CVM UNIVERSITY

MASTER OF SCIENCE

BIOTECHNOLOGY (INDUSTRIAL BIOTECHNOLOGY)

PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2021-22

CVM UNIVERSITY

Programme M.Sc. Biotechnology (Industrial Biotechnology)
(Under the Choice based Credit Scheme)

STRUCTURE WITH EFFECT FROM 2021-2022

Type of course	Course Code	Title	T/P	Credit	Exam Duration in Hrs	Component of Marks		
						Internal	External	Total
						Total / Passing	Total / Passing	Total / Passing
Semester - I								
Core Course	Core 1	Cell Communication & Cell Signaling	T	4	3	40/16	60/24	100/40
	Core 2	Biodegradation & Bioremediation	T	4	3	40/16	60/24	100/40
	Core 3	Food Biotechnology	T	4	3	40/16	60/24	100/40
	Core 4	Practical Based on Core 1 & Core 2	P	4	3	40/16	60/24	100/40
	Core 5	Practical Based on Core 3& Elective X	P	4	3	40/16	60/24	100/40
	Core 6	Comprehensive Viva-Voce		1			50/20	50/20
Elective Course (Any One)	Elective 1	Plant Biotechnology	T	4	3	40/16	60/24	100/40
	Elective 2	Microbial Technology	T	4	3	40/16	60/24	100/40
	Elective 3	Environmental Chemistry	T	4	3	40/16	60/24	100/40
	Elective 4	Clinical biochemistry	T	4	3	40/16	60/24	100/40
	Total Credit			**25**				

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: CELL COMMUNICATION & CELL SIGNALING
COURSE CODE: CORE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Introduction membrane structure, transport across it, intracellular vesicular traffic
2. Cytoskeletal structures, cell cycle
3. Introduction to various signaling pathways in living system, types of receptors
4. Pathways of intracellular transduction

UNITI: Cell-cell and cell-matrix adhesion:
Cell adhesive molecules, cell junctions, cadherins mediate cell-cell adhesion, Desmosomes, Tight junction
Integrins Mediate cell-ECM adhesion, Gap junction, Plasmodesmata
Basal lamina and extra cellular matrix.
Cell Cycle – Phases of Cell Cycle, functional importance of each phase, Molecular events during cell cycle, Checkpoints.
General account on programmed cell death (Apoptosis) - intrinsic and extrinsic pathways

UNITII: Mechanisms of Cell communication:
General principles of cell communication, Introduction to signalling Receptors (GPCRs, Ion Channel Coupled receptors, Enzyme coupled receptors) and ligands,
Signalling through G-protein coupled receptors (GPCRs) - Adenylyl Cyclase, Phospholipase C and small mediators, heterotrimeric G-proteins, : effectors, Secondary messenger: NO , Calcium, cAMP
Tyrosine kinase receptors, Cytokine receptors, Src kinases

UNITIII:
Pathways of intracellular transduction: Wnt and Hedgehog Signaling, Notch/Delta signaling, ras/MAPK pathways, Mitogenic signaling Cytokine signaling/JAK-STAT/mTOR, NFkappa B signaling, TGF Beta signaling, PI3-kinase Lipid Signaling

Unit IV:Host Parasite interaction:
Recognition and entry process of different pathogens like bacteria, viruses into cells.
Alteration of host cell behavior by pathogens.
Cancer: Genetic rearrangement in progenitor cells, oncogenes, tumor suppressor genes

REFERENCE BOOKS:

1.Cell and Molecular Biology by E.D.P.DeRobertis and E.M.P.DeRobertis. 8th Edition, Reprinted -2007) B.I.PublicationsPvt. Ltd.(Indian Edition).ISBN: 0-7817-3493-2.
2. Cell and Molecular Biology: Concepts and Experiments by Gerald Karp.5th Edition, Wiley International Edition, John Wiley&Sons,Inc. ISBN: 0-471-65665-8.
3. Molecular Biology of THE CELL by Albert et al.4th Edition, 2002, Garland Science, Taylor & Francis Group. ISBN: 0-8153-3218-1
4. The Cell – A Molecular Approach by Geoffrey M. Cooper and Robert E. Hassman. 3rd Edition, 2004, ASM Press, Sinauer Associates, Inc.ISBN:0-87893-214-3.
5. Molecular cell Biology by Harvey Lodish, 5th Edition, (2004) W.H.Freeman and Company, New York.ISBN:0-7167-4366-3.
6. Cell Biology by C.B. Powar.(Reprinted-2004)Himalaya Publishing House, Mumbai.
7. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V.K. Agarwal(Reprinted -2007) Pub.S.Chand& Company Ltd.Ram Nagar, New Delhi.
8. Cytology by P.S. Verma and V.K. Agarwal (Reprinted -2006) Pub:S.Chand& Company Ltd.Ram Nagar, New Delhi-110055.ISBN: 81-219-0814-0.

PRACTICALS:

1. Mitosis preparation
2. Meiosis preparation
3. Histological localization of DNA and RNA
4. Histone protein localization
5. Nucleolus localization
6. Enzyme localization
7. Protein localization
8. Lipid localization
9. PAS reaction for GAG molecules

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: BIODEGRADATION & BIOREMEDIATION
COURSE CODE: CORE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Introduction to biodegradation, enzymes involved, degradation of hydrocarbons,
2 Microbial transformation of pesticides, degradation of woods, degradation of some VOC
3 Bioremediation of soil and water pollutants
4 Various bioremediation strategies, bioremediation of air pollutants

UNIT I:

Biodegradation-I: Introduction, Determination of biodegradability, Principles of bacterial degradation, environmental factors affecting biodegradation, enzymes, toxicity. Aerobic degradation of hydrocarbons, growth associated aliphatic compound degradation, Degradation of Aromatic compounds. Anaerobic bacterial degradation-biopolymer, fats, lipids, hydrocarbon, N-alkyl, S-alkyl, ketones compound degradation.

UNIT II:

Biodegradation-II: Microbial transformation of pesticides, Fundamental reactions of pesticide metabolism-β-oxidation, oxidative dehalogenation, dealkylation, decarboxylation, epoxidation. Aromatic Non-heterocyclic Ring Cleavage-Hydrolysis, Halogen reaction, Nitro-reduction. Anaerobic degradation of 2,4 D, 2,4,5-T and PCB. Degradation of selected volatile organic compounds in ground water-Chlorinated alkanes-PCE, PCA, TCA, TCE, DCA and CT (biotic, abiotic, aerobic and anaerobic transformations).

UNIT III:

Overview of bioremediation strategies**,** Ex Situ versus In Situ Bioremediation**.** Factors affecting bioremediation.In-situ bioremediation- Biosparging, Bioventing, Bioaugmentation (Benefits, Limitation, Process and factors to consider). Ex-situ Bioremediation- Land farming, composting, Biopiles. Bioreactors. Phytoremediation: Types of phytoremediation technologies (phytoextraction, phytostabilization, phytovolatilaztion,rhizodegradation, rhizofilteration).

UNIT IV:

Use of bacteria fungi and algae in biosorption, Biomineralisation& Bioleaching: Microorganisms involved in Bioleaching of ores, mechanisms of bioleaching, Bioleaching & Metal recovery.Molecular techniques in bioremediation,Role of plasmids in bioremediation, Genetics and gene manipulation: Metagenomics in Bioremediation, Bio-surfactants in bioremediation, Microbial surfactants. Bioremediation of air pollutants-Microbial

degradation of contaminants in gas phase, Biofilteration, Biofilter media, Microbial ecology of biofilters.

REFERENCE BOOKS:

1. Ronal L. Crawford, Don L. Crawford. Bioremediation: Principles and Applications. ISBN: 0521470412.
2. Anthony H. Rose. Microbial Biodeterioration. Academic Press. ISBN: 0125965567.
3. Dennis Allsopp, Kenneth J. Seal, Christine C. Gaylarde. Introduction to Biodeterioration. Cambridge University Press. ISBN 0521528879.
4. Alan Scragg. Environmental Biotechnology. 2nd Edition. Oxford Press. ISBN: 0-19926867-3.
5. Pradipta Kumar Mohaparta. Textbook of Environmental Biotechnology. I. K. International Publishing House Pvt. Ltd. ISBN: 81-88237-54-X.
6. R. Margesin and F. Schinner. Manual of Soil analysis: Monitoring and Assessing Soil Bioremediation. Springer Publishers ISBN: 3540253467.
7. James J. Valdes. Bioremediation Kluwer Academic Publishers ISBN 0792364597.
8. Subhas K. Sikdar and Robert L. Irvine Biodegradation Technology Developments Vol: II, Bioremediation: Principles and practice. CRC Press. ISBN-10: 1566763088.

PRACTICALS:

1. Isolation of hydrocarbon degrading microorganisms.
2. Analysis of Chromium.
3. Analysis of iron.
4. Isolation of metal detoxifying microorganisms.
5. Study of biodegradation of aromatic compounds using TLC.
6. Decolourization of dye.
7. Study of biofilm: slide immersion tech and staining

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: FOOD BIOTECHNOLOGY
COURSE CODE: CORE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Opportunities and applications of food biotechnology
2 Probiotics and prebiotics: their significance and guidelines for use
3 Production of genetically modified foods, guidelines for their production and release
4 Application of biotechnology in improving nutritional value of food

UNIT I:

Scope of food biotechnology
Food as a substrate
Role of Microbes in food Biotechnology – Bacteria, yeasts and moulds
Food Spoilage
a) General principles underlying food spoilage and contamination.
b) Spoilage of canned food,vegetables, fruits, meat and meat products,milk and milk products fish and seafood

UNIT II:

Food poisoning
Food borne pathogens
a) Bacterial food borne infections and intoxications- Brucella, Campylobacter, Clostridium, Escherichia (ETEC/EHEC/EPEC/EAEC), Salmonella, Shigella, Listeria and Vibrio
b) Non- bacterial food borne infections and intoxications- Protozoa, fungi& viruses

UNIT III:

a) Food preservation
Principles of food preservation – Physical and chemical preservation methods,
Bio preservatives
b) Starter cultures for dairy &fermented foods
Oriental fermented foods: Shoyu and Tempeh
Fermented milk products: Yogurt and Kefir
Fermented vegetables – Sauerkraut

UNIT IV:

Genetically modified foods
Food research organizations/institutes in India

Food sanitation – Microbiology of food plant sanitation, water and milk testing
Food laws and quality control – HACCP, Codex Alimentarius, PFA, FPO, MFPO, BIS, AGMARK.

REFERENCE BOOKS:

1. Food Microbiology, Frazier and Westhoff
2. Food microbiology, Adam and Moss
3. Dairy Microbiology by Robinson. Volume I and II.
4. Fundamental Food Microbiology, Bibek Ray and ArunBhuniya

PRACTICALS:

1. Microbiological examination of fresh and canned foods
2. Microbiological examination of spoiled foods and fruits
3. Microbiological examination of milk by Breeds method
4. Microbiological quality testing of milk (MBRT test)
5. Extraction of Mycotoxins from contaminated grains/foods.
6. Detoxification of mycotoxins.
7. Isolation, Screening and Identification of bacterial probiotics like LAB
8. Isolation, Screening and Identification probiotic yeast
9. Microbiological examination of mushrooms

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: PLANT BIOTECHNOLOGY
COURSE CODE: ELECTIVE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Tools and techniques of plant genetic engineering
2 Molecular biology of nitrogen fixation, nif gene transfer, herbicide resistant plants production
3 Transgenic plants for agriculture and commercial applications
4 Plant tissue culture techniques

UNIT I:

Plant biotechnology present scenario, Micropropogation and its application; Types of different organ culture and its application; Somaclonal variation: Introduction, Different pathways of somaclonal variation; factor affecting of somaclonal variation, Detection of somaclonal variation; Somaclonal variation its application in crop improvement.

UNIT II:

Chloroplast transformation: Structure of chloroplast; Plastid chromosome; Transformation methods-Agrobacterium mediated transformation, Particle gun method, Gene replacement, Gene insertion; Limitation of chloroplast transformation; Application of chloroplast transformation.

UNIT III:

Secondary metabolite: Role of secondary metabolites, Basic biosynthetic pathways,
Techniques used in biosynthesis, Source of secondary metabolites; criteria for cell selection, factor affecting the culture of cells, Different bioreactors and their use in secondary metabolites production, Production of bioactive secondary metabolites by plant tissue culture.

UNIT IV:

Transgenic plants production: Development of abiotic (Insect, Disease, Herbicide) and biotic (Drought) resistant plants.
Peptide production, biodegradable plastic and edible vaccine.
DNA barcoding in plants its application.

REFERENCE BOOKS:

- An introduction to Plant Tissue culture by MK Razdan. M.K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.

- Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008.
- Biochemistry & Molecular Biology of Plants. Bob Buchanan, Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.
- Plant biotechnology – J Hammond, et. al., Springer Verlag.
- Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, et. al.
- Biotechnology in crop improvement – H S Chawla.
- Practical application of plant molecular biology – R J Henry, Chapman & Hall. ¾ Elements of biotechnology – P K Gupta.
- An introduction to plant tissue culture – M K Razdan.
- Plant propagation by tissue culture: The technology (Vols. 1 & 2) – Edwin George.
- Handbook of plant cell culture (Vols. 1 to 4) – Evans et. al., Macmillan. ¾ Plant tissue and cell culture – H E Street, Blackwell Scientific.
- Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
- Plant cell culture technology – M M Yeoman.
- Plant tissue culture and its biotechnological applications – W Bary, et. al., Springer Verlag.
- Principles of plant biotechnology: An introduction to genetic engineering in plants – S H Mantel, et. al.
- Advances in biochemical engineering / Biotechnology – Anderson, et. al.
- Applied and fundamental aspects of plant cell tissue and organ culture edited by Reinert & Bajaj Y P S, Springer Verlag.
- Plant cell and tissue culture – S Narayanswamy, Tata Mc Graw Hill Co.
- Introduction of plant biotechnology – H.S. Chawla. Third Edition; Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

PRACTICALS:

1. Preparation of MS media for inoculation
2. Micropropogation through nodal explants
3. Callus induction
4. Mass multiplication of banana
5. *Agrobacterium tumefaciens* mediated plant transformation
6. Protoplast isolation
7. Embryo dissection and culture
8. DNA isolation of plant material

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: MICROBIAL TECHNOLOGY
COURSE CODE: ELECTIVE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Exploitation microorganisms for industrial product production (primary metabolites)
2. Industrial production of secondary metabolites using microorganisms (e.g. antibiotics)
3. Steroidbiotransformation and ergot alkaloids production, biofuels.
4. Food and dairy products production e.g. Cheese, yoghurt, Beer, Wine.

UNIT I:

Scope of Microbial biotechnology.
Microbial production and applications of primary metabolites: Citric acid, Ethanol, L-Glutamic acid, Vitamin B_{12}
Industrially important microbial enzymes: Types, mode of action and industrial applications of microbial amylases and proteases

UNIT II:

Microbial production of therapeutically important products:-
Antibiotics: Penicillin, Streptomycin
Ergot alkaloids: Production by Saprophytic cultivation
Biotransformations of steroids: Hydroxylation and dehydrogenation,
Steroid biotransformations.

UNIT III:

Production of single cell protein from bacteria, fungi and algae, Characteristics, nutritional value and safety, substrates used, process examples, applications.
Cultivation of edible and medicinal mushrooms: Nutritional and medicinal properties
Production and applications of microbial exopolysaccharides: Classification, Biological functions, structure and biosynthesis of Xanthan and Alginate,
Factors affectingfermentative production of exopolysaccharides and downstream processing(recovery).
Production of bioplastics (Polyhydroxyalkonates)

UNIT IV:

Microbiology and technology of fermented dairy products:
Cheese making: Cheese varieties, manufacture of cheddar cheese,
Sources andproperties of rennets.
Yoghurt making
Beer and Wine production

REFERENCE BOOKS:

1. Biotechnology - Rehm and Reid.
2. Comprehensive biotechnology - Murray Moo Young.
3. Microbial Technology Vol I & II - Henry J. Peppler&D.Perlman
4. Microbiology & technology of fermented foods - Robert W. Hutkins. Blackwell publishing.
5. Modern Industrial Microbiology and Biotechnology 2nd edition - Nduka Okafor, Benedict C. Okeke - (2017, CRC Press)

PRACTICALS:

1. Production of cellulase enzyme by solid-state fermentation.
2. Saccharification of agro-waste by cellulase enzyme.
3. Bioassay of antibiotics
4. Production of citric acid by submerged fermentation
5. Production of protease by submerged fermentation.
6. Single cell oil production by Yeast
7. Production of Yoghurt
8. Downstream processing of penicillin

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: ENVIRONMENTAL CHEMISTRY
COURSE CODE: ELECTIVE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes
At the end of this course, the student will be able to:

1 Structure and composition of atmosphere, greenhouse effect
2 Water cycle, its pollutants, types of reactions in various water bodies
3 Organic and inorganic components of soil
4 Biochemical cycling of elements

UNIT I:

Atmospheric Chemistry and Air Pollution: Chemical processes for formation of inorganic and organic particulate matter, thermochemical and photochemical reactions in the atmosphere.Gaseous pollutants, sources, reactions, control and effects of air pollutants on living and non-living things. Effects of meteorological and topographical factors. Global Climate change: Ozone depletion, Acid Rain and Greenhouse effect. Formation and effects of Photochemical smog.

UNIT II:

Water Chemistry and Water Pollution: Chemistry of Natural Waters, Water resources, hydrological cycle, physical and chemical properties of water, complexion in natural and waste water, role of microorganisms, Water pollutants, Types, Sources, Heavy metals, Metalloids Organic, Inorganic, Biological and Radioactive. Types of reactions in various water bodies including marine environment, Eutrophication and ecological magnification due to water pollution.

UNIT III:

Biogeochemical cycling of elements:Gaia Hypothesis, The Carbon cycle-Carbon transfer through food webs-Carbon cycling within Habitats-Carbon Monoxide cycling. The Hydrogen Cycle, The oxygen Cycle. The Nitrogen Cycle-Ammonification, nitrification and denitrification. The Sulfur Cycle-Oxidative and reductive sulfur transformation. The phosphorus Cycle, Iron cycle, Manganese Cycle and Calcium Cycle.

UNIT IV:

Soil chemistry & soil composition: Soil profile: Organic & Inorganic components of soil, Physical and Chemical Properties, cation exchange capacity, soil pH, environmental properties of soils. Leaching and erosion. Reactions with acids and bases. Geochemical reactions that neutralize acidity. Biological Process that neutralize acidity, Pesticide and Polymer Pollution. Physiochemical control of soil pollution.

REFERENCE BOOKS:

1. Environmental Chemistry, a global perspective. Gary W. Valoon& Stephen J. Duffy, Oxford University Press.
2. Environmental chemistry, B. K. Sharma.
3. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw-Hill, 1985.
4. M. Arora, Environmental management of toxic and hazardous waste.
5. Tyagi, O. D. and M. Mehra, Textbook of Environmental Chemistry.
6. A.K. de. Environmental Chemistry 2000 (4^{th} edition). New age International (P) Ltd., New Delhi, India.
7. Kenneth Wark, Cecil F. Warner, Wayne T. Davis, Air pollution origin and its control work, 3rd Edition, Prentice Hall.
8. R. M. Atlas. (1993) Microbial Ecology Fundamentals and Applications. 4^{th} edition Pearson education Pte. Ltd. ISBN: 81-297-0771-3.
9. Stanley E. Manohar, Environmental Chemistry, Williard Grant press, Beston, Massachutes

PRACTICALS:

1. Spectrophotometric analysis of nitrate.
2. Spectrophotometric analysis of nitrite.
3. Analysis of ammonia.
4. Determination of sulphate by turbidometric method.
5. Determination of zinc by EDTA complexometic reaction.\
6. Analysis of Total Hardness, Ca^{+2} Hardness and Mg^{+2} Hardness.
7. Analysis of Ca^{+2} from egg shell.
8. Analysis of sulfite.

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – I
NAME OF COURSE: CLINICAL BIOCHEMISTRY
COURSE CODE: ELECTIVE 4
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes
At the end of this course, the student will be able to:

1 Specimen collection, preservation and transportation, composition of various body fluids
2 Acid base balance and disorders, types and functions of carbohydrates
3 Clinical enzymology, haemoglobin
4 General organ function tests

UNIT I:

Introduction to clinical biochemistry: Specimen collection, preservation and transportation (blood, urine, spinal fluid, saliva, synovial fluid, amniotic fluid).
Chemistry, composition & functions of lymph, CSF, ascitic fluid, pleural fluid & synovial fluid.

UNIT II:

pH and Acid base balance & disorders, Electrolytes balance & imbalance, Blood gases and blood buffers.
Types, function and importance of carbohydrates, proteins and lipid, Lipoproteins, Apolipoproteins, Lipoprotein metabolism and disorders.

UNIT III:

Clinical Enzymology: Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme.
Hemoglobin (Biochemistry, synthesis and breakdown), Hemoglobinopathies, Thalessemia, Bilirubin metabolism, Jaundice, Vandenbergh test.

UNIT IV:

General Organ function tests: Liver function tests, , Thyroid function tests, Pancreatic function tests, Cardiac Function Test.
Biochemistry of Diabetes mellitus, Atherosclerosis, Fatty liver, and obesity.

REFERENCE BOOKS:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company AisaPvt. Ltd. ISBN-13: 978-0721656106
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998). ISBN-13: 978-0-471-58505-3
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.

4. Diagnostic Microbiology, Balley& Scott's. Eleventh Edition. ISBN 0-323-01678-2
5. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 4th Edition By Carl A. Burtis, , Edward R. Ashwood, and David E. Bruns, - ISBN -9780721601892
6. The Science of Laboratory Diagnosis, Crocker Burnett. ISBN 1899066624
7. Text books of Medical Laboratory Technology – Dr. Praful B. Godkar
8. Henry's Clinical Diagnosis and Management by Laboratory Methods 2 Richard McPherson Matthew Pincus ISBN: 978-1-4160-0287-
9. Biochemistry for medical students: Vasudeven and Shreekumar Jay pee prakashan.
10. Practical Clinical biochemistry by Harold verly
11. Text book of medical biochemistry by- Chatterjea and Rana Shinde

PRACTICALS:

1. Preparation of standard solution, molar solution and other reagents
2. Analysis of normal and abnormal urine
3. Estimation of blood /serum glucose by various methods/ GTT
4. Glycosylated Hb, Hb Electrophoresis
5. Estimation Bilirubin , direct , total
6. Estimation of total protein and A/G ratio
7. Electrophoresis of plasma proteins
8. Estimation of total cholesterol and its fractions
9. Estimation of total lipids
10. Estimation of SGPT,SGOT
11. Hormone estimation: Determination of T3 or T4 by ELISA

CVM UNIVERSITY

MASTER OF SCIENCE

BIOTECHNOLOGY (INDUSTRIAL BIOTECHNOLOGY)

PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2021-22

CVM UNIVERSITY

Programme M.Sc. Biotechnology (Industrial Biotechnology)
(Under the Choice based Credit Scheme)

STRUCTURE WITH EFFECT FROM 2021-2022

Type of course	Course Code	Title	T/P	Credit	Exam Duration in Hrs	Component of Marks		
						Internal	External	Total
						Total / Passing	Total / Passing	Total / Passing
Semester - II								
Core Course	Core 1	Industrial Waste Management	T	4	3	40/16	60/24	100/40
	Core 2	Bioprocess Engineering and Technology	T	4	3	40/16	60/24	100/40
	Core 3	O'-mics	T	4	3	40/16	60/24	100/40
	Core 4	Practical Based on Core 1 & Core 2	P	4	3	40/16	60/24	100/40
	Core 5	Practical Based on Crore 3& Elective X	P	4	3	40/16	60/24	100/40
	Core 6	Comprehensive Viva-Voce		1			50/20	50/20
Elective Course (Any One)	Elective 1	Animal Biotechnology	T	4	3	40/16	60/24	100/40
	Elective 2	Bioseperation Technology	T	4	3	40/16	60/24	100/40
	Elective 3	Protein Engineering	T	4	3	40/16	60/24	100/40
	Elective 4	Environment Policy and Legislation	T	4	3	40/16	60/24	100/40
	Total Credit			**25**				

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: INDUSTRIAL WASTE MANAGEMENT
COURSE CODE: CORE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes
At the end of this course, the student will be able to:

1. Waste water management
2. Aerobic and anaerobic biological treatment process
3. Paper pulp, dairy and textile industry

UNIT I:

Wastewater management: Types and sources of water pollutants, Methods for measurement of water pollutants: BOD, COD, coliforms, biotechnological methods used for monitoring of pollutants. Wastewater treatment methods: Primary: Screening, grit removal, floatation tank, coagulation, flocculation, sedimentation. Secondary treatment methods: Biological treatment methods examples of attached and suspended techniques. Tertiary treatment methods: Nutrients removal, advanced oxidation processes and sludge treatment methods.

UNIT II:

Aerobic Biological Treatment Processes: Process fundamentals Methods of aeration, design considerations, Operational difficulties. Description, design and operation of aerobic treatment systems: Activated Sludge process, Trickling Filters, Waste stabilization ponds. **Anaerobic Biological Treatment Processes:**Description, design and operation of attached and suspended growth processes: Anaerobic digestion, up flow anaerobic sludge blanket reactors (UASB), Septic tank. **Solid Waste Management**: Composting.

UNIT III:

Biomedical waste management: Introduction, Types of biomedical waste, sources of biomedical wastes, Hazardous biomedical wastes. Waste segregation and labeling, Handling, Collection, Storage and transportation.

Hazardous Waste management: Definition, sources, characteristics and categories of hazardous wastes. Toxicology and Risk Assessment, Environmental Fate of Hazardous Materials. Hazardous waste collection and transportation.Hazardous waste treatment technologies: Physical, chemical.

UNIT IV:

Dairy: General Characteristics of Dairy Wastewaters and Treatment of Dairy Effluent Wastewater. Paper Pulp: Problems Related with Pulp and Paper Industry.

Textile industry: Characterization of textile industrial wastewater, Treatment Technologies of textile industrial effluents.

Tanning Industry: Characterization of Effluents, Environmental Impact of Tannery Effluents.

Pharmaceutical Industry: Characterization of effluents, treatment technologies for pharmaceutical effluents.

REFERENCE BOOKS:

1. Clesceri LS. Greenberg AE, Eaton AD. (2004) Standard methods for examination of water &wastewater. American Public Health Association.
2. Gabriel Bitton. Wastewater Microbiology. 3rd edition, A John Wiley & Sons, INC., Publication. ISBN: 0-471-65071-4.
3. Metcalf and Eddy Inc. (1979) Wastewater Engineering treatment, Disposal, Reuse. Tata McGraw Hill Publication. Co. Ltd.
4. Soli J. Arceivala. Wastewater treatment for pollution control. 2nd edition, Tata-McGrawHill Publishing Company Limited. ISBN: 0-07-463002-4. 11. M. N. Rao and A. K. Datta. Wastewater Treatment. ISBN: 8120402154.
5. Hazardous wastes: Sources Pathways Receptors by Richard J. Watts ISBN: 9780471002383.
6. Criteria for hazardous waste landfills – CPCB guidelines 2000.
7. Anantpreet Singh and Sukhjit Kaur. (2012). Biomedical Waste Disposal. Jaypee Brothers Medical Publishers. ISBN: 978-93-5025-554-4.
8. Indu Shekhar Thakur. ***Environmental Biotechnology Basic concepts and applications.*** IK International Pvt, Ltd. ISBN 81-88237-52-3.
9. M. N. Rao and A. K. Datta. Wastewater Treatment. ISBN: 8120402154.

PRACTICALS:

1. Determination of Dissolved oxygen
2. Determination of BOD of sewage
3. Determination of COD sewage
4. Estimation of Total Solids (TS)
5. Estimation of Total Suspended Solids (TSS)
6. Estimation of Total Dissolved Solids (TDS)
7. Estimation of MLSS/MLVSS
8. IMViC tests.
9. Routine Bacteriological analysis of water: a. Tests for coliforms: Presumptive test, Confirmatory test and Completed test.
10. Determination of MPN of coliform.
11. Field trip to a wastewater treatment plant.

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: BIOPROCESS ENGINEERING & TECHNOLOGY
COURSE CODE: CORE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Design of fermenter, media for industrial fermentations
2 Sterilization of media and air, microbial growth kinetics
3 Components of Aeration and agitation, scale up and scale down, Control systems
4 Introduction to downstream processing

UNIT I:

Introduction to Bioprocess technology- History of fermentation, Range of fermentation processes, Chronological development of fermentation industry, Introduction of types of fermentation processes.

Isolation, primary and secondary screening, preservation, maintenance and improvement of Industrially important organisms.

UNIT II:

Media for industrial fermentation: Components of medium, Addition of precursor and Metabolic regulators to media, Media optimization by conventional and statistical methods (Plackett-Burman design, Response surface method)

Sterilization of media and air: Kinetics of medium sterilization, Design of batch sterilization process, Scale up of batch sterilization process, Design of continuous sterilization process, Sterilization of air by filtration, Theory and design of depth filters

UNIT III:

Bioreactor design: Laboratory, pilot and large-scale reactors. Mechanical, pneumatic and Hydrodynamic systems. Plug flow reactors, immobilization and immobilized enzyme reactors.

Scale up and Scale down and Aseptic operations &containment. Components of Agitation and aeration. Inoculum development.

UNIT IV:

Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and Continuous fermentation systems.

Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, advanced control.

REFERENCE BOOKS:

1. Principles of Fermentation Technology – Peter F. Stanbury, Allan Whitaker & Stephen J. Hall.
2. Comprehensive Biotechnology - Murray Moo Young
3. Methods in Industrial Microbiology - Sikyta
4. Fermentation Microbiology and Biotechnology - El Mansi and Bryc
5. Modern Industrial Microbiology and Biotechnology – Nduka Okafor & Benedict C. Okeke
6. Industrial Microbiology:An Introduction – Mickael J. Waites, Neil L. Morgan, John S. Rockey& Gary Higton
7. Upstream industrial biotechnology / edited by Michael C. Flickinger

PRACTICALS:

1. Screening for amylase producing organisms
2. Screening for organic acid producing microorganisms
3. Isolation of antibiotic producing microorganisms by crowded plate technique
4. Isolation and culturing of yeasts
5. Separation of amino acids by chromatography
6. Estimation of glucose by DNS method
7. Estimation of ethanol by dichromate method
8. Immobilization of microbial cells by entrapment method

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: O'-MICS
COURSE CODE: CORE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes
At the end of this course, the student will be able to:

1 Introduction to genome and proteome, DNA microarray
2 Human genome project, Large scale sequencing methods, some model organisms and their genome projects
3 Protein structure and function, Methods to study protein-protein interactions
4 concept development about transcriptomics and metabolomics

UNIT I:
Introduction to the proteome and the genome, codon bias, gene expression, Genome size-C value paradox, DNA sequencing: Maxam-Gilbert, Sanger, Pyrosequencing, automated DNA sequencing. Other features of nucleic acid sequencing. Analysis and Annotation-ORF, Exon-intron boundaries

UNIT II:
Human genome project- Strategies for large-scale sequencing projects; landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map.
Model organisms and other genome projects (*Arabidopsis, Caenorhabditis elegans*); Comparative genomics of relevant organisms such as pathogens and non-pathogens

UNIT III:
Relationship between protein structure and function, Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry: ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector. Protein interaction maps. Protein arrays-definition, applications- diagnostics, expression profiling.

UNIT IV:
DNA Microarray technology: The generation of cDNA expression libraries, their robotic arraying, Complex hybridization on DNA chips. Transcriptomics: Comparative transcriptomics, Differential gene expression; Genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

REFERNCE BOOKS:

1. Principles of Gene Manipulation and Genomics by Primrose

2. Genetics & Genomics by Csaba Szalai
3. Proteomics: From protein sequencing to function by S.R. Pennington and M.J. Dunn
4. Introduction to genomics by Arthur M Lesk

PRACTICALS:

1. Introduction to genome sequence databases
2. Protein and DNA sequence databases
3. Designing a primer
4. Total Protein profile of plant system using PAGE.
5. Determination of molecular weight and quantitation of separated proteins.
6. Demonstration of 2D gel electrophoresis

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: ANIMAL BIOTECHNOLOGY
COURSE CODE: ELECTIVE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Introduction and scope of Animal Biotechnology
2 Basic techniques of animal cell culture
3 Applications of animal tissue culture
4 Techniques for producing transgenic animals

UNIT I:

- Introduction and scope of Animal Biotechnology
- Basic requirements for animal tissue culture: Infrastructure, necessary equipments and accessories for animal tissue culture lab.
- Culture Media: Different types of media-Natural media, Defined media, Serum free media Chemical, physical and metabolic functions of different constituents of culture media.
- Role of serum in tissue culture media
- Sterilization techniques
- Biohazards and Bioethics

UNIT II:

- Biology and characterization of cultured cells
- Basic techniques of animal cell culture: Primary culture techniques,
- Enzymatic and mechanical disaggregation techniques
- Sub culture methods
- Development of cell lines, nomenclature and types of cell lines.
- Explant culture, Organ culture – 3Dimensional culture
- Large scale culture of cells-suspension and monolayer culture
- Cell separation methods
- Cell cloning
- Transformation and immortalization

UNIT III:

- Application of animal tissue culture
- Contaminants- source, types and prevention
- Cell viability Cytotoxicity assays
- Cryopreservation of cultured cells
- Hybridoma technology – production of MAbs.
- Vaccine Production

UNIT IV:

- Transgenic Animal Technology:

- Techniques for producing transgenic Animals,
- Application of transgenic animals
- Artificial animal breeding, Artificial insemination,
- In vitro fertilization (IVF), Embryo Transfer, Embryo sexing
- Tissue Engineering- scaffold materials, synthesis of scaffold, cell sources and applications of Tissue engineering

REFERENCE BOOKS:

1) Culture of animal cells: A manual of basic technique- R. Ian Freshney, Wiley Publication.
2) Animal cell culture & technology-M. Butler.
3) Animal cell culture techniques- M. Clynes, Springer.
4) Animal Biotechnology- M. M. Ranga. Agrobios (India).
5) Animal Biotechnology-Young, Murray, Moo. Pergamon Press, Oxford.
6) Methods in Cell Biology-Vol. 57, Animal cell culture methods- Mather, J.P., Academic Press.
7) Animal Cell Biotechnology-Spier, R.E. Academic press.
8) Animal biotechnology – P. Ramadass, MJP Publishers
9) Biotechnology- U.Styanarayan, Books and Allied (P) Ltd.

PRACTICALS:

1. Introduction of animal tissue culture laboratory with necessary equipments and accessories.
2. Preparation of culture media
3. Sterilization of culture media
4. Primary culture from Chick embryo.
5. Cell counting using hemocytometer.
6. Cell viability
7. Organ culture – trachea culture
8. Short term lymphocyte culture.
9. Chromosome preparation from cultured cells.
10. Cytotoxicity test-MTT

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: BIOSEPARATION TECHNOLOGY
COURSE CODE: ELECTIVE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes
At the end of this course, the student will be able to:

1. Students able to understand about various downstream processing
2. Product isolation and purification methods
3. Final Product Purification and Preparation

UNIT I:
Introduction to downstream processing, Characteristics of fermentation broth and its pretreatment, Separation of cells and suspended solids: Filtration: theory of filtration, use of filter aids, Batch filters, Continuous filters, cross flow filtration.

Membrane processes – Dialysis, ultrafiltration, Reverse osmosis and electrodialysis

UNIT II:
Product isolation methods:
Centrifugation: Cell aggregation and flocculation, Types of commercial centrifuges
Cell disruption by physical and chemical methods,
Liquid-liquid extraction-choice of solvent, co current and counter current extraction, Centrifugal extractor, Solvent recovery, Two-phase aqueous extraction system, super critical fluid extraction.

UNIT III:
Chromatography techniques for product isolation and purification:
Adsorption chromatography, Gel permeation chromatography, Ion-exchangechromatography, hydrophobic chromatography, Affinity chromatography, High performance chromatography (HPLC). FPLC, Expanded bed chromatography

UNIT IV:
Final Product Purification and Preparation Crystallization; Drying and lyophilisation; Formulation Strategies

Case studies: Recovery of Ethanol, Citric acid, Penicillin.

REFERENCE BOOKS:

1. Principles of Fermentation Technology – Peter F. Stanbury, Allan Whitaker and Stephen J. Hall.
2. Fermentation Microbiology and Biotechnology – E.M.T. El-Mansi and C.F.A. Bryee.
3. Comprehensive Biotechnology – Murray Moo Young
4. Biochemical Engineering Fundamentals – J.E.Bailey& D.F. Ollis.
5. Downstream industrial biotechnology : recovery and purification / edited by Michael C. Flickinger

PRACTICALS:

1. Determination of dry weight and wet weight of cells
2. Determination of total protein of cells by alkali lysis
3. Recovery and estimation of penicillin
4. Ammonium Sulphate fractionation of protein
5. Dialysis of fractionated proteins
6. Recovery of protein by acetone precipitation
7. Demonstration of chromatography techniques

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: PROTEIN ENGINEERING
COURSE CODE: ELECTIVE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Different tools and methods used in proteomic study.
2. The sources of protein, Industrial and medical application of proteins,
3. Different expression of proteins for large scale purifications,
4. Protein engineering strategy.

UNITI:

Proteomics: Sample preparation, Gel-based proteomics - two-dimensional gel electrophoresis (2-DGE), two-dimensional fluorescence difference in-gel electrophoresis (DIGE), Staining methods, PF-2D, Tandem FPLC, Mass spectroscopy: basic principle, ionization sources, mass analyzers, different types of mass spectrometers (MALDI-TOF Q-TOF, LC-MS)

UNIT II:

Multidimensional proteomics: SELDI-TOF. Quantitative proteomics - stable isotope labeling by amino acids in cell culture (SILAC), isotope-coded affinity tag (ICAT), isobaric tagging for relative and absolute quantitation (iTRAQ); Label-free proteomics., Nuclear magnetic resonance spectroscopy (NMR), basic principles, chemical shift, spinspin interaction, NOE, 2D-NMR, NOESY, COSEY.

UNIT III:

X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor.

UNIT VI:

Protein Engineering: Protein sources, Industrial and medical application of proteins, different expression of proteins for large-scale purifications, protein engineering strategy, rational and random mutagenesis. Applications of protein engineering protein in Chemical and Medical Industries: Generation of heat stable, pH stable enzymes, application in vaccine development, drug development, sensor development. Practicals, Protein electrophoresis-1D+2D, HPLC, FPLC, MALDI-TOF & LC-MS

REFERENCE BOOKS:

1. Principles of Protein X-Ray Crystallography *[3rd ed.]* by Jan Drenth
2. Protein engineering in industrial biotechnology by L Alberghina,Net Library, Inc.
3. Protein Engineering Protocols *[1 ed.]* by Kristian Müller, Katja Arndt
4. Protein Engineering by C Kohrer, U Rajbhandary

5. Protein Engineering Handbook Volume 3 *[1 ed.]* by Stefan Lutz, Uwe Theo Bornscheuer
6. Protein Engineering by P. Kaumaya
7. Protein Structure Prediction: Methods and Protocols by Webster, David (Southern Cross Molecular Ltd., Bath, UK)
8. Essential Bioinformatics by JinXiong

PRACTICALS:

1. To perform protein extraction.
2. Determine an importance of various electrophoresis techniques in protein engineering.
3. A study an application of liquid chromatographic technique.
4. To understand the importance of gas chromatographic techniques with demonstration.
5. Understanding of principles and applications of MALDI-TOF and SELDI TOFF

MASTER OF SCIENCE – BIOTECHNOLOGY
(INDUSTRIAL BIOTECHNOLOGY), SEMESTER – II
NAME OF COURSE: ENVIRONMENT POLICY AND LEGISLATION
COURSE CODE: ELECTIVE 4
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Legal structure of India and fundamentals of environmental legislation and policy making.
2. Understand the environmental performance including compliance with environmental legislation.
3. Implementation of environmental policies and practices and raise awareness about the emerging environmental issues.
4. Study of various acts, laws and rules related to air, water, environment and wastes in India

UNIT I:

International Law and Environmental Protection: Fundamental Principles of International Environmental Law. United Nations Conference on Human Environment, 1972 (Stockholm Conference) – Aims and Objectives of the Conference, Stockholm Declaration. UNEP- Vienna Convention & Montreal Protocol, World Charter for Nature, 1982. WCED – The Brundtland Commission, Brundtland Report 1987. United Nations Conference on Environment and Development (UNCED/Earth Summit) – Aims and Objectives of Conference, Rio Declaration 1992, Agenda 21, Convention on Biological Diversity. Earth Summit Plus Five - Kyoto Protocol, 1997; Millennium Development Goals.Johannesburg Conference 2002 (WSSD) - Johannesburg Declaration & Major Outcomes.

UNIT II:

History and Development of Environmental Law in India: Environmental Protection in Ancient Indian Tradition and Culture - Protection of Environment in Ancient India and During Medieval Period. Protection of Environment during British Period – Major Legislations. Protection of Environment during Post Independence Period – Pitambar Pant Committee, Tiwari Committee, NCEP, Department of Environment, MOEF Guidelines and Notifications, Appellate Authority Act, Other related Notifications.

UNIT III:

Protection of Environment under the Indian Constitution: Introduction – Indirect Provisions, International Obligations, 42nd Constitution Amendment Act, 1976. Directive Principles of State Policy - Fundamental Duties. Development of Fundamental Right to Environment - Judicial Role, Expansion of Locus Standi, PIL, Constitutional Remedy for Protection of Environment, Dynamic Interpretation of Article 21, 14 & 19 of the Constitution. Right to Wholesome Environment – Right to Clean and Pollution-free Environment, Right to Sweet Water. Incorporation of International Principles under Indian

Constitution – Sustainable Development - Precautionary and Polluter Pays Principles, Absolute and Strict Liability.

UNIT IV:

Protection of Water, Air and Environment in India:

EP Act 1986, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Mines and Mineral Act, Factories Act, Pesticides Act, Indian Forest Act, Wildlife Act, Ancient Monuments and Archaeological Sites and Remains Act, Hazardous Waste Management and Handling Rules / Biomedical Rules / Solid Waste Management Rules, Environment Tribunal Act, Climate change Protocols and Conventions,

REFERENCE BOOKS:

1. S.C. Shastri, *Environmental Law*, (3rd Edition.), Eastern Book Company, Lucknow, 2008.
2. Maheshwara Swamy, *Textbook on Environmental Law*, (2ndEdition.), Asia Law House, Hyderabad, 2008.
3. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India*, Oxford University Press, New Delhi, 2005.
4. Amod S. Tilak, *Environmental Law*, (1stEdition.), Snow White Publication, Mumbai, 2009.
5. I.A. Khan, *Environmental Law*, (2ndEdition.), Central Law Agency, Allahabad, 2002.
6. P Leelakrishnan, *Environmental Law in India*, (2ndEdition.), Lexis Nexis, New Delhi, 2005.
7. S. Shantakumar, *Introduction to Environmental Law*, (2ndEdition.), Wadhwa & Company, Nagpur, 2005.

PRACTICALS:

1. Bio-ethanol production from waste materials.
2. Production of biodiesel from vegetable oil.
3. Production of biofuel from algae.
4. Physico-chemical analysis soil.
5. Isolation of *Actinomyctes* from soil.
6. Demonstration of Lab scale biogas production plant.
7. Saponification value of an oil sample