Deccan Education Society's
Fergusson College (Autonomous), Pune

Department of Microbiology
M. Sc. – I Microbiology

Semester	Course Code	Title of the Course	No. of Credits
I	MIC4101	Microbial Diversity and Molecular Taxonomy	4
	MIC4102	Biochemistry	4
	MIC4103	Molecular Biophysics & Instrumentation	4
	MIC4104	Advanced Cell Biology	4
	MIC4105	Practical course I: Microbial Diversity and Molecular Taxonomy	4
	MIC4106	Practical course II: Biochemistry, Cell biology and Biophysics	4
	MIC4107	Scientific Communication – I	1
		Total	**25**

Extra Credits

Semester	Course Code	Title of the Course	No. of Credits
I	XHR0001	Human Rights - I	1
	XCS0002	Introduction to Cyber Security - I / Information Security - I	1
	XSD0003	Skill Development - I	1
TOTAL			**03**

M.Sc. –I MIC4101 MICROBIAL DIVERSITY AND MOLECULAR TAXONOMY

	Credit Title and Contents	No. of lectures
Unit I	**Microbial diversity and introduction to Bergey's manuals** **a) Microbial Diversity** • The expanse of microbial diversity • Estimates of total number of species • Species Divergence and the measurement of microbial diversity. • Measures and indices of diversity. b) **Introduction to Bergey's manuals** • The 5-Kingdom classification system • The 3-Domain classification system • Determinative bacteriology (Phenetic approach) • Systematic bacteriology (Phylogenetic approach) • Polyphasic approach **References:** 1. Species Divergence and the measurement of microbial diversity. Catherine Lozupone and Rob Knight. FEMS Microbiol. Rev. **32** (2008) 557 – 578 2. Methods of studying soil microbial diversity. Jennifer Kirk *et al*, (2004). Journal of Microbiological Methods **58**, 169 – 188. 3. Keller M. and Zengler K. (2004). Tapping in to Microbial Diversity. Nature Reviews 2, 141-150. 4. Pace N. (1997) A Molecular View of Microbial Diversity and the Biosphere, Science, 276, 734-740. 5. Woese C (1987), Bacterial Evolution. Microbiological Reviews, 221-271. 6. Jacquelyn G. Black (2013). Microbiology: Principles and Explorations, 6th Edition. John Wiley and sons Inc.	**15**
Unit II	**Study of Extremophiles and extreme environments** **a) Study of Extremophiles** Isolation, classification, adaptation mechanisms and biotechnological applications of extremophiles: • Thermophiles • Psychrophiles • Acidophiles • Alkaliphiles • Halophiles • Barophiles • Methanogens • Radiation resistant microbes **b) Study of extreme environments** • Marine environment	**15**

	• Deep subterranean habitat • Thermophilic environment	
	References: 1. Horikoshi K. and Grant W. D. Extremophiles – Microbial Life in extreme environments (1998). Wiley Liss Publications 2. Horikoshi K. and K. Tsujii. Extremophiles in deep sea environments (1999). Springer Japan Publications 3. Horikoshi K. Alpkaliphiles – Genetic properties and applications of enzymes (2006). Kodansha Springer.	
Unit III	**Gene sequencing**	**15**
	a) Gene sequencing • Objectives and challenges of gene sequencing • Vectors used in gene sequencing • Maxam Gilbert's method of sequencing, • Sanger's method of sequencing and automated sequencing • Newer methods of sequencing such as Pyrosequencing, Ion torrent sequencing • Strategies for whole genome sequencing • Whole Genome Shotgun Sequencing • Applications of gene sequencing (identification of organisms) **b) Introductory Bioinformatics** • Types of Databases- primary, secondary, sequence, structure, metabolic • Biological data retrieval • Pairwise and multiple sequence alignments • Scoring matrices • Needleman-Wunsch Algorithm and Smith-Waterman Algorithm • BLAST and FASTA • Concept of phylogenetic trees and related terminology • Construction of phylogenetic trees using softwares such as Mega, Phylip • Cladogram, additive trees and ultrameric trees, rooted, unrooted trees and tree shapes **References:** 1. Sandy Primrose, Richard Twyman, Bob Old (2001), Principles of Gene Manipulation 6th Edition, Blackwell Science Ltd. 2. Sambrook, J., Fritsch, E. F. And Maniatis, T. (1989) Molecular Cloning: A laboratory Manual, 2nd ed. Cold Spring harbour NY: Cold Spring Harbour Laboratory Press 3. Ausbel F. M. and Brent R. (1994) Current Protocols in Molecular Biology, John Wiley & Sons Inc, New York 4. Bioinformatics – A practical guide to the analysis of genes and proteins (2001). Baxevanis A. D. and Ouelette B. F. F. John Wiley and sons Inc. 5. Bioinformatics - Sequence and genome analysis 2nd edition (2001). Mount D. W. Cold spring harbor laboratory press.	

	6. Molecular Evolution – A phylogenetic approach (1998). Page Roderic D. M. and Holmes Edward C. Blackwell Publishing Ltd. URL: National Center for Biotechnology Information *www.ncbi.nlm.nih.gov/* *Ribosomal Database* Project - Release 10 *rdp.cme.msu.edu/ rdp.cme.msu.edu/seqmatch/* Building *phylogenetic trees* www.itu.dk/~sestoft/bsa/dinaws/phylogeny.html Reading a *Phylogenetic Tree* - Nature *www.nature.com/.../reading-a-phylogenetic-tree-the-meaning-of-419.* *PHYLIP* - Wikipedia, the free encyclopedia	
Unit IV	**Exploration of Un-culturable bacteria** • Concept of 'unculturable' bacterial diversity. • Strategies for culture of unculturable' bacteria. • Culture - independent molecular methods for identifying unculturable bacteria • Methods of extracting total bacterial DNA from a habitat and metagenome analysis. **References:** 1. Michael S. Rappe and Stephen J. Giovannoni (2003). The Uncultured Microbial Majority. *Annual Review of Microbiology*, **57**: 369 – 94. 2. Rakesh Sharma, Ravi Ranjan, Raj Kishor Kapardar and Amit Grover (2005). Unculturable bacterial diversity: An untapped resource. *Current Science*, **89 (1).** 3. Sonia R. Vartoukian, Richard M. Palmer and William G. Wade (2010). Strategies for culture of 'unculturable' bacteria. Minireview, FEMS Microbiol Lett **309**, 1 – 7. 4. James D. Oliver (2005). The Viable but Nonculturable State in Bacteria (2005). The Journal of Microbiology, **43**, Special Issue, 93 – 100. 5. Z L Sabree, M. R. Rondon and J Handelsman (2009). Metagenomics. Elsevier, 622 – 632.	**15**

M. Sc. - I MIC4102 BIOCHEMISTRY

	Credit title and contents	No. of Lectures
Unit I	**Bioorganic Chemistry** 4. Chemical reactivity: Concept and factors affecting reactivity (Inductive effect, Resonance / Mesomeric effect, Conjugation and Hyper- conjugation, Tautomerism, etc.) b. Bonding other than covalent: • H-bonds, • Van der Wall's interaction, • Charge transfer complexes, • Ionic bonding, Iondipole, • Host-guest interactions c. Reactions of organic molecules: A brief overview of important reactions in organic chemistry: • Substitution, • Addition, • Elimination, • Rearrangement, • Oxidation, • Reduction, etc. d. Bioorganic mechanism of enzyme catalyzed reactions: • Acid – base • Covalent catalysis • Metal ion catalysis with examples of respective enzymes **e.** Stereochemistry: • Three dimensional shape of molecules, • Conformation and configuration, • Structure and biological activity **f.** Concept of pH of weak acids and weak bases • Henderson- Hasselbalch equation, • Concept of buffer, • Strength of buffer, • Buffer value, • Important biological buffers g. Properties of water	**15**

	h. Polar, non- polar compounds and its classification • Numerical based on above topics **References** 1.Clayden, Greeves, Warren and Wothers, *Organic Chemistry*, Oxford Press 2. Jerry March, *Advanced Organic Chemistry*, John Wiley 3. Voet Donald and Voet Judith G. (1995) *Biochemistry*, 2nd Ed.. John Wiley and sons, New York. 4. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H.,(1987) *Outlines of Biochemistry* 5th Ed , John Wiley and Sons, New Delhi.	
Unit II	**Biochemistry- proteins and nucleic acids** **a) Biochemistry of Proteins:** • partial double bond nature of peptides, determination of primary structure of polypeptide (N-terminal, C-terminal determination method of sequencing of peptides) • Physical and chemical properties of amino acids • Ramchandran plot • Numerical based on above topics **b) Biochemistry of nucleic acids:** • Tm value Cot curves • structure of t-RNA, r-RNA, and m-RNA and • other RNAs: mi RNA, si RNA, sn RNA, sno RNA • Numerical based on above topics **References:** 1. Cox M. M., Nelson D. L., (2008) Lehninger Principles of Biochemistry, Fifth edition, W. H. Frreman and Company New York Berg Jeremy, Tymoczko John, Stryer Lubert (2001) 2. *Biochemistry* 4th Ed, W. H. Freeman, New York. 3. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry*. 3rd 4. Ed. Brooks/Cole, Publishing Company, California 5. Segel Irvin H. (1997). *Biochemical Calculations*. 2nd Ed.John Wiley and Sons, New York. 6. Campbell M. K.(1999)Biochemistry. 3rd edition Harcourt 7. Brace College Publishers	**15**

Unit III	**Enzyme Kinetics** a) Purifications of enzyme, purification chart b) Kinetics of single substrate enzyme catalyzed reaction. c) Kinetics of reversible inhibitions enzyme catalyzed reactions, d) King Altman approach to derive – two substrate enzyme catalyzed reactions, e) Types of two substrate enzyme catalyzed reactions, f) Concept of allosterism, positive and negative co-operativity g) Models of allosteric enzymes (Monod, Wyamann and Changuax model, Koshland, Nemethy and Filmer model), h) Kinetics of allosteric enzyme, Hill plot, examples of allosteric enzymes and their significance in allosteric regulation • Numerical based on above topics **References:** 1. Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York. 2. Palmer Trevor (2001) *Enzymes: Biochemistry, Biotechnology and Clinical chemistry*, Horwood Pub. Co. Chinchester, England. 3. Segel Irvin H. (1997) *Biochemical Calculations* 2nd Ed., John Wiley and Sons, New York	**15**
Unit IV	**Bioenergetics** a)Laws of thermodynamics, entropy, enthalpy, b)Free energy • Free energy and equilibrium constant, • Gibbs free energy equation, • Determination of free energy of hydrolytic and biological oxidation reduction reactions, under standard and non-standard conditions, c) High energy compounds, d) Coupled reactions, e) Determination of feasibility of reactions,	**15**

	f) Atkinson's energy charge, g) Phosphorylation potential and its significance • Numerical based on above topics **References:** 1. Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York. 2. Segel Irvin H. (1997) *Biochemical Calculations* 2nd Ed., John Wiley and Sons, New York 3. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry.* 3rd 1Ed. Brooks/Cole, Publishing Company, California	

M. Sc.- I MIC4103 MOLECULAR BIOPHYSICS AND INSTRUMENTATION

	Credit Title and Contents	No. of lectures
Unit I	**Biomolecular Separation and Detection** • Chromatography- Partition Coefficient, Selectivity, Resolution, Column Efficiency, Van Deemter equation, Interpretation of chromatograms • Principle, components of instrument, operation and application of: Gel filtration chromatography, Ion-exchange Chromatography, Affinity chromatography, Gas chromatography, High Performance Liquid Chromatography. • Ultra centrifugation, Differential centrifugation, Isopycnic and Rate zonal centrifugation. • Problem solving on above topics **References** 1. Clive Dennison (2002) *A guide to protein isolation*, Kluwer Academic Publishers 2. Pattabhi, V. and Gautham, N. (2002) *Biophysics.* Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi. 3. David J Holme, Hazel Peck (1998) *Analytical Biochemistry*, 3rd ed., Prentice Hall, Pearson Education Limited, Harlow England. 4. Nölting, B. (2006) *Methods in modern biophysics.* Second Edition. Springer, Germany. 5. Cotterill, R. M. J. (2002) Biophysics: An Introduction. John Wiley & Sons, England.	**15**
Unit II	**Spectroscopies of Biomolecules** • Electromagnetic spectrum, Atomic orbitals, Molecular orbitals, Electronic, Rotational and Vibrational transitions in spectroscopy, Interpretation of spectra. • UV/Visible spectroscopy- Instrumentation, Molar Absorptivities, Beer and Lamberts Law, Bathochromic and hypsochromic shifts. • Fluorescence spectroscopy- Instrumentation, Quantum Yield, Quenching, FRET, Binding and Folding studies, Infrared spectroscopy- Principle , Instrumentation, Absorption bands, FTIR and its advantages, • Circular Dichroism (CD) – Instrumentation, Circular polarization, Cotton Effect. • Mass spectroscopy- Principles of operation, Ionization, Ion fragmentation, Mass Analyzers, GC-MS, MALDI-TOF • Problem solving on above topics	**15**

	References 1. Clive Dennison (2002) *A guide to protein isolation*, Kluwer Academic Publishers 2. Pattabhi, V. and Gautham, N. (2002) *Biophysics.* Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi. 3. David J Holme, Hazel Peck (1998) *Analytical Biochemistry*, 3rd ed., Prentice Hall, Pearson Education Limited, Harlow England. 4. Nölting, B. (2006) *Methods in modern biophysics.* Second Edition. Springer, Germany. 5. Cotterill, R. M. J. (2002) Biophysics: An Introduction. John Wiley & Sons, England.	
Unit III	**Biophysical Techniques** • X-ray crystallography: Purification of proteins, Crystallization of proteins, Instrumentation, acquisition of the diffraction pattern, basic principles of x-ray diffraction, working and applications • NMR spectroscopy: Basic Principles of NMR, Chemical shift, Intensity, Line width, Relaxation parameters, Spin coupling, Nuclear Overhauser Effect Spectroscopy, Correlation Spectroscopy, Approach to structure determination by 2D-NMR • Problem solving on above topics **References:** 1. Pattabhi, V. and Gautham, N. (2002) *Biophysics.* Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi. 2. Cavanagh John *et.al.* (1995) *Proteins NMR Spectroscopy: Principles and Practice*, Academic Press. 3. Keeler, J. (2002) *Understanding NMR Spectroscopy.* John Wiley & Sons, England. 4. Drenth, J. (2007) *Principles of protein X-ray crystallography.* 3rd Ed. Springer, Germany. 5. Nölting, B. (2006) *Methods in modern biophysics.* Second Edition. Springer, Germany. 6. Cotterill, R. M. J. (2002) *Biophysics: An Introduction.* John Wiley & Sons, England.	**15**
Unit IV	**Synthesis and Characterization of Bio-Nanoparticles** • Biogenic nanoparticles – Synthesis and applications. • Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Significance of the physical properties of nanoparticles • Characterization of nanoparticles, Imaging techniques like TEM (Transmission Electron Microscope), SEM (Scanning Electron Microscope), AFM (Atomic Force Microscopy), Dynamic Light Scattering (DLS), Scanning Probe Microscopy (SPM), EDAX analysis, Zeta analysis. • Problem solving on above topics	**15**

	References: 1. Christof M. Niemeyer and Chad A. Mirkin (2000) *Nanobiotechnology*, John Wiley & Sons. 2. Daniel L. Feldheim and Colby A. Foss, Jr. *(2002) Metal nanoparticles synthesis and characterization and application.* 3. Marcel Dekker, Inc. Mahendra Rai and Nelson Duran (2011) *Metal nanoparticles Microbiology*, Springer Verlag Berlin Heidelberg.	

M. Sc. - I MIC4104 Advanced Cell Biology

	Credit title and contents	No. of lectures
Unit I	**Ultrastructure and Organization of Eukaryotic Cell** a)Structural organization of: • Cytoskeleton • Endoplasmic Reticulum • Golgi apparatus b) Protein trafficking among various cellular compartments c) Events in cell cycle, Regulation of cell cycle, apoptosis d) Localization of macromolecules using: • Electron microscopy • Immunoelectron microscopy • Confocal microscopy Problem solving on above topics **References:** 1. Alberts Bruce (1985) *Molecular Biology of Cell.* Garland Pub *2.* Metzler David E. (2001) *Biochemistry: The chemical* 3. *Reactions of Living Cells*, Volume 1&2, Academic Press California. 4. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul 5. Matsudaira, David Baltimore, and James Darnell (2000) 6. Molecular Cell Biology, 4th edition, W. H. Freeman & co.,New York.	**15**
Unit II	**Membrane Transport** a) The composition and architecture of Membrane b) membrane dynamics c) Solute transport across membranes: • Passive diffusion, • Facilitated transport, • Primary and secondary active transport using P , V and F type ATPases Ionophores, • Ion mediated transport, • Transport of ions across membranes (ion pumps),	**15**

	d) Ligand and voltage gated ion channels, e) liposomes and model membranes Problem solving on above topics **References:** 1. Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles ofBiochemistry*, Fourth edition, W. H. Freeman & Co. New York. 2. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry.* 3rd 3. Ed. Brooks/Cole, Publishing Company, California. 4. Berg Jeremy, Tymoczko John, Stryer Lubert (2001) 5. *Biochemistry* 4th Ed, W. H. Freeman, New York.	
Unit III	**Microbial Communication and Coordination** a) Life cycle of *Dyctiostellium discoidum*, b) Molecular mechanism of quorum sensing in slime moulds c) Life cycle of myxobacteria, Molecular mechanism of quorum sensing in myxobacteria. d)Quorum sensing in Gram positive (*Staphylococcus aureus* virulence factors) and Gram negative bacteria (*Vibrio fischeri* lux operon) e)Biofilms: • Their organization • Signals involved in biofilm formation • and dispersal • Applications of study on biofilms in pathogenic (*Pseudomonas aeruginosa*) and non-pathogenic environments (dental plaque) Problem solving on above topics **References:** 1. Hamilton W. Allan, (1987) *Biofilms: Microbial Interactionsand Metabolic activities*, in Ecology of Microbial Communities, (Eds. M. Fletcher, T. R. G. Gray and J. G. Jones) Cambridge University Press, Cambridge. 2. Peters J. E. (1969) Isolation, cultivation and maintenance of *Myxobacteria*, Methods in Microbiology (Eds. Norris J. R. and W. Ribbons) Vol. 3B, Academic Press London, 185-210. 3. Toole 'O' George, H. B. Kaplan, R. Kolter,(2000) *Biofilm formation as microbial development* Annual Review of Microbiology, Vol. 54, 49-79 4. Melissa B. Miller and Bonnie L. Bassler (2001) *Quorum sensing in bacteria***.** Annu. Rev. Microbiol. Vol. 55, 165–99. 5. Christopher M. Waters and Bonnie L. Bassler (2005) *Quorum sensing:cell-to-cell communication in bacteria*. Annu. Rev.Cell Dev.	**15**

	Biol. Vol. 21, 319–46.	
Unit IV	**Cell signaling in prokaryotic and eukaryotic systems** • Secretory systems in bacteria, competence development, sporulation • Signaling in eukaryotes: autocrine, paracrine, endocrine, neurotransmitters • Pathways in cell signaling: GPCRs- a)ion channels b) rhodopsin c) adenylate cyclase pathway d) regulation of cytosolic Ca^{2+} Problem solving on above topics **References:** 1. Alberts Bruce (1985) *Molecular Biology of Cell.* Garland Pub 2. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul 3. Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York. 4. Alberts Bruce (1985) *Molecular Biology of Cell.* Garland Pub 5. Munehiko Asayama and Yasuo Kobayashi (1993) Signal transduction and sporulation in Bacillus subtilis: autophosphorylation of SpoOA, a sporulation initiation gene product. Molecular and General Genetics. Vol. 238, Issue 1, 138–144	**15**

MIC4105: PRACTICAL COURSE I: MICROBIAL DIVERSITY & MOLECULAR TAXONOMY

<table>
<tr><td>Unit I</td><td>Isolation and identification of Eubacteria</td><td>No. of hours</td></tr>
<tr><td></td><td>Isolation of the following types of bacteria from natural samples. Identification of the bacteria to at least the Genus level using the Bergey's Manuals:
• Mesophilic bacteria
• Actinomycetes
• Thermophiles
The identification key must be designed for each isolated and identified bacterium.
Students are expected to isolate at least one genus from each group.

References:
1. Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 8th Edition, 1974.
2. Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 9th Edition, 1982.
3.Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).
4. Sykes, G. and F. A. Skinner (Eds). Actinomycetales: Characteristics and Practical Importance. Society for Applied Bacteriology Symposium Series No. 2, Academic Press. 1973.</td><td>15</td></tr>
<tr><td>Unit II</td><td>Isolation and identification of Fungi
Isolation of the following types of fungi from natural samples. Identification of the fungi.
• Molds (Saprophytic)
• Yeasts
The identification key must be designed for each isolated and identified fungus.
Students are expected to isolate at least one genus from Mold and Yeast each.

References:
1. Barnett, H. L. and Hunter, B. B. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Co., Minnesota.
2. Lodder J. (1974). The Yeasts: A Taxonomic Study, North Holland Publishing Co. Amsterdam.</td><td>15</td></tr>
<tr><td>Unit III</td><td>Isolation and identification of Cyanobacteria</td><td>15</td></tr>
</table>

	Isolation and identification of any one type of cyanobacterium from a natural sample. The identification key must be designed for each isolated and identified cyanobacterium. Students are expected to isolate at least one genus of cyanobacteria. **References:** 1. Bergey's Manual of Systematic Bacteriology (2nd Edition) Volume One: The Archaea and the Deeply Branching and Phototrophic Bacteria. Boone, David R.; Castenholz, Richard W. (Eds.). Originally published by Williams & Wilkins, 1984	
Unit IV	**Molecular Taxonomy** • Isolation, purification and checking purity of isolated chromosomal DNA of bacteria • Demonstration of the following steps, if not possible to perform in your lab: Cycle sequencing PCR Purification of PCR product Sequencing using automated machine • Sequence matching by BLAST analysis. • Drawing phylogenetic tree using related sequences (Using standard software like Phylip, Mega etc) **References:** 1. Sandy Primrose, Richard Twyman, Bob Old (2001), Principles of Gene Manipulation 6th Edition, Blackwell Science Ltd. 2. Sambrook, J., Fritsch, E. F. And Maniatis, T. (1989) Molecular Cloning: A laboratory Manual, 2nd ed. Cold Spring harbour NY: Cold Spring Harbour Laboratory Press 3. Ausbel F. M and Brent R. (1994) Current Protocols in Molecular Biology, John Wiley & Sons Inc, New York 4. URL:***National Center for Biotechnology Information*** *www.**ncbi**.nlm.nih.gov/* ***Ribosomal Database*** **Project - Release 10** *rdp.cme.msu.edu/* ***rdp.cme.msu.edu****/seqmatch/* **Building *phylogenetic trees*** **www.itu.dk/~sestoft/bsa/dinaws/**phylogeny**.html Reading a *Phylogenetic Tree* - Nature** *www.nature.com/.../reading-a-**phylogenetic-tree**-the-meaning-of-419.* ***PHYLIP* - Wikipedia, the free encyclopedia** ***en.wikipedia.org/wiki/PHYLIP*** ***MEGA* :: *Molecular Evolutionary Genetics Analysis*** *www.**mega**software.net/*	**15**

M. Sc. – I MIC4106: PRACTICAL COURSE II: BIOCHEMISTRY, CELL BIOLOGY & BIOPHYSICS

Unit I	**Biochemistry- I**	
	• **Good laboratory practices:** Laboratory safety, hazard from chemicals, handling of chemicals, disposal of chemicals and cultures, recording of scientific experiments. Standardization of laboratory procedures, preparing / designing SOP for the same, maintenance of instruments • Calibration of analytical instruments - Colorimeter and Spectrophotometer by estimation of biomolecules and statistical analysis of data generated. • **Buffer:** Determination of pKa of a monoprotic weak organic acid; Preparation of buffers using KH_2PO_4 and K_2HPO_4, acetic acid and sodium acetate, K_2HPO_4 and H_3PO_4	**15**
Unit II	**Biochemistry- II** • Purification of enzyme from natural sources like animal, plant, bacterial/fungal by ammonium sulfate precipitation, organic solvent precipitation, gel filtration, etc. • Establishment of enzyme purification chart • Determination of Km and Vm values of any hydrolytic enzyme • To determine the ion-exchange capacity and nature of given resin using anion exchange chromatography.	**15**
Unit III	**Cell biology** • Studying the stages mitosis in growing tip of onion root cells • Isolation and characterization of bacterial pigment	**15**
Unit IV	**Biophysical instrumentation-I** • Biological synthesis of nanoparticles (actinomycetes /fungi /yeast) and their characterization by UV-Vis spectroscopy. • Interpretation of Ramchandran Plot and study of conformations of protein molecule using Molecular Graphics Visualization Tool. • Determination of molar extinction coefficient of biological molecule.	**15**

MIC4107: SCIENTIFIC COMMUNICATION – I

Unit I	**Scientific communication** Preparation of Visual Aids: • Photomicrography, taking photographs of experimental results and using them in the reports • Scanning pictures Making Power Point slide shows **References:** 1. Alley, M. 1996. The craft of scientific writing, 3rd edition. Prentice Hall, NJ. [and accompanying web site: http://filebox.vt.edu/eng/mech/writing/] 2. Day, R. 1998. How to write and publish a scientific paper, 5th edition. Orynx Press. 3. Day, R. 1995. Scientific English: A guide for scientists and other professionals, 2nd edition. Orynx Press.	**No. of hours 15**