SCHOOL OF BIOTECHNOLOGY & GENETIC ENGINEERING
DEPARTMENT OF MICROBIAL BIOTECHNOLOGY

Syllabus
M.Sc., Industrial Biotechnology (CBCS –UD)
2019-2021 BATCH & ONWARDS

Bharathiar University
Coimbatore-46

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M.SC., INDUSTRIAL BIOTECHNOLOGY (UNIVERSITY)
FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR
2019 – 2021 BATCH & ONWARDS
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	University examination			Credit
			Internal Mark	External Mark	Total Mark	
SEMESTER I						
19MBTAC01	Paper-I	Molecular cell biology	25	75	100	4
19MBTAC02	Paper - II	Basics of Microbiology	25	75	100	4
19MBTAC03	Paper - III	Microbial physiology and Biochemistry	25	75	100	4
19MBTAC04	Paper - IV	Microbial Genetics and Recombinant DNA Technology	25	75	100	4
19MBTGE12A	Elective 1 A	**List Enclosed**	25	75	100	4
19MBTGE12B	Elective 1 B	**List Enclosed**				
	Supportive 1	**List Enclosed**	12	38	50	2
19MBTACP1	Practical - I	Basic Microbiological Techniques	40	60	100	4
SEMESTER II						
19MBTAC05	Paper-V	Immunology and Immunotechniques	25	75	100	4
19MBTAC06	Paper - VI	Molecular pathogenesis and clinical diagnosis	25	75	100	4
19MBTAC07	Paper - VII	Food Biotechnology	25	75	100	4
19MBTAC08	Paper - VIII	Environmental Biotechnology	25	75	100	4
19MBTGE13A	Elective 2 A	**List Enclosed**	25	75	100	4
19MBTGE13B	Elective 2 B	**List Enclosed**				
	Supportive 1	**List Enclosed**	12	38	50	2
19MBTACP2	Practical - II	Advanced Microbiological Techniques	40	60	100	4
SEMESTER III						
19MBTAC09	Paper-IX	Bioinformatics and Nanobiotechnology	25	75	100	4
19MBTAC10	Paper – X	Biosafety, Bioethics , IPR and Biostatistics	25	75	100	4
19MBTAC11	Paper – XI	Research Techniques	25	75	100	4
19MBTAC12	Paper – XII	Bioprocess Technology	25	75	100	4
19MBTGE14A	Elective 3 A	**List Enclosed**	25	75	100	4
19MBTGE14B	Elective 3 B	**List Enclosed**				
	Supportive 1	**List Enclosed**	12	38	50	2

19MBTACP3	Practical - III	Applied Microbiological Techniques	40	60	100	4
SEMESTER IV						
19MBTGE15A	Elective 4 A	**List Enclosed**	25	75	100	4
19MBTGE15B	Elective 4 B	**List Enclosed**				
		Project viva voce*	60	90	150	6
		Industrial / Institute visit and Summer Training (Viva voce)**	50		50	2
		Grand total			2250	90

* The report should be a Bonafide work carried out by the candidate in the department or any other recognized institute or laboratory under the guidance of a faculty/external guide and should be authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

** The Industrial training report should be submitted by the candidate. This report must be presented and defended by the candidate in the department attended by all faculties.

ELECTIVE COURSES OFFERED

Semester/ Code No.	**Paper**	**Subject**	**University examination**			**Credit**
			Internal Mark	**External Mark**	**Total Mark**	
19MBTGE12 A	Elective 1A	Animal Biotechnology	25	75	100	4
19MBTGE12B	Elective 1B	Biomolecular Metabolism	25	75	100	4
19MBTGE13A	Elective 2A	Plant Biotechnology	25	75	100	4
19MBTGE13B	Elective 2B	Bioremediation & Waste Management	25	75	100	4
19MBTGE14 A	Elective 3A	Pharmaceutical Chemistry	25	75	100	4
19MBTGE14B	Elective 3B	Good Manufacturing Practices and Quality Assurance	25	75	100	4
FINISHING SCHOOL PAPER						
19MBTGE15A	Elective 4A	Entrepreneurship development	25	75	100	4
19MBTGE15B	Elective 4B	Teaching Techniques in Sciences	25	75	100	4

SUPPORTIVE COURSES OFFERED

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER I	18MBTGS24	Microbial Biotechnology	2	3	50	2
SEMESTER II	18MBTGS60	Food Biotechnology	2	3	50	2
SEMESTER III	18MBTGS25	Clinical Microbiology	2	3	50	2

SEMESTER I
PAPER I: 19MBTAC01MOLECULAR CELL BIOLOGY

COURSE OBJECTIVES:

- Recalling the structural organization of organelles in both prokaryotic and eukaryotic cells
- Providing information on the functional aspects of the cellular organelles
- Understanding the molecular interaction of cells with regard to metabolism and cell cycle
- Perceiving the molecular interactions in terms of regulation of cell cycle

UNIT I

Cell architecture: Structure of cells – structure of prokaryotic and eukaryotic cells; Surface appendages – Cilia and Flagella, Capsules, Pili, Fimbriae and slime layers; Cell walls – Algae, fungi, bacteria ; Membranes of Gram positive, Gram negative bacteria and acid fast bacteria; protoplast, spheroplast and endospores; Transport across membrane – active and passive transport, transport channels and pumps, transport across nuclear membrane; Neurotransmission, neuromuscular junction.

UNIT II

Cellular constituents: Cytoskeleton and structural components – Microfilaments, Intermediate filaments, Microtubules; Mitochondria – structure, biogenesis; Chloroplast – structure, biogenesis; Endoplasmic reticulum and Golgi complex – structure, function, vesicular transport and import into cell organelles; Structure and function of ribosomes, mesosomes, lysosomes, peroxysomes.

UNIT III

Nucleus: Nucleus structure – structural organization, nucleosome, supranucleosomal structures, specialized chromosomes, polytene and lamp brush chromosomes and chromosome banding; Nucleic acid structure: DNA and RNA.

UNIT IV

Cell cycle: Mechanism of cell division – Mitosis, meiosis and genetic recombination; regulation of cell cycle – factors and genes regulating cell cycle (Cyclins, CDK and CDKI). Biochemistry and molecular biology of Cancer – malignant growth, tumour suppressor genes (p53, RB) and oncogenes (Ras), chemical carcinogenesis, hormonal imbalances.

UNIT V

Cellular development: Extracellular matrix – cell to cell and cell-matrix adhesion, cell junctions; Cellular systematic – components of systematic, receptors (cell surface – GPCR, RTK, TGF-β, Hedgehog, Wnt, Notch-Delta, NF-Kb, ion channels; intracellular – NO, Nuclear receptor), secondary messengers, effectors ; cell differentiation; gametogenesis and fertilization; development of Drosophila and Arabidopsis – spatial and temporal regulation of gene expression.

TEXT BOOKS

1. Molecular Biology of Cell, Alberts, B et al.
2. Molecular cell Biology, Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.

REFERENCES

1. Introduction to genetics: A molecular approach, T.A. Brown, Garland Science, 2011.
2. Molecular Biology of the Gene (7^{th} Edition, J.D.Watson, Tania A. Baker, Stephen P. Bell , Michael Levine, Richard Losick) Benjamin/Cummings Publ. Co., Inc., California, 2013.
3. Genes XI (9^{th} Edition) Benjamin Lewin, Jones & Bartlett Learning, 2008
4. Molecular biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed) Wiley-Blackwell Publishers, 1995

COURSE OUTCOMES:

CO 1 - Able to coordinate structural organization with functions
CO 2 - Abe to differentiate the prokaryotic and eukaryotic cells
CO 3 - Capable of understanding the molecular mechanism of several diseases
CO 4 - Capacity to determine the causes of cancer and drug resistance
CO 5 - Able to understand the molecular mechanisms of body movement
CO 6 - Abe to explain the process of development of organisms to adult

PAPER II: 19MBTAC02 BASICS OF MICROBIOLOGY

Course objectives:

- Recalling the history and theories in microbiological research.
- Gaining information on staining and sterilization techniques.
- Understanding the ultrastructure and function of prokaryotic and eukaryotic organisms.
- Learning various aspects of microbial nutrition and reproduction.

Unit- I

Early history & scope of Microbiology: Spontaneous generation conflict- Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Winogradsky, Paul Ehrlich, Lederberg and Zinder, Lwoff, Arber and Smith, Temin and Baltimore.

Microscopic techniques: Principles, working mechanism and application-simple, compound, dark field and phase contrast microscope, fluorescence, SEM & TEM.

Unit II

Methods of sterilization: physical methods-Dry heat, moist heat, radiation methods, filtration methods, chemical methods & their application. Preservation and maintenance of Microbial cultures- Lyophilizers, Deep freezer.

Microbial cultures: Methods of pure culture technique- Serial Dilution, Pour Plate, Spread Plate and Streaking methods. Microbiological Media- Types and composition of media.

Staining Techniques: Simple, Differential (Gram's AFB), special- capsular staining (negative), spore, Acid Fast Staning, Fungal Staning - LPCB.

Unit- III

Microbial Taxonomy: Domains and Kingdoms of Life- Bacterial Nomenclature- Classification of Bacteria by Physiological, Metabolic, Serological and Molecular methods- Bergey's Manual of Systematic Bacteriology with general characteristics of each division- Numerical Taxonomy- 16S rRNA based classification. Archeabacterium, Actinomycetes- Structure and Classification.

Unit – IV

General Characteristics and Classification of Algae (Fritsch Method). General Characteristics and Classification of Fungi (Alexopolus). General Characteristics and Classification of Protozoa. Structure and Reproduction of *Paramecium* sp.

Unit – V

General Properties and Classification of Viruses. Cultivation of Plant and Animal Viruses- Characterization and Enumeration of Viruses- Quantitative assay. Genome

replication, Protein synthesis and assembly of DNA containing Plant Viruses- CaMV and Gemini Virus- RNA containing Plant Viruses- TMV, Cowpea Mosaic Viruses.

Reference Books

- Prescott L M, J P Harley and D A Klein (2005). Microbiology.Sixth edition, International edition, McGraw Hill.
- PelczarTR M J Chan ECS and Kreig N R (2006). Microbiology.Fifth edition, Tata McGraw-Hill INC. New York.
- Hans G. Schlegel. General microbiology. 7th edition. Cambridge university press (1993).
- Dubey RC and Maheswari DK (2012). A text of Microbiology (Revised edition). S. Chand and Company Ltd., New Delhi.
- GeetaSumbali and Mehrotra RS (2009). Principles of Microbiology.First edition, Tata McGraw Hill P. Ltd., New Delhi.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Gain a strong foundation on basic microbiological practices

CO 2 - Understand nature of microbial cell structure, function and nutrition

PAPER III: 19MBTAC 03 MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Course objectives:

- To recall the bioenergetics' process of the microbe.
- To describe the mechanism of microbial fermentation process.
- To provide the information about the nutritional uptake of microbial cells.
- To familiarize the energy driven process of the microbes from inorganic substances.
- To know the regulatory responses of the environmental stress and changes in microbes.

UNIT I

Modes of nutritional uptake - Entry of nutrition in the cell, passive diffusion, facilitated diffusion and different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms. Utilization of nutrients that cannot enter the cell

UNIT II

Principles of microbial metabolism: Methods used to study, microbial metabolism – nutrient balance, metabolically blocked microbes; radiolabelled compounds.

Bioenergetics: **Energy yielding metabolism** – Energy from organic compounds – carbohydrates – aerobic (EMP, HMP, ED, TCA, ET) in prokaryotes and eukaryotes; complete oxidation.

Energy from visible radiation – photosynthesis in eukaryotes, blue-green algae, bacteria.

UNIT III

Anaerobic fermentation – alcoholic fermentation, propionic acid fermentation, formic acid fermentation**. Energy from inorganic compounds** - ET in chemolithotrophs - ammonia oxidation by members of Genus Nitroso group, nitrite oxidation by Nitro group of genera., production of reducing power in chemolithotrophs - Oxidation of molecular hydrogen by Hydrogenomonas species Ferrous and sulfur/sulfide oxidation by Thiobacillus species**.**

UNIT IV

Stress physiology --- effect of oxygen toxicity ,pH, osmotic pressure, heat shock etc on bacteria Adaptations in thermophiles, halophiles ,alkaliphiles ,acidophiles , Extremophiles – adaptations & significance in biotechnology

UNIT V

Enzymes and co –enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Machanism and induced fir hypothesis, Enzyme kinetics- enzyme inhibition: Reversible – Competitive, Noncompetitive, uncompetitive, Irreversible inhibition.

Reference Books:

- Brock Biology of Microorganisms (14thEdition) Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley,David A. Stahl, January 12, 2014; ISBN-10:0321897390; ISBN-13:978-0321897398
- Microbial Physiology, 4thEdition Michael P. Sector),Albert G. Moat(Editor),John W. Foster(Editor),Michael P. Spector
- Chemical microbiology –An introduction to microbial physiology –AH Rose, Butterworth, London
- The Physiology and Biochemistry of Prokaryotes-4thEdition David White,James Drummond,Clay Fuqua,December 2011
- Chemical microbiology –An introduction to microbial physiology –AH Rose, Butterworth, London
- The Physiology and Biochemistry of Prokaryotes-4thEdition David White, James Drummond,Clay Fuqua,December 2011

Course Outcome

On successful completion of the course, the students will be able to

CO 1 - Describe the types of the growth factors involved in the microbial communities.

CO 2 - Apply the theoretical knowledge to solve the problems in microbial metabolic engineering.

CO 3 - Describe how the microbes can regulate their structure and metabolism in response to environmental stimuli.

CO 4 - Design, carry out, and report on lab experiments in microbial metabolism and microbial regulation.

PAPER IV: 19MBTAC04 MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

COURSE OBJECTIVES:

- To improve the knowledge on genomic structure of microbes
- Recalling the molecular genetics concepts and genetic transformation.
- To familiarize recombinant DNA technology
- To learn gene cloning strategiesand expression analysis
- Applications of recombinant DNA technology in various fields

UNIT I

Origin of Molecular Genetics-Structure of DNA-Mutations-Luria and Delbruck's Fluctuation Test-Spontaneous mutations-nonsense, missense, frame-shift mutations-Induced mutagenesis-Physical agents-UV,X-Rays-Chemical agents-NTG, Base Analogues etc., Reversion-AMES Test-DNA Replication-Messelson and Stahl's Experiment-Okazaki's fragment-DNA polymerases-DNA damage-SOS response-DNA repair.

UNIT II

Gene transfer in bacteria-Transformation-discovery and its significance-competence and factors involved-joint transformation and its uses-Conjugation-F+ and F^- nature of *E.coli*-Origin of Hfr and F' strains-Zygotic induction -Chromosome transfer by Hfr - circular nature of *E.coli* DNA -Use of Hfr strains in genetic mapping-Transduction - λ phage and specialized transduction - Generalised transduction-P1 phage-origin of transducing particles-pre zygotic and post zygotic exclusion-Co-transduction-fine structure mapping of genes by P1 transduction-Wu's Formula-Ratio Test, C-value paradox.

UNIT III

Elucidation of genetic code- Benzer, Khorana and Crick's contributions-Triplet nature of the Genetic code and Adaptor hypothesis-Wobble hypothesis- Bacterial translation, Suppression of nonsense, missense and frame-shift mutations-Intragenic and extragenic suppressions of mutations-modern aspects-structure and function relationship-Gene expression-RNA polymerase-σ factors-other accessory transcription factors-small RNAs'-Concept of Gene and operon-Regulation of gene expression- well studied operon models-*lac*, *trp* and *ara* operon

UNIT IV

Birth of r-DNA technology- Restriction enzymes and their role in r-DNA technology-Restriction-modification system methylase,ligase, adaptors, linkers, homopolymer tailing, *E.coli*-Types of restriction enzymes - Plasmid vectors as cloning vehicles-Vectors for protein over expression, protein secretion and controlled expression-Bacteriophages as cloning vehicles-λ mediated vectors-M13 phage and its use, Cosmids, Phagemids, plasmids, BACS.

UNIT V

Gene Cloning -Purpose – Genomic Library construction-Polymerase chain Reaction (PCR)-Cloning into gram negative, gram positive bacteria and Yeast-Screening of recombinants- α complementation and blue-white selection - Construction of cDNA Library - use of phagemids and Cosmids-DNA sequencing- DNA and RNA hybridization- Southern and Northern blotting-DNA sequencing- Sangers method-Basics of pyrosequencing, next generation sequencing strategies-western blotting for proteins-Semi-quantitative and Real time PCR to quantify gene expression-Yeast two hybrid system-Application of r-DNA technology in human genetics and forensic science-RAPD, RFLP, AFLP, SSCP, Dot and colony blotting.

TEXT BOOKS

1. Principles of Gene Manipulation and Genomics-S.B.Primrose and R.M.Twyman, 2006.John Wiley & Sons Ltd.

2. Molecular Genetics: An introductory narrative, Second Edition - Gunther.S.Stent and Richard Calendar, 2002. CBS Publishers and distributors.

REFERENCE BOOKS

1. A Short Course in Bacterial Genetics: A Laboratory Manual and Handbook for Escherichia coli and Related Bacteria- Jeffrey. H. Miller, 1992.CSHL Press.

2. Fundamental Bacterial Genetics - Nancy Trun and Janine Trempy, 2004. Blackwell publishing 3. From Genes to Genomes: Concepts and Applications of DNA Technology, Second Edition-Jeremy.W.Dale and Malcolm Von Schantz, 2007. John Wiley & Sons Ltd.

COURSE OUTCOMES:

CO 1 - After completing the course, the student should be able to
CO 2 - Explain the processes behind mutations and other genetic changes
CO 3 - Identify and distinguish genetic regulatory mechanisms at different levels
CO 4 - Solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
CO 5 - Plan basic experiments in microbial genetics concerned with recombinant DNA technology
CO 6 - Perform gene cloning and their expression studies using various advance techniques

PRACTICAL I – 19MBTCP1 BASIC MICROBIOLOGICAL TECHNIQUES

1. Media preparation – Liquid and Solid media, Agar deep, slant and plate.
2. Pure culture techniques – Streak plate, pour plate, spread plate, decimal dilution.
3. Motility determination- soft agar inoculation.
4. Enumeration of microorganisms from soil: Bacteria, Fungi and Actinomycetes.
5. Staining: Smear fixation, simple, Gram, acid fast, spore, capsule and negative.
6. Growth curve and Effect of various intrinsic factors such as pH, Temperature on the growth of bacterium-Spectroscopic method
7. Anaerobic culture techniques; Mc Intosh Fildes anaerobic jar, Wright's tube method.
8. IMViC test
9. Hydrogen sulphite test
10. Oxidase test
11. Calalase test
12. Urease test
13. Nitrate reduction test
14. Polymer degradation – Starch, Gelatin, Casein.
15. Carbohydrate fermentation.
16. Observation of mitotic cell division using onion root tips –Demo
17. Micropropagation of ex-plant
18. Isolation of DNA from plant cells
19. Giemsa banding and Karyotyping of chromosomes by lymphocyte culture
20. Animal cell culture – MTT assay and COMET assay

SEMESTER II
PAPER V: 19MBTAC05 IMMUNOLOGY AND IMMUNOTECHNIQUES

Course Objective

- Provide knowledge on the mechanism of action of immune system
- Understanding principle and methodology of various immunological techniques
- Learning the fundamental mechanism behind autoimmune disorders
- Perceiving information on different types of hypersensitive reactions

Scope: This paper imparts information about the structure and function of immune system and the related immunological techniques.

UNIT -1

History and scope of Immunology Lymphoid organs and tissues. Immunity- types-innate and acquire, active and passive, Cell mediated and Humoral Immunity. Hematopoiesis- origin, development and differentiation of immune cells.

UNIT-2

Cells of the immune system: Macrophages, B and T lymphocytes- Activation and types, Dendritic cells, Natural Killer cells, lymphokine activated killer cells, Eosinophils, Neutrophils, Mast cells. Antibody; Production, Primary and Secondary antibody response. Immunoglobulin structure, types and functions. Antigen- types.Haptens, adjuvants, carriers, bacterial, viral and tumour antigens, autoantigens, blood group antigens and Rh factor.

UNIT-3

Antigen-Antibody reactions.Factors governing antigens-antibody interactions; affinity, avidity, valency, cross reactivity.Applications of Immunologicaltechniques- Immunoflourescence, RIA, RAST, ELISA and Flowcytometry. Structure and functions of MHC molecules. Response of B cell to antigen, T cell products.

UNIT-4

The complement systems: Mode of activation and pathways. Transplantation immunology: MLR, HLA Typing. Bone marrow transplantation, organ transplants. Tumor immunology. Cancer of the immune system. Autoimmune disorders and Immunology of infectious diseases – viral, Bacterial and protozoan and Immunodeficiencies.

UNIT-5

Hypersensitivity reactions and types. Immune tolerance and suppression. Immunotheraphy. Hybridoma technology- Monoclonal Antibody production and applications in diagnosis and theraphy.Catalytic antibodies.FACs. Vaccination methods, Vaccine Technology and recombinant vacccines- DNA vaccines and Edible vaccines..

REFEENCES:

1. Kubey, J. 1993. Immunology Freeman and company.
2. Janeway, C.A., Immuno-biology Paul Travers1994.
3. SeemiFarhatBasir., Text Book of Immunology by. First edition. PHI LrarningPvt Ltd, New Delhi.
4. MadhaveeLatha, P., A Text Book of Immunology, First Edition. S.Chand& Company Ltd, New Delhi

Course Outcomes

CO 1 - Able to understand the structure, function, principles and practices outlining various key concepts in immunology.
CO 2 - Equipped to perform various immunological assays

PAPER VI: 19MBTAC06 MOLECULAR PATHOGENESIS AND CLINICAL DIAGNOSIS

COURSE OBJECTIVES:

- Create knowledge on the various groups of causative organism
- Enable the students to know the pathway involved with microbial infections
- Impart information on methods of diagnosis of various diseases.
- Allow them to apply their gained knowledge in controlling the infections

UNIT I

Microbes and parasites: Mile stones in medical Microbiology, Introduction: classification in clinical practices: Bacteria, Fungi, Viruses, Protozoa, Helminthes, Arthropods and Prions; Host-parasite relationship, Infectious disease process-modes of transmission, factors predisposing to microbial pathogenicity, stages, pathological patterns, virulence and infectivity

UNIT II

Invasion of Microbes: Adsorption to the potential sites, membrane trafficking in eukaryotic cells, routes of invasion and selection of intracellular niche, bacterial manipulation of host cell cytoskeleton, nosocomial infection; Normal microflora of human body; Bacterial toxins and virulence genes; Strategies of host defense.

UNIT III

Methods of Disease Diagnosis: Sampling site-normally sterile and with normal microflora; Sample collection-method of collection, transport and processing of samples, antibiogram,interpretation of results; Diagnostic methods- cultured: microscopy, microbial antigen; non-cultured: PCR based microbial typing: Eubacterial identification based on 16s rRNA sequences-Amplified ribosomal DNA Restriction analysis(ARDRA)-Culture independent analysis of bacteria-DGGE and TRFLP; Molecular diagnosis of fungal pathogens based on 18s rRNA sequences; Detection of viral pathogens through PCR; Monoclonal antibodies.

UNIT IV

Diagnosis of Infections : Bacteria- Staphylococcus, *Streptococcus*, Coliforms, *Salmonella*, *Shigella*, *Vibrio* and *Mycobacterium Bacillus anthracis, Treponema pallidum.* Fungi-Major fungal diseases, Dermatophytoses – Blastomycosis, Cryptococcosus, Histoplasmosis Candidiosis and Aspergillosis DNA and RNA Viruses- DNA virus- Herpes, Adeno, Pox, RNA virus-Rota virus, Influenza virus, Rhabdo Virus, Hepatitis Virus and Retro Virus.

UNIT V

Diagnosis of Infections Protozoan diseases-Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis; Helminthis diseases-*Fasicola hepatica* and *Ascaris lumbricoides*; Filariasis and Schistomiosis.

TEXT BOOKS

1. Medical Microbiology (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers
2. Henry‟s Clinical Diagnosis and Management by Laboratory Methods (2007). Mepherson.

REFERENCES

1. Bailey and Scott‟s Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahm, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby
2. Fundamental of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Sauders group.
3. Molecular Diagnostics for the Clinical Laboratorian 2nd ed. (2006). W.B.Coleman. Humana Press.

COURSE OUTCOMES:

CO1: Able to Identify the type of specimen to be collected and collection methods for an infection
CO2: Able identify the causative organism by culture based and molecular analysis
CO3: Capable to design research work for control of the infection at molecular level

PAPER VII: 18MBTAC07 FOOD BIOTECHNOLOGY

Course Objectives

- To impart knowledge about the various areas related to food science as a discipline
- To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways
- To develop an understanding of food composition, principles of preservation, new product development, food quality and analysis and food safety laws.

UNIT I

Fermentation products: Dairy products: - Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss. Fermented foods: Soy sauce, Miso, Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauerkraut, pickles, Olives. Fermented sausages.

UNIT II

Distilled beverages: Alcohol, wine, brandy and beer. **Food additives**: Production of additives - organic acid (acetic acid, lactic acid and citric acid), amino acids (glutamic acid, lysine, threonine, arginine and histidine), food flavourants and pigments.

UNIT III

Food spoilage and public health: Gram Negative and Gram Positive Food borne pathogens**,** Botulism, aflatoxin and amine production; food spoiling enzymes; Deterioration of foods- vegetables, meat, poultry, sea food and fruits.

Food preservation: Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere); Chemical (Sodium benzoate Class I & II); Aseptic packaging techniques; Labelling and preservation techniques by using Nano science and technology, Biological: Probiotics and bacteriocins.

UNIT IV

Indicator organisms – Direct examination – culture techniques – enumeration methods – plate – Viable & Total Count; Alternative methods – Dye reduction tests , electrical methods , ATP determination: Rapid methods, immunological methods – DNA / RNA methodology – Laboratory accreditation.

UNIT V

Food process technology: Packaging and canning of foods – preparation for packaging, thermal processing of foods: Microwave heating, thermal inactivation of microorganisms, thermal process, evaluations, freezing and thawing of foods. Food process operations: Evaporation - single and multi- effect evaporation, dehydration, psychometric charts, drying-tunnel, tray, drum, freeze, distillation; food processing aid through biotechnology.

Food sanitation: Good manufacturing practices-Hazard analysis, Food safety and standard act, Critical control points, Personnel hygiene

TEXT BOOKS

1. Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.

2. Food Microbiology- Frazier, 1987, Tata McGraw-Hill Education.

REFERENCES

1. Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York

2. Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, Verlag Chemie,Wainheim.

3. Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey.

4. Fundamentals of Food Process Engineering, 1980, Toledo,R.T., AVI Publishing Co., USA.

5. Food Engineering Operations, 1979, 2nd Edition, Brennan,J.G., Bulters,J.R., Gowelx,N.D and Lilly, A.E.V., Applied Science Publishers.

5. Food Process Engineering, 1977, 2nd Edition, Heldman, D.R., AVI Publishing

Course Outcome

CO 1 - Explain importance of different types of food in balanced diet and diet planning

CO 2 - Differentiate between different nutrient components in food and their role in processing and consumption.

CO 3 - Correlate basic food microbiology with food safety laws and standards.

CO 4 - Apply traditional methods for food preservation in developing a new food product.

CO 5 - Determine food quality by food analysis as per food laws and their importance in food industry.

PAPER VIII: 19MBTAC08 ENVIRONMENTAL BIOTECHNOLOGY

COURSE OBJECTIVES

- To give information about various pollution sources and preventive measures to control pollution.
- To learn intensive process in various pollution treatments
- Applications of Environmental biotechnology in various industries

UNIT I

Basic concepts ecology: Interaction between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Soil Microbiology-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources.

UNIT II

Aerobiology-Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Microflora, Outline of Airborne diseases (Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal - Aspergillosis, Cryptococcosis; Viral – Chickenpox, Influenza, Measles), Air sanitation. Air pollution : Types, source, method of sampling, measurement, impact on ecosystem and control. Control of noise and air pollution by biotechnological methods. Gaseous pollutants and odours: General sources, methods of control; fundamentals of adsorption, mechanism of adsorption.Application of adsorption for control of gaseous and odour emission. Noise pollution: Source, measurement, impact on ecosystem and control.

UNIT III

Aquatic Microbiology-Microbiology of water (Aquatic environment-Fresh and Marine)-Water pollution: Impurities in water, water pollution by industrial waste, examination of water, collection of water samples, water analysis – physical, chemical and biological. Assessment of water quality (Chemical and Microbial-indicator organisms) Water treatment processes: Primary treatment, screening, skimming with coagulants, flocculation, filteration, aeration and disinfection; Secondary treatment: Aerobic processes – activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors; Tertiary treatment: Activated carbon treatment, reverse osmosis and electro dialysis. Water borne pathogens.

UNIT IV

Solid waste management: sewage sludge treatment and utilization, refuse disposal, excreta disposal in unsewered area; composting and vermiculture.; biodegradation of

cellulosic and noncellulosic wastes for environmental conservation and fuel; bioaugmentation and biostimulation,bioconversion of cellulosic wastes into protein and fuel; biodegradation of xenobiotics; bioremediation of contaminated soils and waste lands; radioactive product waste disposal.

UNIT V

Effluent treatment – Case studies: Sources of pollution, impact on ecosystem and treatment of following industrial effluents: starch, paper and pulp, tannery, dairy, distillery, oil refineries and pharmaceutical. Microbes in mining, ore leaching, oil recovery, biopolymers, biosurfactants.

TEXT BOOKS

1. Environmental Biotechnology by Alan Scragg.(2005). IInd edition. Pearson Education Limited, England.
2. Environmental Biotechnology by S.N. Jogdand. (1995). Ist edition. Himalaya Publishing House.Bombay.

REFERENCES

1. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata McGraw Hill, NewDelhi
2. Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
3. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

COURSE OUTCOMES:

After completing the course, the student should be able to

CO 1 - Students will be able to understand use of basic microbiological, molecular and analytical methods, which are extensively used in environmental biotechnology.

CO 2 - To combat any pollution problems arising from industries.

PRACTICAL II – 19MBTACP2 ADVANCE MICROBIOLOGICAL TECHNIQUES

1. Wine production
2. Organic acid production – Citric acid – Solid state and submerged fermentation.
3. Isolation of nitrogen fixers – free living, symbiotic, ammonification, nitrification, denitrification.
4. Isolation of Phosphate solubilizers.
5. Isolation of Coliphage.
6. Isolation of Plasmids and chromosomal DNA from microbes.
7. Restriction digestion and ligation of bacterial DNA
8. Preparation of competent cells
9. Gene transfer in bacteria by calcium mediated method and identification of recombinants by antibiotic marker
10. Size determination and fractionation of nucleic acids and proteins – Agarose gel electrophoresis, SDS – PAGE.
11. Identification of food pathogen
12. Estimation of coliforms by MPN in water -Demo
13. Determination of BOD of effluent -Demo
14. Determination of COD of effluent -Demo
15. Biofertilizer production and formulation using *Rhizobium* culture -Demo
16. Biopesticide production and formulation using *Trichoderma viride-Demo*
17. Nano particle synthesis from microbes –Demo
18. Characterisation of nano particles by SEM, XRD and FTIR –Demo

SEMESTER: III

PAPER IX: 19MBTAC09 BIOINFORMATICS AND NANOBIOTECHNOLOGY

COGNITIVE LEVEL 1

Understanding and learning the basics of the nanoscience technology and bioinformatics roles in applied biology.

COURSE OBJECTIVES

This paper is aimed to provide an enhanced and understanding the basics of the nano-biotechnology for the students to perceive various nanomaterial syntheses and characterization.

The bioinformatics provides the introductory knowledge concerning genomics, proteomics and their applications, including the primary tools used for the structural elucidation and characterization of the biomolecules.

UNIT I

Bioinformatics - Definition, History, Web servers, computer systems, languages, - machine, high level and assembly. Internet basics – internet connection, web browsing and URL. **Introduction to biological databases** - Sequence databases, structural databases, specialized databases, sequence retrieval system from net - SRS, Entrez,

UNIT II

Structure prediction –similarity and database structure tools, FASTA, BLAST - Sequence and similarity – sequence alignment – local, global pairwise and multiple sequence, Iintroduction to phylogenetic trees.

UNIT III

Genomics: Methods of preparing genomic DNA; Types of genomics -structural, functional, comparative and environmental genomics. Metagenomics–study onUn-cultivablemicrobes. SNPs-EST- RAPD-RFLP; DNA sequence analysis methods:Sanger Di-deoxy method and Fluorescence method;Strategies for Whole Genome Sequencing – Hierarchical and Whole Genome Shotgun Sequencing- De novo and reference based assembly; Pyrosequencing.

UNIT IV

Proteomics: Protein sequencing; Protein modifications and proteomics; Protein engineering; Protein chips and functional proteomics;Relation between gene and protein. Approaches for study of proteomics. Types of proteomics -expression proteomics, structural proteomics and functional proteomics; Proteomics industry.**Infectomics**: Introduction and definitions of Infectomics. Genomics and proteomics of microbial infections –Structural and functional strategies.Types of Infectomics -ecological, immuno-and chemical Infectomics. DNA and protein microarrays, cloning, PCR, gene knockout and knockin, antisense strategies, Bio sensors. Future of Infectomics.

UNIT V

Nanoscience basics: Definition, Nanotechnology- Nano biotechnology- Nanomaterial- Nanocomposites- Classification of nanostructure- Top down & Bottom-up approach- Quantum dots- Bio inspired nanomaterials; Nanomaterial synthesis, Physical methods (Plasma, Laser), Chemical method (Sol-gel, Co-precipitation) & Biological method (Microbes, plant). **Nanomaterial characterization:** Electron microscopy – TEM, SEM & AFM – For particle imaging, XRD andFTIR for analyze the size, shape, structure, chemistry and crystallography. Drug delivery nanoparticles in cancer therapy, military application of nanotechnology- Future perspectives.

TEXT BOOKS

1. Introduction to bioinformatics by T.A Atwood
2. Introduction to computers by Alexis Leon and Mathews Leon
3. Genomics: The Science and Technology Behind the Human Genome Project (2000). Edited by C.Cantor and C.L.Smith, Wiley -Interscience, New York
4. J.W. Dale. (1998). Molecular Genetics of Bacteria, 3rd Edition. Wiley Publishers.
5. Singer M and Berg P. (1991). Genes and Genomes. University Science Books.
6. Lewin B. (2005). Genes IX. Oxford University press.
7. A. Pandey and M. Mann. (2000). Proteomics to study genes and genomesNature.
8. Sheng-He Huang, Timothy Triche, Ambrose Y. Jong. (2002). Infectomics: genomics and proteomics of microbial infections. Springer-Verlag publications.
9. **Fundamentals of Nanotechnology.** Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta. December 22, 2008 by CRC Press. Textbook - 786 Pages.
10. **Introduction to Nanoscience.** Stuart Lindsay. Oxford university press. Textbook – 448 pages.

REFERENCE BOOKS

1. Genome Mapping – A Practical Approach (1997) by P.H. Dear, Oxford University Press, Oxford.
2. Reviews and Articles from Journals such as Nature, Science, PNAS (USA), NucleicAcids Research, Trends Series & Current Opinion Series.
3. Protein Research: New Frontiers in Functional Genomics (1997). Edited by M.R. Wilkins, K.L. Williams, R.D.Appel and D.F. Hochstrasser, Springer – Verlag, NewYork2-D Proteome Analysis Protocols (1998). Edited by A.L. Link, Humana Press, Totowa, NJ.
4. Proteins and Proteomics. 2002. R.J. Simpson. Cold Spring Harbor Lab. Press. New York.
5. Cantor and Smith, Genomics. John Wiley & Sons, 1999.
6. Introduction to Genomics - Arthur M Lesk, Oxford University Press, 2007.
7. R.M.Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
8. P.Michael Conn, Handbook of Proteomic Method. Humana Press, Totowa, New Jersay, USA, 2003.
9. L.Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.
10. Introduction to Nanoscience and Nanotechnology 1st Edition by Chris Binns. Wiley publishers. 320 Pages.
11. Nanotechnology: A Gentle Introduction to the Next Big Idea by Mark A. Ratner; Daniel Ratner. Pearson Education (US). 208 Pages.

12. Textbook of Nanoscience and Nanotechnology. Authors: Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. Springer, 2013. 244 Pages.

Outcomes

- **To acquire the theory and practical experience of the use of common computational tools and databases which facilitate investigation of molecular biology concepts.**

- **To acquire knowledge and understanding of fundamentals of genomics and proteomics, transcriptomics and metabolomics and their applications in various applied areas of biology.**

- **To acquire basic science behind the properties of materials at nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.**

PAPER XI: 19MBTAC10 BIOSAFETY, BIOETHICS, IPR & BIOSTATISTICS

COGNITIVE LEVEL 1

Learning includes Basic concepts of Intellectual Properties, Intellectual property Rights, applications, advantages, Government rules and regulations for the same. Major issues concerned to the field of Biotechnology like Biosafety and GMO.

Course Objectives:

To make the students to:

- aware / understand the laws governing patents, trade secrets, copy rights and Be trademarks with special emphasis to biotechnology at national and international level.
- Familiarize with various criteria of patents and sort out the requirements of patent and trade secret.
- Get acquainted with principles of biosafety and gain knowledge about basic and advanced laboratory practices and safety precautions followed during biotechnological work.
- Be aware of the general guidelines for research in microorganisms, animals and plants
- Gain Ethical, Legal and Social Implications of Human Genome Project.

CONTENTS

UNIT I:

Introduction to ethics and bioethics Perspective of Ethics, Personal vs professional ethics: Moral Reasoning – Ethical theories Deontological, Utilitarianism – Ethical leadership (integrity and ingenuinity) - framework for ethical decision making- Michael Macdonald model &Storch model.

UNIT II:

Biotechnology and ethics Biotechnology in agriculture and environment: GM crops and GMO‟s - benefits and risks – ethical aspects of genetic testing – ethical aspects relating to use of genetic information and bio-warfare.

Ethical implications of cloning -Reproductive cloning , therapeutic cloning ; Ethical, legal and socio-economic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Biotechnology and biopiracy – ELSI of human genome

UNIT III:

Introduction to biosafety Biosafety issues in biotechnology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment

UNIT IV:

Introduction to intellectual property and intellectual property rights Types, patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable

and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO)

UNIT V:

Definition-Scope of Biostatistics, Measures of central tendency- Arithmetic Mean, Median, Mode. Measures of Dispersion , Standard deviation, Standard error, Correlation & Regression. Basic ideas of significant testing- Hypothesis testing, Level of significant test, t-test, chi square.

REFERENCES:

1. Principles of cloning, 2nd E6dition, Jose Cibelli, Robert Lanza , Keith H.S. Campbell, , Michael D. West, 2013
2. Ethics in Engineering 4th Edition by Martin, Mike W.; Schinzinger, Tata McGraw Hill Science, 2005
3. Ethical Issues in Biotechnology, Richard Sherlock, John D. Morrey, Jan 1 2002, Rowman & Littlefield.
4. S.P.Gupta-Statistical Methods
5. Khan and Khan – Fundamental of Biosatistics
6. http://books.cambridge.org/0521384737.htm
7. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
8. http://www.actahort.org/members/showpdf?booknrarnr=447_125
9. http://www.cordis.lu/elsa/src/about.htm
10. http://www.csmt.ewu.edu/csmt/chem/jcorkill/bioch480/bioLN98.html
11. http://www.accessexcellence.org/AE/AEPC/BE02/ethics/ethintro.html

COURSE OUTCOME:

After learning the course the students should be able to:

- Develop fundamental understanding Intellectual properties and IPR
- Understand the applications and advantages of IPR
- Understand the Biosafety and its relation to Biotechnology
- Understand GMO and its rules and regulations
- Understand the basics of Biostatistics.

PAPER XI: 19MBTMC11 RESEARCH TECHNIQUES

COGNITIVE LEVEL 1

To Understand and learn the basics concepts of the research methods and techniques.

COURSE OBJECTIVES

The objectives of this course are to emphasize the methodologies used to do research, use framework of these methodologies for understanding effective lab practices and scientific communication and appreciate scientific ethics.

UNIT: 1

BASIC CONCEPTS: Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research. Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire - Sampling Merits and Demerits.Research ethics.

Unit 2

WRITING RESEARCH PROPOSAL: Developing an outline Preamble, the problem, specific aims, background and significance, hypothesis to be tested, study design, setup, measurement procedures, and analysis of data, displaying preliminary data in tables, graphs and charts. Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals, presenting the research funding in open defense.

UNIT: 3

RESEARCH REPORTS: Structure and Components of Research Report, editing and evaluation of final draft, evaluating the final draft; Good Research Report, observation and research report. Pictures and Graphs; Research proposal/ Grant- definition, structure, budget allocation, specific aims, background and significance. Hierarchy of funding agencies in India and their operations. H-index, i10 index, Impact factor, Plagiarism. Title and abstract for a given text - Choosing and indexing key words from a given paper- Writing the paper based on a given set of instructions to authors.

UNIT: 4

Bioinstrumentations: Separation of Biomolecules: Centrifugation-Preparative, Analytical and Density gradient centrifugation. Chromatographic Techniques-Theory and application of Paper, TLC and HPLC Chromatography, Gel Filtration, Ion Exchange, Column, Gel permeation, Chiral, Hydroxy apatitie , Immuno adsorption, Affinity

Chromatography. Electrophoretic Techniques: Theory and Application of PAGE, SDS PAGE. Staining & detection methods-Isoelectroporesis, iso electric principle.

UNIT: 5

Structural analysis of Biomolecules: UV, NMR, GC-MS, LC-MS, Mass Spectroscopy, MALDI-ToF, 2D gel, Fluorescence Spectroscopy, Colorimetry, flame photometry and ESR principles

Text Books

11. Handbook of Biomedical Instrumentation – R.S. Khandpur, Tata McGraw Hill
12. Biophysical chemistry – Upadhyay., Upadhyay and Nath
13. Practical Biochemistry – Principles and techniques -Wilson. K and Walker. J,

REFERENCE BOOKS:

1. Wilkinson &Bhandarkar: Methodology and Techniques of Social Research.
2. Pauline Vyoung: Scientific Social Surveys and Research.
3. Panneerselvam, R., Research Methodology, Prentice Hall of India, New Delhi, 2004.
4. Kothari: Research Methodology.
5. Sellitz, et al: Research Methods in Social Relations.
6. Jerrold H. Zar. Biostatistical Analysis (4^{th}edition).
7. Janet Buttolph Johnson and Richard A. Joslyn, Political Science Research Methods (Washington D.C.: CQ Press, 2001), pp. 131-145.
8. Instrumental methods of chemical analysis – P.K. Sharma
9. A Biologist‟s guide to principle and techniques of practical biochemistry – Brigan L. Williams.
10. Experimental methods in Biophysical chemistry- Nicolau, C.
11. Chromatographic methods- Alan Braithwaite, Frank J. Smith
12. Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames.
13. Introduction to Spectroscopy- DonaldL.Pavia Gary M.Lipman, George S Kriz.

OUTCOMES

- To acquire themethodologies of scientific research, applying these to recent paper publications;
- To acquire practice scientific reading, writing and presentations;
- To acquire the basic science behind the research techniques

PAPER XII: 19MBTAC12 BIOPROCESS TECHNOLOGY

COURSE OBJECTIVES:

- To introduce the role f microbes in industries
- To impart knowledge on different types of fermentors and fermentation processes
- To familiarize with the various industrial production process involving microbes
- To provide the information on the role of various factors influencing the fermentation processes

CONTENTS

UNIT I

Types and design of bioreactor: Fermentor structure - Construction material, Basic components – Agitator, aerator, valves and steam traps, seals and stirrer glands. **Measurement and control of parameters** (on-line and off line sensors) – temperature, flow rate, pressure, pH, DO, gas analysis, computer control pathways. **Fermentors** - Air-lift, stirred tank, tower, fluidized bed, packed bed, pulsed, photo bioreactors, CSTR, PFR.

UNIT II

Process kinetics: Growth kinetics - Batch, Continuous and fed batch; **Kinetics** - batch, fed-batch and continuous process; Sterilization methods - batch sterilization, continuous sterilization of medium. and air. Solid state and submerged; aerobic and anaerobic fermentation. **Inoculum development –** Development of inocula for yeast, bacterial, mycelial and vegetative fungal processes; aseptic inoculation of the fermentor. **Mixed microbial populations**; **Immobilization** - immobilization of cells and co-immobilization; **Chemical kinetics** and classification of chemical reactors. **Transport phenomena** - Mass transfer, heat transfer, oxygen transfer; transfers in immobilized cells.

UNIT III

Production kinetics: Design for single and multiple reaction**:** size comparisons of single reactor for single reactions, multiple reactor systems for single reaction, reactions in parallel, in series, and series-parallel reactions of first order. Heterogeneous reactions - kinetics and mechanism of heterogeneous, non catalytic, and catalytic reactions; Non ideal flow - residence time distribution studies, C,E, F and I curves; RTD in ideal reactors; Models for Non ideal flow – zero – parameter model, One parameter model and two parameter model

UNIT IV

Downstream processing: Removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

UNIT V

Quality analysis: Quality analysis and product formulation - Product appearance, product stabilization and shelf life analysis, usage specific formulations, quality analysis and control. Fermentation economics of citric acid – process economics and project economics.

TEXT BOOKS

1. Fundamentals of Bioanalytical Techniques and Instrumentation, Ghosal and Srivastava, PHI Learning Pvt. Ltd., 2009.

2. Principles of Fermentation technology, Stanbury PF and Whitaker A. Pergamon Press, 1984.
3. Introduction to Biochemical Engineering, D.G.Rao, Tata McGraw Hill Publishers, 2005.
4. Bioprocess Engineering: Basic Concepts, 2nd edition, Shuler,M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs, 2001

COURSE OUTCOMES:

CO1: Able to select and design a fermentation process for a specific product
CO2: Capable of identifying industrially important microbes and its potential applications
CO3: Able to device means to improve the production rate of existing fermentation processes
CO4: Capable of designing processes for higher production yield at economically cheaper rate
CO5: Ideally skilled for employment in biotechnology industries

REFERENCES

1. Instrumentation, measurement and analysis, II edition, Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2004
2. Fermentation Microbiology and Biotechnology , Mansi El-Mansi and Charlie Bryce, Taylor and Francis Ltd., 2002.
3. 3. Manual of Industrial Microbiology and Biotechnology, III edition, Arnold L. Demain and Julian Davies, ASM press, Washington DC, 1999.
4. Biochemical Engineering Fundamentals, Baily,J., Bailey J. and Ollis,D.F., McGraw-Hill Book Co. New York, 1986.
5. Pharmaceutical Biotechnology: Fundamentals and Applications, 3rd edition, Daan J. A. Crommelin, Robert D. Sindelar, and , Bernd Meibohm, 2007.
6. Handbook of Downstream processing, Edin Goldberg, Blackie and Academic Professional, 1997.

PRACTICAL III- 19MBTACP3 APPLIED MICROBIOLOGICAL TECHNIQUES

1. Diagnostic Microbiology: Isolation and identification of pathogens from clinical specimens-Swab/ Urine
2. Haemolytic testing of bacteria
3. Differential test of *Staphylococci* through growth on agar plates (Mannitol agar, DNA agar plate and Coagulase test method)
4. Isolation and identification of clinically important fungi - *Candida albicans, Aspergillus* sp
5. Antibiotic susceptibility test. - Kirby Bauer technique
6. Identification and enumeration of Lymphocytes.
7. Agglutination reaction - Blood grouping & Rh Typing – Cross matching demonstration.
8. Precipitation reaction – ODD Test.
9. Serological Tests – WIDAL (Slide & Tube Test), RPR.
10. Immunoelectrophoresis – Counter Current & Rocket Immunoelectrophoresis.
11. ELISA – HIV, HBV & HCV.
12. Separation techniques: Chromatography - Paper, TLC and Column.
13. Molecular visualization of proteins (PYMOL)
14. Gene structure and function prediction (GENEMARK)
15. Gene structure prediction (GENSCAN)
16. Protein sequence analysis and protein secondary structure prediction (EXPASY and PROTEOMICS tools)
17. Molecular phylogeny (PHYLIP)
18. Analysis of protein and nucleic acid sequences (EMBOSS)

ELECTIVE

ELECTIVE PAPER I: 19MBTGE12A ANIMAL BIOTECHNOLOGY

Objectives:

1. To impart the theoretical knowledge on animal cell and tissue culture techniques.
2. To give a hands-on practical exposure on explants isolation, cell derivation, culturing and maintenance.
3. To enable the learners explore advancements of the field and recent technical updates.
4. To provide the knowledge on various aspects of applications including therapeutics, diagnostics and cell culture based products.

UNIT I

Introduction -History of animal cell culture techniques. Types of animal cell/tissue culture. Advantages and limitations of animal cell culture techniques. Aseptic techniques inside the cell culture laboratory. Biology of cultured cells –Cell adhesion, proliferation, differentiation, cell signaling, energy metabolism and senescence.

UNIT II

Basic requirements for animal cell culture - equipments and culture vessels. Media and supplements- physical, chemical and metabolic functions of different constituents of culture medium; Various media- Complete and defined media, serum and protein free media. Antibiotics in culture media. Media preparation and sterilization.

UNIT III

Establishment of primary culture. Methods of cell disaggregation. Subculture and cell line propagation. Cloning and selection of cultured cells. Cell separation techniques. Cell synchronization. Cryopreservation of cultured cells. Contamination of cultured cells. Large scale production of therapeutic proteins, hormones and vaccines from cultured animal cells.

UNIT IV

Stem cell Biology: Introduction, biology and classification-Unipotent, Pluripotent and Totipotent. Sources of stem cells-embryonic stem cells, embryonic germ cells and adult stem cells (Mesenchymal, Hematopietic, Induced pluripotent stem cells (iPS), Umbilical cord blood cells, Adipose tissue). Stem cells characterization-Genetic markers and membrane markers. Therapeutic applications of stem cells.

UNIT V

Tissue Engineering: Principles, tissue engineering triad – Basic Constitutents (Matix molecules, Ligands, Growth factors, Biomaterials). Tissue engineering bioreactors. Biodegradable polymers in tissue engineering. Therapeutic applications of tissue engineering.

Outcome of the course:

CO 1 - Students would understand and appreciate basic and advanced methods of mammalian and plant tissue culture techniques.

CO 2- The practical exposure would kindle the ideas of students to come up with novel applications of the field.

CO 3 - The technical details would expand the knowledge on the field that would equip the students to implement their views.

TEXT BOOKS

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition- R. Ian Freshney (Wiley Publishing)
2. Animal Cell Culture: A Practical Approach, 3rd Edition -John R. W. Masters (Oxford University Press)
3. Principles of Tissue Engineering, 4th Edition, Robert Lanza, Robert Langer, Joseph P. Vacanti.(Academic Press)
4. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.

REFERENCES

1. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David Barnes, Academic press.
2. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
3. Stem Cells: Scientific Progress and Future Research Directions (http://stemcells.nih.gov/)
4. Essentials of Stem Cell Biology, 2nd Edition - Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut (Academic Press)

ELECTIVE PAPER II: 19MBTGE12B BIOMOLECULAR METABOLISM

Course Objectives:

- To provides information about the significance of biomolecules
- Recalling the fundamental concepts of biochemistry
- To learn the structure and functions of biomolecules

Unit I

Foundations of Biochemistry: Chemical foundations of Biology: pH, pK, acids, bases and buffers, Henderson-Hassel Balch Equation, biological buffer solutions. Concept of free energy:

Unit II

Principles of thermodynamics; Kinetics, dissociation and association constants; energy rich bonds and weak interactions; Coupled reactions; group transfer; biological energy transducers.

Unit III

Aminoacids: Structural features of amino acids, classification of amino acids, peptide linkage, determination of primary structure of polypeptide (N-terminal, C-terminal determination, method of sequencing of peptides), structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins, protein detection and estimation.

Unit IV

Carbohydrates: Monosaccharides, Disaccharides and Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins, and Glycolipids. Carbohydrate metabolism: Glycogenolysis, Gluconeogenesis, interconversion of hexoses and pentoses.

Unit V

Lipids: Classification, chemical nature, properties. Biosynthesis of fatty acids. Oxidation of fatty acids. Storage Lipids, Structural Lipids in Membranes, Lipids as Signals, Cofactors, and Pigments.

Reference Books

- Microbial Biochemistry-2nd Edition - Georges N. Cohen Springer, Feb 2, 2011 – SCIENCE
- Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, Michael M. Cox

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Get a distinct idea about structure and function, synthesis and breakdown of Biomolecules.

CO 2 - Understand metabolic events that occur in cells.

CO 3 - Distinguish the mechanism of regulation associated with these metabolic events.

ELECTIVE PAPER III: 19MBTGE13A PLANT BIOTECHNOLOGY

COURSE OBJECTIVES:

- To understand the basic and latest techniques for in vitro culture of plants.
- Providing advanced knowledge about use of plant biotechnology in breeding and micropropagation techniques.
- To introduce the students to the theory and practice of plant tissue culture and their role from modifying plants in plant biotechnology to the propagation of endangered plants.

Unit – I

Laboratory organization and Techniques in Plant Tissue Culture. Organ culture, root, shoot tip or meristem, ovary, flower and ovule culture and their importance.

Unit – II

Callus culture-principle, protocol and significance, Cell suspension culture – Principle, protocol and its importance. Totipotency, cytodifferentiation and organogenesis – Principle, factors influencing Organogenesis and applications.

Unit – III

Somatic embryogenesis and synthetic seeds – Principle, protocol and importance. Single cell culture, embryo culture – Principle, protocol and applications. Anther and Pollen culture – Principle, protocol, and its significance. Protoplast, isolation, fusion and culture somatic hybridization, chemofusion, electrofusion, important properties of protoplast, somatic hybrids, cybrids – Principle, protocol and importance.

Unit – IV

Somaclonal variation – Causes and significance, plant tissue culture in forestry, micro propagation, clonal propagation production of useful biochemicals – Gene conservation bank – plant tissue culture in biotechnology-commercial aspects of plant tissue culture.

Unit – V

Application of transgenic plants for Biotic Stress tolerance: Herbicide resistance: phosphoinothricin and glyphosate; Insect resistance: *Bt* genes and alpha amylase inhibitor. Disease resistance: chitinase and 1,3-beta glucanase; Virus resistance: coat protein mediated, nucleocapsid gene; Nematode resistanc;. **Abiotic stress:** Drought, cold and salt; Post-harvest losses: long shelf life of fruits and flowers, male sterile lines, RNAi and Reverse genetics; Nutritional enhancement- Golden rice; Edible vaccine.

References:

1. Edwin F. George and Paul Sherington, D. 1984. Plant Propagation by Tissue Culture, Exegetics Ltd., Edington, Westbury, England.
2. Indra K. Vasil, 1980. Cell Culture and Somatic Cell Genetics of Plants. Academic Press Inc., New York.
3. Kalyanakumar De. 1997. An Introduction to Plant Tissue Culture, New Central Book Agency, Calcutta.
4. R.L.M. Pierik, 1987. In vitro culture in higher plants.MartinusNijhoff Publishers, Boston.

COURSE OUTCOMES:

CO 1 - Capable of understanding the totipotency of plants.
CO 2 - Able to identify the cell differentiation.
CO 3 - Able to understand cell and tissue culture contributes to global sustainability.
CO 4 - Abe to develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell, tissue culture and genetic engineering.
CO 5 - It will also develop the practical skills and confidence of students to successfully perform plant cells and tissues culturing.
CO 6- Capacity to establish commercial plant tissue culture lab.

ELECTIVE PAPER IV: 19MBTGE13B BIOREMEDIATION AND WASTE MANAGEMNT

Course Objective:

1. To impart knowledge on the management of solid and liquid wastes from municipal, industrial sources.
2. To provide the principles of remedial measures of recycling, reuse and wealth from the wastes.
3. To enable the degradation possibilities using biological methods called bioremediation.

UNIT – I:

Waste Classification and Quantification: Solid Waste Management- Sources and Generation of Solid Waste, characterization, composition, classification and disposal strategies. Hazardous Waste Management: Cyanides, Dioxins, Detergents, Plastics, Nylon and Paper. Radioactive Waste management: Sources, half life of radioactive elements, modes of decay. Radioactive waste disposal strategies and its impact of on living organisms.

UNIT - II

Recycling of Wastes – Types – sources – composition of waste – recycling of waste for Industrial, Agricultural and Domestic Purposes. Recycling of metals and reuse, recovery and reduction of paper and plastics. Various Waste Disposal Methods – composting, incineration, pyrolysis. Medical waste disposal strategies.

UNIT – III:

Microbial Activity in Soil and Ground Water. Microorganisms in rock and minerals, Mineral soil and Organic soil. Physiological groups of prokaryotes. Geomicrobial transformations – Biodegradation of carbonates – Biomobilization of silicon, phosphate, nitrogen.

UNIT - IV

Principles of Bioremediation – Rapid growth and Metabolism- Genetic plasticity – Metabolic pathways for the degradation of xenobiotis, hydrocarbons. Biodegradation potential – Bioprocess design, optimization – Microbial removal rates – inherent problems associated with biotreatment studies. Microbiological methodologies – Standard biotreatability protocols – Quantification of biodegradation.

UNIT – V

Aerobic Bioremediation: Bioremediation of Surface Soils: Fate and transport of contaminanats in the Vadose zone – Biodegradation in soil ecosystems – Types of soil treatment systems – Bioreactors. Subsurface Aerobic Bioremedidation: Selection of bioremediation system – in situ Bioremediation – in situ Bioventing – in situ treatment of Harbour Sediments – in situ Lagoon treatment. Bioremediation in fresh water and marine systems. Anoxic/Anaerobic Bioremediation:– Anoxic/Anaerobic Processes – Fermentation,

Degradation of xenobiotic. Anoxic/Anaerobic bioremediation of hydrocarbons, Chlorophenolic compounds, Phenols, Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds, Cyanide. Factors influencing anaerobic Bioremediation, Phytoremediation. Legislation, Regulation and Policy - Current Regulations and programs of interest – Hazardous Waste Management Act.

Outcome of the Course:

CO 1 - The course creates awareness about the various wastes and associated risks to living organisms and environment.

CO 3 - Students would understand the methods of hazardous waste disposal strategies and its merits and demerits.

CO 4 - The course would enable the learners to understand the minimal utilization and benefits of waste conversion into useful products.

REFERENCE:

1. Microbial Ecology, IV Ed., Atlast, R.M and Bartha,R.,(2000) Addison Wesley Longman Inc.
2. Bioremediation, Baker,K.H. and Herson,D.S., (1994) McGraw–Hill Inc.
3. Biology of Microorganisms, VII Ed., Brock,T.D., Madigan,M.T. Martinko,J.M. and Parker,J (1994) Prentice Hall, New Jercy.
4. Geomicrobiology, Ehrlich,H.L (1996) Marcel Dekker Inc., New York.
5. Bioremediation – Principles, Eweis,J.B., Ergas,S.J, Change,D.P.Y and Schroeder, E.D (1998) McGraw-Hill Inc.
6. Environmental Engineering, Kiely, G (1998) Irwin/McGraw Hill International, U.K.
7. Hazardous Waste Management, II Ed, LaGrega,M.D.,Buckingham,P.L., and Evans,J.C (2001) McGraw Hill Inc.
8. Microbial Degradation of Xenobiotics and Recalcitrant Compounds, Leisinger, T, Cook,A.M., Hutter,R and Nuesch,J (1981) Academic Press, London.
9. Hazardous Wastes and Solid Wastes, Liu, D.H.F and Liptak,B.G (2000),Lewis Publishers, New York.
10. Microbiology, Pelezar, M.J.Jr., Chan, E.C.S and Kreig,N.R (1993) Tata McGraw Hill, Delhi.
11. Remediation of Petroleum Contaminated Soils – Biological, Physical and Chemical processes, Riser-Roberts, E., (1998) Lewis Publisher, New York.
12. Vadose-Zone and Ground Water Contamination – Assessment, Prevention and Remediation, RusselBoulding, J (1995), Lewis Publishers, Tokyo.
13. Recycling of Crop, Animal and Human Waste in Agriculture, Tandon (1995), McGraw Hill Publishing Co.

ELECTIVE PAPER V: 19MBTGE14A PHARMACEUTICAL CHEMISTRY

Objectives:

1. To enable the students to understand the basics of drug administration and metabolism.
2. To provide the knowledge about drug discovery, designing, and testing.
3. To impart the real-life difficulties encountered in the pharmaceutical industry.
4. The course gives a detailed outline on the natural resources for the drug production.

CONTENTS

UNIT I

Introduction to Pharmaceuticals : Routes of drug administration, Pharmacokinetics: Absorbtion, Distribution, Metabolism- Oxidation, reduction, hydrolysis, conjugation and Elimination, absorption enhancement / solubility factor/ bioavailability; Pharmacodynamics; Assay systems and models (e.g., Knock-out Mice); Inter species scaling.

UNIT II

Drug discovery: Need for developing new drugs: Substances derived from bacteria, plants, insects, and animals; Sources of active principles; Combinatorial Synthesis: Chemistry, Biology, and Biotechnology**.**

UNIT III

Drug designing: Procedure followed in drug design; Molecular modification of lead compounds and proteins; Prodrug and soft drugs; Physico-chemical parameters in drug design; QSAR; Active site determination of enzymes; Design of enzyme inhibitors; Protein molecular modeling by computer: Docking studies; Structure based drug designing using software.

UNIT IV

Pharmaceutical products: Microbial products - Antibiotics (penicillin, streptomycin, tetracycline), vitamins, probiotics. Plant secondary metabolites -alkaloids, flavanoids, steroids, terpenoids**. A**nimal vaccines-Subunit vaccines, peptide vaccines, attenuated and vector vaccines. Clinical trials.

UNIT V

Therapeutic proteins: Insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators, erythropoietin, DNAseI, alginate lyase, muteins; Production, advantages, limitations and applications of monoclonal antibody.

Course Outcome:

CO1: The concepts gained through this subject will help the students to understand the right choice of drug from, the mode of drug administration and correct drug concentration required.

CO2: The course will give insight on various natural raw materials as resources for the drug production and the candidates will gain the ability to think of an unexplored resource for a new type of diseases.
CO3: Students will understand various methods of drug designing through virtual-wet lab combinations and will impart the technical details of pre-clinical trials.

TEXT BOOKS

1. Daan Crommelin, Robert D Sindelar, "Pharmaceutical Biotechnology", Tailor andFrancis Publications, New york, 2002.
2. Remington"s Pharamaceutial sciences, 18th edtion, Mack publishing & Co., Easton, PA (20 Ed, 2000).

REFERENCE

1. Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology", WILEY-VCH Publication, Germany, 2002.
2. Jay P Rho, Stan G Louie, "Hand book of Pharmaceutical Biotechnology", Pharmaceutical products press, New York, 2003.
3. Lachman L Lieberman, HA, Kanig, J, "Theory and practice of industrial pharmacy", 3rd edition, Varghese publishing & Co, New Delhi, 1986.

ELECTIVE PAPER VI: 19MBTGE14B GOOD MANUFACTURING PRACTICES AND QUALITY ASSURANCE

Cognitive Level 2

Objective:

1. Provide the student with an understanding of the principles and practice of GMP
2. Enable them to realise the importance and compliance of GMP.
3. Impart knowledge on the Administrative structure in the Industries
4. Will be taught about the designing an Industry and construction of SOPs

CONTENTS

UNIT I

Principles and Importance of GMP – Definition of GMP, Quality management, Personnel, Risk management, Quality control, Documentation, Inspections. **Public Health Protection** - adulteration definition - approved chemicals (lubricants, steam additives, etc.) - toxic chemical control and storage - hazard review: chemical, physical, biological - potential sources (humans, animals, environment) and controls **Premises** - Design, construction, and maintenance of the production and staff areas in the facility, Layout (design) of the facility - separation from farm/animals/pets (small scale) - perimeter, entrances, drainage - construction, heating/ventilation, humidity control - separation raw versus. pasteurize; product flow - equipment / pipe layout / drainage - water source (treatment, hardness) monitoring

UNIT II

Equipment - Design, construction, and maintenance of equipment, Equipment arrangement and operation, cleaning-in-place process. **Personnel** - Ensuring facility personnel are qualified for their job responsibilities, personal health and disease control, personal hygiene; clothing, habits, hand wash, restrooms, plant traffic control.

UNIT III

Sanitation - Sanitation programs: Cleaning and sanitation compounds and their uses – for process equipments - for environmental cleaning (drains, coolers, etc.) - influence of water quality, formulation control - concentrations and time. Environment sanitation and monitoring - environmental monitoring / pathogen testing - pest control programs.

UNIT IV

Raw Material Testing - Testing raw materials - Identifying when product or raw materials must be tested - Accepting raw materials from a vendor without additional regular testing - Supplier certification. **Good practices in production and control** - Controlling the manufacturing process - Stages in the production cycle – contracting quality tools – R & D - Self-inspection programs for fabricators, packagers/labelers - Testing requirements for packaging materials including supplier certification. **Finished Product Testing** - Finished product testing - Writing product specifications - Conditions and options for finished product testing, distributors - product storage - packaging, distribution. **Process Control** - refrigeration (potential hazardous compounds), pasteurization - culture, pH, incubation temperature, aging temperature.

UNIT V

Quality Control Department and Audits - Establishing a QC department - Investigating product quality. Audits- Records -Maintaining accurate, clear, and precise documents - Identifying individuals responsible for maintaining documents. Validation - Qualification, Process validation, Cleaning validation and Computer validation. GMP regulations - US-FDA, Europe, Japan, ICH, PICS/S, WHO.

TEXT BOOKS

Compendium of Good Practices in Biotechnology, BIOTOL series

REFERENCE BOOKS

1. **A WHO guide to good manufacturing practice (GMP) requirements: Volume 1,2,3,4,5. Part 2-Validation, by** Gillian Chaloner-Larsson, Ph.D, GCL Bioconsult, Ottawa

2. **Good Manufacturing Practices for Pharmaceuticals, Sixth Edition by: Graham Bunn** Publisher: Informa Healthcare; 6 edition | 424 pages (2007) http://ebookee.org/Good-Manufacturing-Practices-for-Pharmaceuticals-Sixth-Edition_859976.html#uPYoXd8huFeqqXB9.99

3. A Primer – Good Laboratory Prcatices and current manufacturing practice, by Ludwig Huber, Published by Agilent Technologies, Germany (2002) http://www.chem.agilent.com/Library/primers/Public/59886197.pdf.

4. GMP manual: Good manufacturing practices and implementation, http://www.gmp-publishing.com/media/ebooks/flyer/files/gmpmanual_eu_4c_online.pdf.

Course Outcome

On finishing the course work the students will be able to

1. Propose the plan of an Industry
2. Outline the eligibility of the workers to be recruited in each section
3. Design the hierarchy of administration in the Industry
4. Aware of the rules and regulation to be followed in an Industry
5. Certifications to be obtained for an Industry based on its type of production

ELECTIVE IVB: 19MBTGE15A ENTREPRENEURSHIP DEVELOPMENT

Objective: To enable the students to acquire knowledge about the various concepts of Entrepreneurship and to develop and enhance entrepreneurial competency and drive to startups.

Unit I:Introduction

Entrepreneurship – Meaning, Definition and concepts – Evolution of Entrepreneurship – Theories of Entrepreneurship – Role of Entrepreneurship in Economic Development, Factors affecting Entrepreneurship - Entrepreneur – Qualities, nature, types and traits – Entrepreneur Vs. Intrapreneur – Entrepreneur Vs. Manager – Entrepreneurship Development – meaning and importance.

Unit II: Entrepreneurial mobility and motivation

Entrepreneurial mobility, Factors affecting Entrepreneurial mobility, types of Entrepreneurial mobility – Meaning and concept of Entrepreneurial competency, developing Entrepreneurial competencies and Culture – Entrepreneurial Motivation – meaning and concept of motivation – motivation theories – Entrepreneurship Development Programs (EDPs) – Needs and objectives – phases of EDPs and evaluation of EDPs.

Unit III: Entrepreneurship Development and Government

Role of Government in promoting Entrepreneurship, MSME policy in India – District Industries Centres (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship Development Board (NEDB) – Recent initiatives by the Central and State Governments to boost startups and entrepreneurship in India , Startup India, Skill India, MSDE and NSDC– Financial Support System for entrepreneurship development.

Unit IV: Business sectors and forms

Business Sectors, Meaning and classifications - primary, secondary and tertiary sectors - Business Organisation – Forms of business organization, Sole Proprietorship, Partnership firms, Joint stock companies, Co-operative Society – their features, relative merits, demerits & suitability – Concept of Social Enterprise and Social Entrepreneurship, Social Entrepreneurs, Sustainability issues in Social Entrepreneurship – Entrepreneurial failure, issues, reasons and revamps.

Unit V: Project Management

Project Management, Concept, features, classification of projects, issues in Project Management – Project identification, Formulation, design and evaluation, Project appraisal, Project Report Preparation, Specimen of a Project Report – Starting a small scale unit,

Procedure and legal formalities, Steps in setting SSI unit, incentives and subsidies – Evaluating entrepreneurial performance.

Suggested books for Reference:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship Development", Tata McGraw Hill
2. Vasanth Desai, "Dynamics of Entrepreneurial Development and Management", Himalayas Publishing House.
3. P. Saravanavelu, "Entrepreneurship Development", Eskapee Publications.
4. N.P. Srinivasan & G.P.Gupta, "Entrepreneurship Development", Sultanchand & Sons.
5. Satish Taneja, Entrepreneur Development", New Venture Creation.
6. Barringer M.J. "Entrepreneurship", Prentice-Hall, 1999

ELECTIVE IVA: 19MBTGE15B TEACHING TECHNIQUES IN SCIENCE

Expected learning outcomes:

After completing the course, the student will be able to -

- Acquire knowledge about teaching- learning process and techniques.
- Comprehend different methods of teaching science.
- Acquire knowledge about various skills of Microteaching.
- Understand and apply the concept of unit plan and lesson plan in teaching science.

Unit I: Teaching Learning Process

Teaching: Meaning, Scope, Importance. Learning: Meaning, Scope, Importance. Teaching Learning Process.Bloom's Taxonomy of Learning objectives in Science.

Unit II: Methods of Teaching Science

Pedagogy: Meaning, concept. Different pedagogy of teaching Science: Seminar, Conference, Symposium and Workshop. Methods of Teaching in Science: Lecture-cum-Discussion Method, Laboratory Method, Observation Method, Project Method and Problem Solving Method.

Unit III : Micro-teaching skills in Science

Micro-teaching: Meaning, Importance, Steps and Cycle. Skills of Micro-teaching: Set Induction, Explaining, Stimulus variation, reinforcement and Closure.

Unit IV: Teachingof Science

Formulation of Instructional Objectives. Unit Planning: Meaning and Steps. Lesson Planning: Meaning and Steps. Improvised of teaching aids in general science.

Unit V: Evaluation in Science

Evaluation : Definition and Objectives. Types of Evaluation: Formative and Summative. Achievement test: Development and Construction.

References:

- Kumar, K.L. (1996). Educational technology. New Delhi: New Age International Publishers.
- Srivastava, A.P. (1987). Teaching and learning in 21st century. New Delhi: Indian Books Centre.
- Vedanayagam, E.G. (1989).Teaching technology for college teachers. New York: Sterling Publishers.

- Sharma, S.R. (2003). Effective classroom teaching modern methods, tools & techniques. Jaipur: Mangal Deep.
- Neel A, GlasGow, Cathy & Hicks. What successful teachers do. Chennai: Tamil Nadu Book House.
- Sampath, K., Panneerselvam, A. &Santhanam, S. (1984). Introduction to educational technology. II revised Edition. New Delhi: Sterling Publishers.
- Witch, W.A. &Schulles, C.F. (1973). Instructional technology: Its nature and use New York: Harpu& Row.
- Maheshkumar. (2004). Modern teaching of information technology. New Delhi: Anmol Publishers.
- Jaganath, Mohanty. (2003). Modern trends in educational technology. Hyderabad: Neelkamal.
- Rameshvarma, et al. (2005). Modern trends in teaching technology. New Delhi: Anmol Publishers.
- Janardan, P. et al. (2003). Advanced educational technology. New Delhi: Kanishka.
- Siidiqui. (2005).Challenges of educational technology. Coimbatore: Global Books Syndicate

SUPPORTIVE PAPER OFFERED

SUPPORTIVE I: MICROBIAL BIOTECHNOLOGY

COURSE OBJECTIVE:

- Empowering Students with knowledge on Microbial products
- Giving insight on Fermentation process

UNIT I

Isolation, Preservation and Maintenance of Industrial Microorganisms. Media for industrial fermentation. Air and Media Sterilization.

UNIT II

Industrial Microbiology – microbial synthesis of organic acids (Citric acid), alcohol (ethanol), Indicator organisms for , antibiotics production (penicillin), vitamin(B12) and amino acid(Tryptophan)

UNIT III

Agricultural Microbiology: Plant Microbes Interaction; Microbial herbicides, Agricultural antibiotics, Bio-fertilizers and Bio-insecticides;

UNIT IV

Medical Microbiology – Methods of isolation of pathogenic organisms; vaccine production; Insulin production

UNIT V

Environmental Biotechnology – Microbes in waste water treatment, microbial ore leaching and mineral recovery, oil recovery.

REFERENCES:

1. Principles of Fermentation Technology, Stanbury, P.F. and Whitaker, A.,Pergamon Press, Oxford.
2. Manual of Industrial Microbiology and Biotechnology, III edition (1999), Arnold L. Demain and Julian Davies, ASM press, Washington DC
3. Food microbiology, Frazier
4. Industrial Microbiology, Casida
5. Industrial Microbiology, by Creuger and Creuger
6. Medical Microbiology – Ananthanarayanan and Panicker
5. Bio-fertilizers in Agriculture and Forestry, 1995, by N.S. Subba Rao.
4. Microbes for Sustainable Agriculture by K.V.B.R. Tilak, K.K. Pal, Rinku Dey

COURSE OUTCOMES:

CO 1 – Able to design process condition for production of microbial products CO 2 – Can perform any fermentation production process.

SUPPORTIVE II: FOOD BIOTECHNOLOGY

COURSE OBJECTIVE:

- Give an insight on the role of microorganism in food industries
- Categorize harmful and beneficial microorganism in food industries

UNIT 1

Introduction: Nutritive factors of food constituents – protein, carbohydrates, fats in nutrition, bioavailability of nutrients, stability of nutrients. Microbes as direct food (Single cell protein and Baker's yeast); mycoprotein and yeast extract.

UNIT II

Fermentation products: Dairy products: General principles of manufacture of Cheese and Yogurt; Fermented foods: Soy sauce and Miso; Fermented vegetable: Sauer Krant and pickles. Fermented sausages.

UNIT III

Distilled beverages: Alcohol, wine, brandy and beer; **Food additives:** Production of additives - organic acid (acetic acid), amino acid (glutamic acid), food flavourants and pigments.

UNIT IV

Food spoilage and public health: *Staphylococcal, Salmonellosis, E.coli,* Botulism, aflatoxin.

Food preservation: Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere); Chemical (Sodium benzoate Class I & II); Boilogical: Probiotics and bacteriocins.

UNIT V

Food process technology: Canning, Microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods. Food process operations: Evaporation - single and multi effect evaporation, dehydration, psychomatric charts; drying-tunnel, tray, spray, drum, freezeing; distillation; food processing aid through biotechnology.

REFERENCES

1. Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.
2. Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York

COURSE OUTCOME:

CO 1 – Can apply techniques for prevention of food spoilage.
CO 2 – Can imply the knowledge for use of beneficial organism in food industry

SUPPORTIVE III: CLINICAL MICROBIOLOGY

COURSE OBJECTIVE:

- Providing information on types of infections and their epidemiology
- Imparts knowledge on host defense and immune system
- Understanding the preventive measures towards infection

UNIT 1

Infection and immunity: General principles of infection, antigens, antibodies, antigen – antibody reactions, complement system.

UNIT II

Pathogenic/Parasitic organisms: Bacterial, viral and protozoal infections of the gastrointestinal system, nervous system, lung, liver, and eye; sexually transmitted diseases, skin infections, zoonoses, arthropod borne diseases. Transmission and spread of diseases – disease epidemiology.

UNIT III

Control and prevention of infections: Drugs and antibiotics, drug resistance, mycobacteria, leprosy and malarial parasite – importance, life cycle, spread and control. Control of vectors – mosquito control – biotechnological approaches.

UNIT IV

Vaccines : Types and methods of action. Biotechnological approaches to disease control and vaccine production. Genetic disorders and gene therapy.

UNIT V

Biochemical changes due to infections: Blood test and tissue analysis. Isolation and identification of organisms from tissue samples. Disease detection – conventional and molecular techniques.

REFERENCES

1. Immunology,Roitt,I.M., Brestoff and Male D.K., 1996.
2. Text book of microbiology, C.J.K. Panicker.
3. Molecular biotechnology, Glick.
4. Clinical microbiology, Ananthanarayanan.

COURSE OUTCOME:

CO1: Able to predict the epidemiology of disease
CO2 : Will know the different types of infections and their causative organism
CO3: Can identify the detection and preventive measures of an infection