



## C. U. SHAH UNIVERSITY

### Skill Enhancement (SE) elective subject pool Biotechnology

#### MOLECULARDIAGNOSTICS

Sr. No.	Course contents	Teaching Hours
1	<b>Enzyme Immunoassays:</b> 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 immunohistochemical techniques. Use of polyclonal or monoclonal antibodies in enzyme immuno assays. Applications of enzyme immunoassays in diagnostic microbiology	15
2	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.	15
3	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. Immunofluorescence. Radioimmunoassay.	18
4	GLC, HPLC, Electron microscopy, flow cytometry and cell sorting. Transgenic animals.	12
<b>Total Hours</b>		<b>60</b>

#### PRACTICALS:

*(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual lab setc.)*

S.No	Experiment
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)



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### **Suggested Readings**

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



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## ENZYMOLOGY

Sr. No.	Course contents	Teaching Hours
1	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, Different plots for the determination of $K_m$ and $V_{max}$ and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.	20
2	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. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feedback control, covalent modification.	15
3	Allosteric enzymes with special reference to aspartate transcarbamoylase phosphofructokinase. Qualitative description of concerted and sequential models, Negative co-operative and half site reactivity. Enzyme-Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and Scatchard plots, kinetics of allosteric enzymes. Isoenzymes—multiple forms of enzymes with special reference to lactate dehydrogenase. Multi-enzyme complexes. Ribozymes. Multifunctional enzyme—eg Fatty Acid synthase.	13
4	Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering—selected examples, Delivery system for protein pharmaceuticals, and structure function relationship in enzymes, structural motifs and enzyme evolution. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding <i>in vitro</i> & <i>in vivo</i> .	12
Total Hours		60



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### PRACTICALS

S.No	Experiment
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



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### **INDUSTRIAL FERMENTATIONS**

<b>Sr. No.</b>	<b>Course contents</b>	<b>Teaching Hours</b>
1	Production of industrial chemicals, biochemicals and chemotherapeutic products. 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
2	Microbial products of pharmacological interest, steroid 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.	15
3	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.	13
4	Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer coefficient ( $K_a$ ) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.	20
<b>Total Hours</b>		<b>60</b>



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### **PRACTICALS**

<b>S.No</b>	<b>Experiment</b>
<b>1</b>	Comparative analysis of design of a batch and continuous fermenter.
<b>2</b>	Calculation of Mathematical derivation of growth kinetics.
<b>3</b>	Solvent extraction & analysis of a metabolite from a bacterial culture.
<b>4</b>	Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

### **SUGGESTED READING**

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,



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## **BASICS OF FORENSIC SCIENCE**

<b>Sr. No.</b>	<b>Course contents</b>	<b>Teaching Hours</b>
1	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.	15
2	Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.	15
3	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of fingerprint science for personal identification,	15
4	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.	15
<b>Total Hours</b>		<b>60</b>

### **PRACTICALS**

<b>S.No</b>	<b>Experiment</b>
1	Documentation of crime scene by photography, sketching and field notes.
2	a. Simulation of a crime scene for training. b. To lift footprints from crime scene.
3	Case studies to depict different types of injuries and death.
4	Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
5	Investigate method for developing fingerprints by Iodine crystals.
6	PCR amplification on target DNA and DNA profiling,
7	E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

### **SUGGESTED READING**

1. Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B.Nanda and R.K.Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K.Bhasin and S.Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).



## C. U. SHAH UNIVERSITY

### MICROBIAL DIAGNOSIS IN HEALTH CLINICS SEMESTER-IV

Sr. No.	Course contents	Teaching Hours
1	<b>Importance of Diagnosis of Diseases:</b> Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.	5
2	<b>Collection of Clinical Samples:</b> How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.	5
3	<b>Direct Microscopic Examination and Culture.</b> Examination of sample by staining - Gram stain, Ziehl-Neelsen staining for tuberculosis, Giemsa-stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.	5
4	<b>Serological and Molecular Methods</b> Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes	5
5	<b>Kits for Rapid Detection of Pathogens</b> Typhoid, Dengue and HIV, Swine flu	5
6	<b>Testing for Antibiotic Sensitivity in Bacteria:</b> Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method	5
<b>Total Hours</b>		<b>30</b>

#### SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, V.S., Mehta G and Sharma K.B. (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13<sup>th</sup> edition, Mosby





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5.ColleeJG,Fraser,AG,Marmion,BP,SimmonsA(2007)MackieandMccartneyPracticalMedicalMicrobiology,14<sup>th</sup> edition,Elsevier.

### BIOFERTILIZERS AND BIOPESTICIDES SEMESTER-IV

Sr. No.	Course contents	Teaching Hours
1	<b>Biofertilizers:</b> General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N <sub>2</sub> fixers: <i>Rhizobium</i> -Isolation, characteristics, types, inoculum production and field application, legume/pulse plants, <i>Frankia</i> -Isolation, characteristics, Alder, Casuarina plants, non-leguminous crop symbiosis. Cyanobacteria, <i>Azolla</i> -Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.	10
2	<b>Non-Symbiotic Nitrogen Fixers:</b> Free living <i>Azospirillum</i> , <i>Azotobacter</i> -free isolation, characteristics, mass inoculum, production.	4
3	<b>Phosphate Solubilizers:</b> Phosphate solubilizing microbes-Isolation, characterization, mass inoculum production, field application	4
4	<b>Mycorrhizal Biofertilizers:</b> Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.	5
5	<b>Bioinsecticides:</b> General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, <i>Bacillus thuringiensis</i> , production, Field applications, Viruses—cultivation and field applications.	7
<b>Total Hours</b>		<b>30</b>

#### Suggested Readings

1. **Kannaiyan, S.** (2003). Bio-technology of Biofertilizers, CHIPS, Texas.
2. **Mahendra K. Rai** (2005). Handbook of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. **Reddy, S. M. et al.** (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. **Subba Rao N. S** (1995) Soil microorganisms and plant growth Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
5. **Saleem F and Shakoori A R** (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
6. **Aggarwal S K** (2005) Advanced Environmental Biotechnology, APH publication.



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### MANAGEMENT OF HUMAN MICROBIAL DISEASES SEMESTER-IV

Sr. No.	Course contents	Teaching Hours
1	<b>Human Diseases</b> Infectious and non-infectious diseases, microbial and non-microbial diseases, Deficiency diseases, occupational diseases, Incubation period, Mortality rate, nosocomial infections	4
2	<b>Microbial diseases</b> Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous System diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.	12
3	<b>Therapeutics of Microbial diseases</b> Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.	8
4	<b>Prevention of Microbial Diseases</b> General preventive measures, Importance of personal hygiene, environmental sanitation and methods to Prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. <b>Vaccines:</b> Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.	6
<b>Total Hours</b>		<b>30</b>

#### **Suggested Readings**

1. Ananthanarayan R. and Paniker C. K. J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G. F., Carroll K. C., Butel J. S., Morse S. A. and Mietzner, T. A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier
4. Willey J. M., Sherwood L. M., and Woelverton C. J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan M. T., Martinko J. M., Dunlap P. V. and Clark D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.