTTC-301
Course Credits: 06

Learning Outcomes

- The course deals with the study and understanding of enzymes as biological catalysts and their biological significance.
- The students learn about various aspects of enzymology like enzyme kinetics, characteristics and structural organization of enzymes and various enzyme catalyzed reactions.
- The students are given an insight into various biophysical and biochemical techniques currently being employed.

UNIT – I

Biophysical and biochemical techniques: Principle, theory and applications of centrifugation, chromatography, types of chromatography; column, paper, TLC, ion exchange chromatography and affinity chromatography. Theory, principle and applications of Spectrophotometry (UV - VIS) and electophoresis.

UNIT – II

History of Enzymology, Enzyme vs chemical catalysts, general characteristics of enzymes, enzyme specificity, Nomenclature and classification of enzymes and their significance, Holoenzyme, apoenzyme, coenzymes, prosthetic group; Enzyme activity units, IU, katal, specific activity, enzyme assay methods, structure of enzyme proteins, Nature of active site, general mechanisms of enzyme action,

UNIT – III

Enzyme kinetics, Michaelis-Menten equation, K_m, V_{max}, equilibrium and steady state approaches for enzyme kinetics study, Lineweaver-Burk plots, enzyme inhibition reversible. Irreversible forms of inhibitions, Competitive, non-competitive, uncompetitive and mixed inhibition; Approaches for Isolation and purification of enzymes, Applications of enzymes in industries-food processing, dairy, textile, brewery, leather, detergent.

UNIT – IV

Introduction to Bioprocess technology, Concept of Fermentation vs bioprocess, Microbial growth kinetics; types of fermentation processes: batch, continuous, fed batch; media for industrial processes, sterilization of media and air, Bioreactors, design and types of bioreactors; Agitation and aeration, impeller and sparger. Bioprocess monitoring and control, scale up, various bioprocess parameters, Effect of pH, temperature medium components on product synthesis.

UNIT – V

Bioprocess based products-antibiotics-penicillin, streptomycin, tetracycline; ethanol, organic acids-citric acid, acetic acid, gluconic acid , butanol, single cell protein; Down stream processing, steps involved in down stream processing, separation of cells and broth, filtration, centrifugation, chromatography, solvent extraction, effluent treatment and disposal, BOD, COD.

Books recommended

1. Shuler, M.L. and Kargi, G. (2003). Bioprocess Engineering: Basic Concepts, Prentice Hall, Englewood Cliffs.
2. Stanbury, P.F. and Whitaker, A. (1997). Principles of Fermentation Technology, Pergamon Press, Oxford.
3. Doran, P.M. (1999). Bioprocess Engineering Principles. Academic Press, New York.
4. Tripathi, G. (1999). Enzyme Biotechnology.Technoscience Publications, Jaipur, India.
5. Palmer, T. (2001). Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Horwood Publishing Chichester, England.
6. Nicholas, P, Stevans, L. Fundamental of Enzymology (1999). OxfordUniversityPress, New York.

Practicals

1. Estimation of ά-amylase activity from saliva.
2. Effect of temperature and pH on enzyme activity.
3. Study of enzyme kinetics.
4. Enzyme purification by salt precipitation.
5. Enzyme purification by chromatography.
6. Enzyme purification by electrophoresis.
7. Isolation of yeast from fruits.
8. Study of microbial growth kinetics.
9. Determination of thermal death point and thermal death time.
10. Ethanol production by fermentation in shake flask.

Books recommended

1. Plummer D.) An T. (1990Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Singh R. and Sawhney, S.K. (2002) Introduction to Practical Biochemistry. Narosa Publications, New Delhi.
3. Wilson, K. and Walker, J. (2004), Practical Biochemistry, Principles and techniques (4th edition), Cambridge University Press.

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Skill Enhancement Course (SEC)-II

Course Title: Food Biotechnology
Course Code: UBTTS-401
Course Credits: 04

Learning Outcomes

- The course deals with the understanding of various components of food, their composition and Biochemistry.
- The various flavours added to our daily dietary food is due to trifling in various components of food besides it maintaining the natural nutrition of various low shelf life foods.
- Minimal processing of food and manufacture of fruit juices, jams etc is the main component of food industry, providing job opportunities.

UNIT I

Introduction to various branches of Food Science and Technology, Basic concept of Food: Nutrient, Nutrition, Classification of Food, Classification of Nutrients, Balanced diet.

UNIT II

Biochemistry of food and its components: Carbohydrates, Proteins, Lipids, Vitamins, Water, Minerals. Enzymes and their properties, Role of different enzymes in food processing.

UNIT III

Methods for food preservation:- Refrigeration and freezing, Drying and Dehydration, pasteurization, sterilization, blanching, Food Irradiation. Application of sugar, salt, antimicrobial and biological agents in preservation of foods.

UNIT IV

Definition, quality concepts, Food additives and contaminants. Quality testing and analysis parameters: GMP/GLP. Food Safety and Standard Rules

UNIT V

Minimal processing of foods: fruits and vegetables, seafood, manufacturing of fruit juices, pulp, ketchups, dairy products, beverages. Safety criteria in minimally processed foods.

Books recommended

1. Lehninger, Nelson & Cox, Principle of Biochemistry, CBS Publication
2.Essentials of Food and Nutrition, Swaminathan, Vol 1 & 2
3.Fundamentals of Food and Nutrition by Sumati. R. Muldambi
4. Desrosier NW & James N. (2007). Technology of food preservation. AVI. Publishers
5. Fellows, P.J

SEMESTER V

Discipline Specific Elective (DSE)-I

Course Title : Plant Biotechnology and Genetic Engineering
Course Code : UBTTC-501
Course Credits: 06

Learning Outcomes

- This course is intended to introduce the student with the theoretical information and practical experience in plant tissue culture. Special emphasis is placed on setting up and operating a plant tissue culture laboratory.
- The course also familiarize the students with the techniques employed in genetic engineering and Recombinant DNA technology.
- Focuses on the course work that prepares the student for immediate employment in plant tissue culture industry.

UNIT – I

Plant tissue culture, Micropropagation, stages of propagation , advantages and applications, culture media (White's and Murashige and Skoog's); Plant growth regulators (Auxins, Cytokinins and Gibberlins) and their use in plant tissue culture; Initiation and maintenance of callus, types of callus and suspension cultures, batch cultures and continuous cultures; Somatic embryogenesis, Virus free plants, shoot tip culture, meristem isolation and culture, thermotherapy, applications and limitations; vitrification.

UNIT – II

Haploid production by anther, pollen and ovule culture, embryo rescue, homozygous lines; Somatic cell hybridization; Protoplast isolation and culture, protoplast fusion and their applications, cybrids; Cryopreservation, types of cryoprotectants, freezing and storage, thawing and germplasm conservation, freeze preservation and slow growth cultures; Production of secondary metabolites.

UNIT – III

Isolation of DNA and RNA from viruses, bacteria, plants and animals. Analysis and characterization of DNA by spectrophotometry and agarose gel electrophoresis. Tools in genetic engineering; Restriction enzymes: types and properties; Polymerases, DNA pol I, Klenow fragment, Reverse Transcriptase,Taq polymerase , ligases T4 and E.coli DNA ligase , kinase, poly nucleotide kinases (PNK) , phosphatases., Bacterial alkaline phosphatase (BAP) and calf instetinal alkaline phosphatase (CIAP) , exonucleases, DNase, RNase and Proteinases; Cloning vectors; plasmids pUC18, , cosmids Supercos and phages Lambda ; Genomic DNA libaray

construction in prokaryotes . Isolation and purification of mRNA, First and second strand synthesis to construct cDNA, construction of cDNA libaray .

UNIT – IV

Polymerase chain reaction, types and procedure, applications; restriction mapping, nucleic acid hybridization; DNA sequencing, DNA fingerprinting, molecular markers, RFLP, RAPD, AFLP, SSR, their applications; Introduction to Bioinformatics, Internet, search engines, biological databases, primary, secondary, nucleotide sequence database, Protein sequence databases, sequence analysis, multiple sequence alignment.

UNIT – V

Gene transfer in plants using *Agrobacterium tumefaciens*, vectorless gene transfer, selectable markers, scorable markers; Major genes transferred through genetic engineering; advantages and application of Genetic engineering, production of transgenic plants with resistance against herbicides and insects; Golden Rice, Bt cotton, Ethical considerations; edible vaccines.

Books recommended

1. Hammound, J., McGarvey, P. and Yusibov, V., eds (2000), Plant Biotechnology; Springer Veriag.
2. Fu, T-J. Singh, G. and Curitis, W.R., eds (1999). Plant Cell abd Tissue Culture for the Production of Food Ingredients, Kluwer Academic/ Plenum Press.
3. Gupta, P.K. (1996). Elements of Biotechnology, Rastogi and Co., Merrut, India.
4. Primrose, S.B. (1994). Molecular Biotechnology, 2nd edition, Blackwell Scientific Publishers.Oxford.
5. Berger, S.L and Kimmel, A.R (1996). Methods in Enzymology, Guide to Molecular Cloning Techniques, vol. 152, Academic Press Inc., San Diego.
6. Bhojwani S.S. and Razdan M.K. (2005) Plant tissue culture: Theory and practice. Elsevier Science, New Delhi.

Practicals

1. Sterilization techniques for glassware/plasticware. Operational use of autoclave and laminar air flow.
2. Lab design and requirements of a standard plant tissue culture lab (It includes a visit to an established PTC lab).
3. Media preparation; making of cotton plugs, plugging and sealing of culture vessels.
4. To prepare different explants for culturing.
5. To demonstrate various steps of explant inoculation.
6. Genomic DNA isolation from plants.
7. Restriction digestion of DNA.
8. Demonstration of steps of Southern blotting.

9. Demonstration of PCR amplification.
10. Demonstration of cloning.

Books recommended

1.Chawla, H.S. (1998) Biotechnology in Crop improvement. International Book Distribution Company.
2. Gupta, P.K. (1996) Elements of Biotechnology. Rastogi and Co., Meerut.
3. Henry, R.J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall.
4. Razdan, M.K. (1996). Plant Tissue Culture, Elsevier.
5. Sambrook, J. Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning. A Laboratory Manual 2nd ed., ColdSpringHarbor Laboratory Press.

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Discipline Specific Elective (DSE)-II

Course Title: Biotechnology for Human Welfare
Course Code: UBTTDSE-502
Course Credits: (06)

Learning Outcomes

- Biotechnology for human welfare aims to provide introduction of various fields of biotechnology e.g. Agricultural, pharmaceutical and industrial biotechnology and their contribution for human welfare.
- It aims at gaining an understanding of current experimentation in biotechnology and genetic engineering.
- The course imparts knowledge regarding benefits of biotechnology in forensic science and crime detection by employing various molecular biology techniques.

UNIT-I

Biotechnology used in the field of Agriculture. GM crops, Herbicide resistant crops; insect resistant crops; disease resistant crops; stress tolerant crops; improvement of crop yield; seed nutritional quality improvement. Biopesticides and Biofertilizers.

UNIT-II

Animal husbandry and biotechnology. Production of transgenic mice, sheep, and fish; biotechnological approaches for the management of pests; mosquitoes and nematodes; diagnosis of shrimp and fish diseases caused by bacterial, fungal and viral pathogens using molecular methods; live stock improvement.

UNIT-III

Human health and Medical biotechnology: Human health care products from recombinant DNA technology; disease diagnosis; Strategies of vaccine development. Gene therapy, Somatic and Germinal. Edible Vaccines.

UNIT-IV

Biotechnology in the field of industry. Types of fermentation process and Bioreactor design; microbial strain improvement techniques; Bioprocessing technology; downstream processing; production of single cell proteins; immobilization of enzymes and whole cells and their applications. Biosensors.

UNIT-V

Benefits of biotechnology in forensic science and crime detection. DNA finger printing, Molecular Markers, Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers, Polymerase chain reaction (PCR). Construction of Genetic and Physical maps.

Practicals

1. To study the effect of pesticide and insecticide on plants.
2. Demonstration of PCR technique to evaluate transgenic animals.
3. Performing ELISA a clinical analytical technique for disease diagnostics.
4. To compare the rate of fermentation of different fruit juices.
5. Molecular diversity analysis of different genotypes using molecular markers.
6. Demonstration of recombinant DNA technology used in Cloning experiments

Books Recommended:

1. Recombinant DNA technology by Watson *et. al.,* (Scientific American Books).
2. Principles of Gene Manipulation by Old and Primrose. (Blackwell).
3. Concepts in Biotechnology by Balasubrahmanian *et. al.,(*University press).
4. Microbiology by Prescott
5. H. S. Chawla. Introduction to plant Biotechnology

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Skill Enhancement Course (SEC)-III

Course Title: Intellectual Property Rights
Course Code: UBTTS-501
Course Credits: 04

Learning outcomes

- The Course will ensure that students understand the concept of Intellectual Property and the need to protect IP.
- Various Intellectual property rights and their applicability in different spheres including biology will make students aware of piracy related issues.
- The students will learn about various organizations which are authorized to grant IPR and various case studies.

Unit I:

Intellectual/Industrial property, Intellectual property rights: Meaning, Evolution - Classification and Forms; Rationale for protection of IPRs - Importance of IPRs in the fields of science and technology.

Unit II:

Patents- Concepts and principles of patenting- Patentable subject matter. Procedure of obtaining patents, Infringement of patent rights, traditional knowledge and digital library, Patentability and emerging issues.

Unit III:

Copyright: Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement; Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences.

Unit IV:

Industrial Designs: Objectives, Rights, Assignments, Infringements, Defences of Design Infringement; Geographical Indications: Objectives, Justification, And International Position

Unit V:

WTO , WIPO and TRIPS agreement ; Indian legislations for the protection of various types of IPs; Multilateral Treaties ; Case studies on Basmati rice and Turmeric.

Recommended Books:

1. Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
2. Intellectual Property Rights: Critical Concepts in Law By D. Vaver Edition: illustrated Published by Taylor & Francis, 2006
3. Intellectual Property: A Reference Handbook By Aaron Schwabach Published by ABC-CLIO, 2007
4. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
5. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
6. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).

SEMESTER VI

Discipline Specific Elective (DSE)-III

Course Title : Immunology and Animal Biotechnology
Course Code : UBTTC-601
Course Credits: 06

Learning Objectives

- The Course aims to educate students on how the body defends itself from pathogenic invasions ; the different strategies and players involved in body's response to various antigenic encounters.
- The students also get to know about animal tissue culture strategies and how animal cell culture is different from microbial and plant tissue culture.
- The students learn about various techniques of clinical and diagnostic significance and how these techniques are useful in diagnosing and identifying various conditions arising in the body.

UNIT – I

Introduction to the immune system – Innate and adaptive, Recognition of self and non self, Hematopoiesis and its regulation, Cells of immune system: Lymphoid cells, T cells, B cells, NK cells, Antigen Presenting Cells (dendritic cells and macrophages), Primary and Secondary lymphoid organs, Lymphatic system.

UNIT – II

Antigen-Antibody interaction, Affinity and avidity, Immunogloublins – classes, basic structure and biological activity, Complement cascade: components of complement, function of complement, different activation pathways. T-cell subsets and surface markers, Recognition of antigen by T-cells and role of MHC, Structure of T and B cell receptors.

UNIT – III

Structure and organization of animal cell, Primary and established cell line cultures, mono-layer and suspension, Secondary culture, Established, transformed / continuous cell lines, commonly used cell lines. Basic techniques of cell culture in vitro; equipment and aseptic conditions, Disaggregation of tissue; cold and warm trypsinization; maintenance of cell culture; cell separation.

UNIT – IV

Biology and characterization of cultured cells: Cell morphology, cell adhesion, cell proliferation, cell differentiation, energy metabolisim. Measurement of growth and viability of cell in culture, Growth kinetics of cells in culture.Measurement of cytotoxicity.Scaling up of the animal cell culture. Organ and hisotypic cultures. Cell transformation.

UNIT – V

Immuno-diffusion and Immuno-electrophoresis, Immuno-blot, ELISA and variants of ELISA, RIA, Monoclonal antibodies, Blood products, Vaccines and hormones, DNA transfer technology, Transgenic technology, production of useful products in transgenic animals.

Books recommended

1. Roitt, I.M., Brostoff, J. and Male, D.K. (2001), Immunology, 6th Edition. Grower Medical Publishing, New York.
2. Kuby, J. (2002), Immunology. 5th Edition. W.H. Freeman and company, New York.
3. Satyanarayana, U. (2005). Biotechnology. Books and Allied (P) Ltd, (Kolkatta) India.
4. Freshney, Ian R. (2005). Culture of Animal Cells 3rd Edition.Wiley- Liss.

Practicals

1. Total and differential Leucocyte count.
2. Total RBC count.
3. Haemagglutination assay.
4. Separation of serum from blood.
5. Blood grouping.
6. Double immunodiffusion test using specific antibody and antigen.
7. Rocket immunoelectrophoresis.
8. Demonstration of ELISA
9. Demonstration of sterilization techniques.
10. Preparation of tissue culture medium.
11. Preparation single cell suspension from the animal tissue.
12. Trypsinization of tissue and establishment of a monolayer and subculturing.

Books recommended

1. Masters, John R.W. (2000) Animal Cell Culture – Practical approach, Oxford UniveristyPrfess, Oxford.
2. Freshney R.I. (2005) Culture of Animal Cells, 3rd Edition, Wiley – Liss.

3. Kannan, N. Laboratory Manual in General Microbiology. Palani Paramount Publications, Palani, India.
4. Talwar, G.P. and Gupta S.K. (1992) A Handbook of Practical and Clinical Immunology, CBS Publishers and Distributors, New Delhi.
5. Clynes M. Animal Cell Culture Techniques, Springer.

GOVT. COLLEGE FOR WOMEN PARADE GROUND JAMMU
(Erstwhile Maharahi Mahila College) **Estd 1944**
(NAAC Re-ACCREDITED A GRADE)
Autonomous College under University of Jammu
College for Potential for Excellence (2016)

Discipline Specific Elective (DSE)-IV

Course Title: Industrial Fermentations
Course Code: UBTTDSE-602
Course Credits: (06)

Learning Outcomes

- The course is designed to provide the basic know how of bioreactors. It provides the insight of various types of fermentation techniques and the product development.
- Process of production of industrial chemicals, purification of proteins and downstream processing is also included for providing students a deeper knowledge of fermentation.
- Metabolic engineering of secondary metabolic products for gaining highest productivity of the product is also included in the curriculum.The course intends to provide the significance of biotechnology in industry.

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid.

UNIT II

Microbial products of pharmacological interest, steriod fermentations and transformations. Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.

UNIT III

Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology.

UNIT IV

Purification & characterization of proteins, Downstream processing – extraction, separation, concentration, recovery & purification (Insulin, Vitamins, Metabolites), Anaerobic fermentations.

UNIT V

Bioreactor / Fermenter – types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermenters (Stirred tank, airlift. bioreactors, Static and Submerged fermentation), advantages & disadvantages of solid substrate & liquid fermentations.

Practicals

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

Books recommended

1 Stanbury, Vitaker and Hall, "Principles of Fermentation Technology", Butterworth Heinemann, 2nd Ed., 1999.
2. El-Mansi (Ed.), "Fermentation Microbiology and Biotechnology", CRC Press, 3rd Ed., 2011.
3.Pauline M. Doran, "Bioprocess Engineering Principles", Academic Press, 2nd Ed., 2012.
4. Badal C. Saha (Ed.), "Fermentation Biotechnology", CBS Publishers & Distributors Pvt. Ltd., 2004.

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Skill Enhancement Course (SEC)-IV

Course Title: Clinical Biochemistry
Course Code: UBTTS-601
Course Credits: 0 4

Learning Objectives

- The Course aims to impart basic knowledge of clinical biochemistry involving techniques ranging from collection, handling and processing of clinical samples.
- The students will be demonstrated the importance of various different diagnostic tools and techniques useful in clinical diagnostics.

UNIT I

Definition and scope of clinical biochemistry, Collection, preparation, preservation, and handling of clinical samples, normal values of important constituents of blood, CSF and urine, Safety measures in clinical laboratory.

UNIT II

Antigens. Blood group antigens (ABO & Rh factor). Blood group types and their inheritance. Immune system, basis of vaccination,Specificity of antibodies to attack only foreign/nonself.

UNIT III

Diagnostic Enzymology: Factors affecting enzyme levels in blood. Principle, assay, and clinical significance of different enzymes. Vitamins: General consideration, clinical importance, Hormones : Introduction, General Mechanism of actions.

Unit IV

Toxicology: Biochemical basis of toxicity, Dose-response relationship, synergism and antagonism, determination of ED50 & LD50; Important Organ Function tests, Inflammation , Autoimmunity, hypersensitivity reactions, Graft rejection and immunosuppressant therapies.

UNIT V

Role of molecular diagnostics in present diagnostic era, Ethical issues related to molecular diagnostics, Basic techniques used in molecular diagnostics, Molecular diagnostics of HIV and Tuberculosis.

Books Recommended:

1. Clinical biochemistry, metabolic and clinical aspects by William J. Marshall, Stephan K
2. Elsevier science health.
3. Fundamentals of Clinical Biochemistry by Teiz, W.B-Saunders Company.
4. Clinical Biochemistry: An illustrated color text 3rd Ed. by Allan Gaw, Micheal Murphy, Robert Cowan, Denis O Reilly, Micheal Stewart and James Shepherd. Churchill Livingtons.
5. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry By Trevor Palmer.
6. Devlin: Textbook of Biochemistry (with clinical correlation) (John Wiley and Sons Publishers).