

GONDWANA UNIVERSITY GADCHIROLI

BIOTECHNOLOGY

SYLLABUS

SEMESTER V & VI

2019-20

SEMESTER-V

Discipline Specific Electives (DSE)

Semester V			
DSE I	Genetic Engineering	DSE II	Plant Biotechnology
DSE III	Microbial Physiology	DSE IV	Medical Microbiology

Skill Enhanced Courses

(Any One of the Following)

1. Industrial Fermentations
2. Molecular Diagnostics

B.Sc. III SEM - V
DSE - I

Semester-V		
Course Code	DSE-I	Marks: 40
Credits: 2		Total Hours :48
Genetic Engineering		
Objective: To make the students to understand the fundamentals of Genetic Engineering.		
Unit No.	Content	Hrs
1	Introduction of Genetic Engineering A. Basics of genetic engineering B. DNA manipulation enzymes: nucleases, ligases, polymerases alkaline phosphatase, T4 polynucleotide kinase. C. Restriction endonuclease enzyme and their types D. Isolation of DNA- lysis of cells, direct purification of DNA E. Generation of DNA fragments for cloning- cDNA, Genomic DNA library F. Amplification of DNA: polymerase chain reaction (PCR)	12
2	Cloning Vectors and r-DNA Preparation A. Plasmid vectors (pBR322, pUC 18/19) B. Cosmid vectors C. Bacteriophage vector (lambda phage) D. Phagemid vector E. Artificial chromosome (YAC, BAC) F. Insertion of foreign DNA into a vector (use of linkers, adaptors and homopolymer tailing)	12
3	Insertion of rDNA into host cells A. Transformation B. Transfection- calcium phosphate coprecipitation, DEAE-dextran mediated transfection C. Particle gun method D. Lipofection E. Microinjection F. Screening of recombinants- direct section and Blue-White selection method	12
4	Application of rDNA A. Gene therapy-somatic gene therapy B. DNA fingerprinting C. Interferon production D. Disease diagnosis- antenatal diagnosis, genetic counseling E. Monoclonal antibodies production	12

B.Sc. III SEM - V

Semester-V		
Course Code	DSE -II	Marks: 40
Credits: 2	Plant Biotechnology	Total Hours :48
Objective: To make the students understand the fundamentals of techniques of Plant Biotechnology		
Unit No.	Content	Hrs
1	Introduction to Plant Tissue Culture A. Introduction and history of cell and tissue culture technique. B. Plant tissue culture media (composition and preparation and its role in media) C. Role of growth hormone (auxins, cytokinins and others) D. Callus and suspension cultures: initiation and maintenance, single cell clones.	12
2	Techniques of Plant Tissue Culture A. Shoot tip culture: rapid clonal propagation and production of virus free plants. B. Organogenesis. embryogenesis C. Embryo culture and embryo rescue. D. Protoplast isolation, culture and fusion. E. Selection and regeneration of hybrid plants, cybrid. F. Production of haploid plants: anther and pollen culture	12
3	Plant Transformation Technology A. Basis of tumor formation, hairy root. B. General features of Ti and Ri plasmids. C. Mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors D. Methods of nuclear transformation, biological and physical transformation methods. E. Brief idea of chloroplast transformation.	12
4	Application of Plant Tissue Culture A. Herbicide resistance -phosphinothricine glyphosate, sulfonyl urea B. Insect resistance-Bt genes. C. Virus resistance, coat protein mediated nucleocapsid gene. D. Fungal resistance, disease resistance, nematode resistance. E. Improvement of crop yield and quality - long shelf life of fruits and flowers. F. Male sterile lines.	12

**Practical's B.Sc. III
(Semester V)
{Practical's based on Paper -I & II}**

Total Hours: 48

CREDITS: 2

Marks: 30

1. *Isolation of genomic DNA
2. *Isolation of Plasmid DNA
3. Isolation of λ phage DNA
4. Isolation of Chloroplast DNA
5. *Restriction digestion of DNA
6. Construction of recombinant DNA
7. DNA amplification by PCR method
8. Preparation of plant tissue culture media.

B.Sc. III SEM - V
DSE - III

Semester-V		
Microbial Physiology		
Course Code.....	DSE - III	Marks: 50
Credits:		Total Hrs :48
Objective: To make the students to understand the fundamentals of Microbial Physiology.		
Unit No.	Content	Hrs.
1	Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphor transferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.	12
2	Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxie growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity. Monod apparatus for microbial growth.	12
3	Effect of the environment on microbial growth Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogen oxidizing bacteria and Methanogens.	12
4	Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle.	12

Practicals

1. To study and plot the growth curve of *E. coli* using turbidometric method and to calculate specific growth rate and generation time.
2. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
3. To study the effect of pH on the growth of *E. coli*
4. To study the effect of temperature of *Aspergillus niger* by dry weight method.
5. Demonstration of the thermal death time and decimal reduction time of *E. coli*.
6. MBRT (*Methylene Blue reduction Test*).

SUGGESTED READING

References:

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
7. A.B. Solunke, V.S. Hamde, P.S. Wakte. 2016. Microbial Technology of TCA. Lambert.

B.Sc. III SEM - V
DSE -IV

Semester-V		
Medical Microbiology		
Course Code.....	DSE - IV	Marks: 50
Credits:		Total Hrs :48
Objective: To make the students to understand the fundamentals of Microbial Physiology.		
Unit No.	Content	Hrs.
1	Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: <i>S.aureus</i> , <i>S.pyogenes</i> , <i>B.anthraxis</i> , <i>C.perferinges</i> , <i>C.tetani</i> , <i>C.botulinum</i> , <i>C.diphtheriae</i> <i>M.tuberculosis</i> , <i>M. leprae</i> .	12
2	Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: <i>E.coli</i> , <i>N. gonorrhoea</i> , <i>N. meningitidis</i> , <i>P.aeruginosa</i> , <i>S. typhi</i> , <i>S. dysenteriae</i> , <i>Y. pestis</i> , <i>B. abortus</i> , <i>H. influenzae</i> , <i>V. cholerae</i> , <i>M.pneumoniae</i> , <i>T. pallidum</i> <i>M. pneumoniae</i> , <i>Rickettsiaceae</i> , <i>Chlamydiae</i> .	12
3	Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.	12
4	Fungal and Protozoan infections. Dermatophytoses (<i>Trichophyton</i> , <i>Microsporun</i> and <i>Epidermophyton</i>) Subcutaneous infection (<i>Sporothrix</i> , <i>Cryptococcus</i>), systemic infection (<i>Histoplasma</i> , <i>Coccidoides</i>) and opportunistic fungal infections (<i>Candidiasis</i> , <i>Aspergillosis</i>), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)	12

Practicals

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of *Aspergillus* and *Candida* by appropriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.

SUGGESTED READINGS

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
4. A.B.Solunke, S.C.Aithal, V.S.Hamde, R.S.Awasthi.2018. Compendium of Immunology and Virology. Notion Press.

Semester - V

SKILL ENHANCEMENT COURSES

(Any One of the Following)

- 1. Industrial Fermentations**
- 2. Molecular Diagnostics**

Semester-V		
Course Code.....	SEC - I	Marks: 50
Credits: 2	MOLECULAR DIAGNOSTICS	Total Hrs :48
Unit No	Content	Hrs
I	Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology	12
II	Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.	12
III	Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno fluorescence. Radioimmunoassay.	12
IV	GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. Transgenic animals.	12

SEC - I

PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through

any other material or medium including videos/virtual labs etc.)

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue)

References

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Century-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert

Semester-V		
Course Code.....	SEC- II	Marks: 50
Credits: 2	INDUSTRIAL FERMENTATIONS	Total Hrs :48
Unit No	Content	Hrs
I	Contributions to Industrial fermentation by: Patents of Louis Pasteur, Patents of S.A. Wakshman, Patents of Jacques Monad, and Patents of Anand Chakraborty Strain Improvement and culture preservation methods.	12
II	Production of industrial chemicals, biochemicals and chemotherapeutic products. Citric acid, Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.	12
III	Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.	12
IV	Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.	12

SEC -II

PRACTICALS

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)
5. Bioassay of antibiotics.
6. Bioassay of vitamins.

Suggested Readings

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology.
6. A.B.Solunke. The Book of Citric acid
7. A.B.Solunke, V.S.Hamde, P.S.Wakte. Microbial Technology of TCA.

SEMESTER-VI

Discipline Specific Electives

Semester VI			
DSE I	Environmental Biotechnology	DSE II	Animal Biotechnology
DSE III	Ecology and Environment Management	DSE IV	Plant Diversity

Skill Enhanced Courses

(Any One of the Following)

1. Bio-Analytical Tools
2. Enzymology

B.Sc. III SEM - VI

Semester-VI		
Course Code.....	DSE – I	Marks: 50
Credits: 2	Environmental Biotechnology	Total Hrs :48
Objective: To make the students to understand the fundamentals of Environmental Biotechnology.		
Unit No.	Content	Hrs.
1	Introduction to Environmental Problems A. Environmental education-Problems and need. B. Environmental pollution: classification of pollutants C. Water pollution- water pollutants- organic, inorganic, microbial, radioactive, eutrophication, D. Air pollution- sources and pollutants. E. Ozone depletion, green-house effect and acid rain	12
2	Water Pollution and Waste water treatment A. Waste water: composition, types B. Measurement of water pollution- BOD (Biochemical oxygen demand), COD (chemical oxygen demand) C. Waste water treatment: classification, types (flow sheet) D. Biological waste water treatment: activated sludge, trickling filter, oxidation pond, rotating biological contactor, anaerobic digester. E. Treatment scheme of industries: paper and sugar industries	12
3	Xenobiotics, Biodegradation and Bioremediation A. Basic concept of xenobiotics, types B. Bioaccumulation and biomagnification C. Biodegradation of xenobiotics in environment: degradative plasmids, Biodegradation of hydrocarbons, surfactant, pesticides, synthetic dyes D. Biobleaching of heavy metals: Copper, mercury, advantages and disadvantages of biobleaching.	12
4	Biofertilizer, Bioenergy and Pest Management A. Biogeochemical cycles: - (nitrogen, carbon and sulphur) B. Biofuel: alcohol C. Biological nitrogen fixation- symbiotic and non-symbiotic nitrogen fixation, mechanism, Role of rDNA technology in nitrogen fixation. D. Biofertilizers- bacterial biofertilizers, algal biofertilizers, fungi as biofertilizers (VAM) E. Biopesticides: Examples and integrated pest management(IPM)	12

B.Sc. III SEM – VI

Semester-VI

Course Code.....			DSE - II	Marks:
50			Animal Biotechnology	Total Hrs :48
Objective: To make the students to understand the fundamentals of Animal Biotechnology				
Unit No.	Content	Hrs.		
1	Basics of Animal Cell Culture A. Concept of animal cell culture B. Various systems of animal tissue culture, advantages and limitations. C. Culture media: Natural media, synthetic media, balanced salt solutions. D. Chemical, physical and metabolic functions of different constituents of culture medium, role of CO ₂ , serum and supplements. E. Characteristics of cells in culture: contact inhibition, anchorage dependence, cell-cell communication.	12		
2	Methods of Animal Tissue Culture A. Isolation of cells: various methods of separation of cell types B. Primary culture: behavior of cells, properties C. Explant culture; suspension culture. D. Established cell line cultures: definition, maintenance and management; cryopreservation, germplasm conservation	12		
3	Developmental Techniques in Animal Cell Culture A. Apoptosis: measurement of cell death. apoptosis (death domain, role of cytochrome C) B. Cell transformation, cell cloning C. Cell synchronization and cell manipulation E. Stem cell cultures, embryonic stem cells and their applications. F. Three dimensional cultures	12		
4	Application of Animal Tissue Culture A. Mass production of biologically important compounds- vaccines, insulin B. Manipulation of reproduction in animals: artificial insemination, embryo transfer in human C. <i>In vitro</i> fertilization technology: embryo cloning and embryonic stem cell. D. Transgenic animals- mice, large animals(sheep)	12		

Practical's B.Sc. III (Semester VI)

{Practical's based on Paper -I & II}

USMBP

Total Hours: 48

CREDITS: 2

Marks: 30

1. Development of primary cell lines/maintenance of established cell lines.
2. *Determination of chemical oxygen demand (COD) of sewage sample.
3. *Production of microbial fertilizers (*Rhizobium/Azotobacter/VAM*).
4. Determination of total dissolved solids of water
5. *Determination of hardness and alkalinity of water sample.
6. Determination of dissolved oxygen concentration of water sample
7. *Determination of biochemical oxygen demand of sewage sample
8. Isolation of xenobiotic degrading bacteria by selective enrichment technique
9. Test for the degradation of aromatic hydrocarbons by bacteria
10. Preparation and formulation of microbial biopesticide (bacteria, fungi)
11. Effect of mycorrhizal fungi on growth promotion of plants.
12. Preparation of animal cell culture media.
13. *Cell count by haemocytometer (RBC/WBC)
14. *Microtomy-Fixation, dehydration, embedding, sectioning and staining of animal tissues.
15. Microphotography

TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc. semester VI:

1. Environmental Microbiology by:Ralph Mitchell,John Wiley And Sops.Inc.
2. Environmental Biotechnology by:C.F.Froster And D.A.JohnWase,ElisHorwood.
3. Biocatalysis and Biodegradation: Microbial Transformation Of Organic Compounds.Y:LawrenceP.Wacekett.
4. A Manual Of Environment Microbiology.By:ChristonJ.Hurst,Asm Publication.
5. Biodegradation And Bioremediation Academic Pressby:San Diego.
6. Biotechnology In The Sustainable Environment,PlenumPress,Nybasic Principles Of Geomicrobiology.
By:A.D.Agate.
7. Environmental Microbiology By:R.M.Maier,I.C.Papper And C>P>Gerba.
8. Methods In Microbiology:Lynch And Hobbie.
9. Experimental Microbial Ecology.By:Arosison Academic Press.
10. Advances In Applied Microbiology.By:D.Pearlman Academic Press.
11. Microbiology Of Extreme Environments,Edited By Clive Edward,Open University Press,Milton Keynes.
12. Environmental Science Working With The Earth.By:Miller.
13. Microbial Biotechnology,Principles And Applications.Lee Yuan Kun.
14. Microbial Biotechnology,Fundamentals Of Applied Microbiology. By:AlexanderN.Glazer.HiroshiNikaido.
15. Textbook Of Organic Medicinal And Pharmaceutical Chemistry.By:JaimeN.Delgado William A.Remers
16. Microbial Ecology By Lynch Et Al.
17. Experimental Microbial Ecology By Burns Et Al. Environmental Microbiology (2004) By K. Vijaya Ramesh, Mjp Publishers
18. Soil Microbiology (2006) By N.S. SubbaRao Oxford &Ibh Publishing Co.Pvt. Ltd.
19. Introduction To Soil Microbiology (1961) By Martin Alexander, John Wiley &Sons , Inc. New York , London
20. Microbial Ecology (1993) By Ronald M. Atlas And Richard Bartha
21. Text Book Of Biotechnology, R.C.Dubey, 2009, S.Chand, Delhi
22. Biotechnology (E.H.), B. D. Singh, 2008, Kalyani Publication
23. Cell Biology Genetics Mole Biology Evolution And Ecology, P. S. Verma, 2005, S.Chand
24. Indutrial Biotechnology, Thakur
25. Biotechnology, U. Satyanarayan, Books And Allied, 2007
26. Biotechnology, B. D. Singh, KalyaniPlb, 2007
27. Techniques In Life Sciences, Dr. D. B. Tembhare, Himalaya Publication, 2004
28. Animal Biotechnology, M.M. Ranga, Himalaya Publishing House, 2007
29. Biotechnology A Lab. Manual, Jeffery M. Becker, Academic Press, 1998
30. Culture Of Animal Cells, Ian Freshney, A John Willey 2007
31. Text Book Of Biotechnology, R.C.Dubey, S.Chand, 2009
32. Invitro Cultivation Of Of Animal Cells, Butterworth,Heinemanm, Open University Publ, 2004
33. Experimental Biotechnology, MadhavSharma,NirmalTripatr, Crescent Pub Corporation, 2008
34. Animal Cell Culture, John R. W. Masters, Oxford Uni. Press Newyork, 2000
35. Biochemical Methods, Sadashivam,2006

Books Recommended for Theory & Practical of B.Sc. III SEM VI

1. Essentials of Molecular Biology by D. Freidfelder
2. Molecular biology by J.D. Watson.
3. Biophysical Chemistry by Chatwal&Anand.
4. Microbial Genetics by D. Freidfelder
5. Microbial Technology by Vol. I & II by A.H. Pepler.
6. Microbial Technology of TCA by A. B. Solunke, V.S. Hamde, P.S. Wakte
7. Principles of Genetics by R.H. Tamarin.
8. Molecular Biology and Genetic engineering by Narayanan.
9. Fundamentals of Bacterial Genetics by Nancy Trum and J. Trumphy.
10. Industrial Microbiology by A.H. Patel
11. Industrial Microbiology by Prescott & Dunn.
12. Modern Industrial Microbiology & Biotechnology by NdukaOkafoe.
13. The Book of Citric Acid by A.B. Solunke
14. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Highten.
15. Text Book of, Microbial Genetics by P.H.Kumbhare&V.U.ThoolRajaniPrakashan, Nagpur
16. Biotechnology by P. Prave
17. Industrial Microbiology by Casida.
18. Text Book of Bioinstrumentation by P.H.Kumbhare& Dr. MeghaKulkarni, RajaniPrakashan, Nagpur.
19. DNA Chromatography by Douglas
20. Ion Chromatography by J. Weiss
21. Encyclopedia of Bioprocessing Technology by M.C. Flickinger& S.W. Drew.
22. Textbook of Microbiology, Molecular Biology and Bioinstrumentation by R.M. Bhute and S.V. Kasbekar.
23. Microbiology for Analytical Chemists by R.K. Dart

**B.Sc. III SEM - VI
DSE- III**

Semester-VI		
ECOLOGY AND ENVIRONMENT MANAGEMENT		
Course Code.....	DSE - III	Marks: 50
Credits: 2		Total Hrs :48
Objective: To make the students to understand the fundamentals of Environment management		
Unit No.	Content	Hrs
1	Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.	12
2	Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N,C,P cycles).	12
3	Pollution & environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations ,Carcinogen, Poisons. Detection of Environmental pollutant. Indicators & detection systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup : Case studies	12
4	Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal.	12

PRACTICALS

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
2. Determination of population density in a terrestrial community or hypothetical community by quad rate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.
3. Principle of GPS (Global Positioning System).
4. Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.
5. Study of the types of soil, their texture by sieve method and rapid tests for -pH, chlorides, nitrates, carbonates and organic carbon
6. Study any five endangered/ threatened species- one from each class.

SUGGESTED READING

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Michael Allabay, Basics of environmental science, Routledge Press.
6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
7. Mohapatra Textbook of environmental biotechnology IK publication.
8. Rana SVS, Environmental pollution – health and toxicology, Narosa Publication
9. Sinha, S. 2010. Handbook on Wildlife Law Enforcement in India. TRAFFIC, India.

B.Sc. III SEM - VI
DSE -IV

Semester-VI		
Course Code.....	DSE - IV	Marks: 50
Credits: 2	PLANT DIVERSITY	Total Hrs :48
Unit No	Content	Hrs
I	<p>Algae:General character, classification and economic importance. Life histories of algae belonging to various classes: Chlorophyceae – <i>Volvox</i>, <i>Oedogonium</i> Xantho phyceae –<i>Vaucheria</i> Phaeophyceae – <i>Ectocarpus</i> Rhodophyceae-<i>Polysiphonia</i></p>	12
II	<p>Fungi: General characters, classification & economic importance. Life histories of Fungi: Mastigomycontina- <i>Phytophthora</i> Zygomycotina-<i>Mucor</i> Ascomycotina- <i>Saccharomyces</i> Basidomycotina-<i>Agaricus</i> Deutromycotina-<i>Colletotrichum</i></p>	12
III	<p>Lichens : Classification, general structure, reproduction and economic importance. Plant diseases: Casual organism, symptoms and control of following plant diseases. Rust & Smut of Wheat. White rust of Crucifers. Late blight of Potato. Red rot of Sugarcane. Citrus Canker.</p>	12
IV	<p>Bryophytes: General characters, classification & economic impotance. Life histories of following: <i>Marchantia</i>. <i>Funaria</i>.</p>	12

PRACTICALS

1. Comparative study of thallus and reproductive organs of various algae mentioned in theory
2. Comparative study of vegetative and reproductive parts of various fungi mentioned in theory.
3. Study and section cutting and lectophenol mount of plant disease materials studied in theory.
4. Study of various types of lichens.
5. Study of external features & anatomy of vegetative and reproductive parts of Marchantia and Funaria
6. Collection of algae, fungi, plant diseases materials and bryophytes available locally.

SUGGESTED READING

1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4th edition, John Wiley and Sons (Asia) Singapore.
3. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.
5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.
8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
9. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
10. Webster, J. and Weber, R. 2007 Introduction to Fungi. 3rd edition, Cambridge University Press, Cambridge.
11. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands.

SKILL ENHANCEMENT COURSES

(Any One of the Following)

- 1. Bio-Analytical Tools**
- 2. Enzymology**

**B.Sc. III SEM – VI
SEC – I**

BIO-ANALYTICAL TOOLS

UNIT I

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra- red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

PRACTICALS

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

**B.Sc. III SEM – VI
SEC - II**

ENZYMOLOGY

UNIT - I

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation,

UNIT – II

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of K_i , suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis.

UNIT – III

Allosteric enzymes with special reference to aspartate transcarbamylase and phosphofructokinase. Qualitative description of concerted and sequential models. Isoenzymes– multiple forms of enzymes Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT – IV

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Application of Immobilized and soluble enzyme in health and industry. Enzyme electrodes. Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.

PRACTICALS

1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as K_m , V_{max} , K_{cat}

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K. Campbell & Shawn O. Farrell, 5th Edition, Cengage Learning, 2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley-VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

Note*

Skill enhancement course (SEC) will be at college level and is of **50 marks**
(35 mark for practical 15 marks for Theory).

Distribution of 35 marks will be as follows.

Experimental work	15M
Visit to industry/study tour	10M
Viva	05M
Record	05M

Distribution of 15 marks (theory):-

Theory exam on **MCQ type 30 Question** each carries $\frac{1}{2}$ marks