M.SC. (INDUSTRIAL MICROBIOLOGY) COURSE

SEM.	CODE	COURSE TITLE	Credits		
			Theory	Practical	Total
I	IM- 601	BIOMOLECULES	3	4	26
	IM- 611	ANALYTICAL TECHNIQUES	3		
	IM- 621	CELL STRUCTURE AND CANCER BIOLOGY	3		
	IM- 631	GENETICS & MOLECULAR GENETICS	3	4	
	IM- 641	BIOSTATISTICS, BIOINFORMATICS & COMPUTER	3		
	IM- 651	BASIC MICROBIOLOGY	3		
II	IM- 602	PROTEINS AND ENZYMES	3	4	29
	IM- 612	MOLECULAR BIOLOGY & GENETIC ENGINEERING	3		
	IM- 622	BASIC IMMUNOLOGY	3		
	IM- 632	MICROBIAL METABOLISM	3	4	
	IM- 642	VIROLOGY	3		
	IM- 652	FERMENTATION TECHNOLOGY	3		
	CBS- 662	CHOICE BASED SUBJECT	3		
III	IM- 603	ENVIRONMENTAL & POLLUTION MICROBIOLOGY	3	4	29
	IM- 613	CLINICAL IMMUNOLOGY	3		
	IM- 623	INDUSTRIAL PRODUCTION PROCESSES	3		
	IM- 633	FOOD MICROBIOLOGY	3	4	
	IM- 643	MEDICAL MICROBIOLOGY	3		
	IM- 653	BIOPROCESS TECHNOLOGY & DOWN STREAM PROCESSING	3		
	CBS- 663	CHOICE BASED SUBJECT	3		
IV	IM- 604	INDUSTRIAL/ LABORATORY TRAINING & REPORT PREPARATION			20
		TOTAL CREDITS			104
		COMPREHENSIVE VIVA (4 CREDITS / SEMESTER)			16
		CREDITS GRAND TOTAL			120

SEMESTER-I	BIOMOLECULES	COURSE: IM - 601
UNIT	**TOPICS**	**LECTURES**
I	**Carbohydrates:** Stereoisomerism, aldose and ketose family of monosaccharides. Structure of oligosachharides and polysaccharide. Enzymatic degradation of polysaccharides.	2 2 2
II	**Lipids:** Structure and types of fattyacids. Structure of triglycerides, phospholipids, Glycolipids, sphingolipids, terpenes and steroids.	2 2
III	**Amino acids** Classification, Structure and properties of amino acids. Non – protein amino acids. Protein degradation Amino acid sequencing.	2 2 2
IV	**Nucleic acids** Structure, physical and chemical properties of nucleic acids. Types of DNA and RNA. Factors stabilizing double helical structure of DNA. DNA melting, DNA packaging, DNA supercoiling, Nucleic acid sequencing.	2 2 2 2

Suggested books:

1. Principles of Biochemistry – Voet & Voet, John Wiley & Sons
2. Introduction to protein structure - Branden and Tooze. Garland Publishing Company.
3. Principles of Biochemistry. - Lehniger, 3rd edition by Nelson and Cox (Worth) 2000
4. Biochemistry. - Stryer 5th edition W.H. Freeman 2001.
5. Harper's Biochemistry, 1999 (McGraw-Hill).
6. Principles of Biochemistry - Zubey GL. Parson WW and Vance DE (1994), WM.C. Brown Publishers, Oxford, England.
7. Modern Microbiology. - Brige EA (1992), WM.C. Brown, Publishers, Oxford, England

SEMESTER- I	ANALYTICAL TECHNIQUES	COURSE:IM - 611
UNIT	TOPICS	LECTURES
I	Cell Disruption techniques: Homogenisation, mechanical and non-mechanical methods of cell disruption	2
	Separation methods:Centrifugation:Basic principle, Types, components.	2
	Preparative centrifugation: differential velocity and density gradient centrifugation	2
	Determination of sedimentation coefficient.	1
II	Basic principle of chromatography, Paper, thin layer and column chromatography , Adsorption chromatography, Partition chromatography, HPLC, Gas Liquid chromatography, Gel filtration chromatography, Affinity chromatography, Ion exchange chromatography	1 2 2 2
	SDS PAGE, native PAGE	2
III	Spectroscopy Beer-Lambert Law, components and applications of spectrophotometer, Spectrofluormeter, Atomic absorption spectrometer	2 1 2
IV	Basic principle and applications of EPR and NMR spectroscopy Radio-isotopic measurements, Basic principle and applications	2 2 2
V	Microscopy Basic Principle , components and applications of Light microscope and electron microscope, Phase contrast microscope, transmission and Scanning microscopy	2 1

Suggested Books:

Analytical techniques: Holeme and Peck, Longman Scientific & Technicals, USA

Analytical Instrumentation Handbook: Jack Cazes, CRC Press

Bioanalytical chemistry, Manz, Pamme & Iossifidis, Imperial College Press

Analytical Techniques in Biochemistry and Molecular Biology: R Katoch

Biological Instrumentation and Methodology: PK Bajpai,

Principles and Techniques of Biochemistry and Molecular Biology: Wilson & Walker

Introduction to Instrumentation in Life Sciences: Bisen P.S and Sharma, A. CRC Press.

Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed.- Wilson Keith and Walker John (2005) Cambridge University Press, New York.

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SEMESTER- I	CELL STRUCTURE AND CANCER BIOLOGY	COURSE : IM - 621
UNIT	**TOPICS**	**LECTURES**
I	Overview of the cell: Introduction to cell and cell research, The evolution of the cell, Prokaryotes to eukaryotes, Single cells to multi-cellular cell structure and organization in plants and animals Cell culture, differentiation medium, primary, diploid and established cell lines, Stem cells, Potencies of stem cells, Embryonic stem cells, adult stem cells, SCNT, iPS	1 1 1 1 1
II	Cell organelles: The plasma membrane, membrane proteins, membrane carbohydrates, Membrane transport of small molecules Membrane transport of macromolecules and particles, exocytosis, pinocytosis and endocytosis The lysosomes, The peroxisomes, The cytoskeleton	2 1 1
III	Ribosome and protein synthesis: Ribosome and protein synthesis, Genes, types and processing of m-RNA, t-RNA, r-RNA, si-RNA, microRNA, RNAi, RNA splicing The endoplasmic reticulum, the signal hypothesis, targeting of mitochondria, chloroplast and peroxisomal proteins, translational modification in the ER The Golgi apparatus, Intracellular traffic, vesicular traffic in the secretary pathway, protein sorting in the Golgi	2 2 2
IV	Cell signalling: Cell-cell communication, Signal transduction pathways, cell junctions and the extracellular matrix, Overview of the extracellular signalling, Signalling pathways, G-Protein coupled receptors and their effectors, Receptor enzymes, Ligand- gated channels, Integrins, Second messengers.	2 1 3
V	Cancer Biology: The nucleus, Cell growth and division, Cell cycle, Mechanisms for regulating mitotic events, cell cycle check points, cell Synchrony, transformed cells, Apoptosis, necrosis, protooncogenes, oncogenes, cancers, angiogenesis, invasion and metastasis, carcinogens, TAA, TSA, Oncoviruses, therapies for cancers	2 2 2

Suggested books:

1. *Cell and Molecular Biology*, 8th Edition, Eduardo D. P. De Robertis, E. M. F. De Robertis, Lippincott Williams & Wilkins, 2010.
2. *The Cell: A Molecular Approach*, 6th Edition, Geoffrey M. Cooper, ASM Press 2013
3. *Cell and Molecular Biology: Concepts and Experiments*, 6th Edition, Gerald Karp, John Wiley & Sons, Inc. 2010
4. *Cancer: Principles and Practice of Oncology*, 9th Edition, Vincent T. DeVita, Jr., Theodore S. Lawrence, Steven A. Rosenberg, Lippincott Williams and Wilkins, 2011.
5. *The Biology of Cancer*, Robert A. Weinberg, Garland Science, 2012.
6. *Introduction to Cancer Biology*, Robin Hesketh Cambridge University Press, 2013
7. *Stem Cells: Scientific Progress and Future Research Directions*, NIH Monograph University Press of The Pacific, 2004
8. *Research Methodology : Methods and Techniques*, C.R Kothari New Age International Publishers, 2004

SEMESTER – I	GENETICS & MOLECULAR GENETICS	COURSE : IM- 631
UNIT	**TOPICS**	**LECTURES**
I	Mendelion Genetics- Mendel's law's of inheritance; Back cross, Test cross, Monohybrid, Dihybrid, Trihybrid cross; Deviation from Mendel's findings; Forked line Method.	2
	Non-Mendelion inheritance patterns- Mitochondrial Inheritance.	2
	Lethality and Interaction of gene- Lethal effects and regression of genes in Drosophila, Mice and Plants.	2
	Interaction of genes- Two gene pairs affecting same character, Epistasis; complementary genes; Duplicate genes.	2
II	Physical basis of heredity- Nucleus, Chromosomes, Special type of chromosomes; Prokaryotic nucleoids, Chromatin structure and nucleosome; Chromosome banding.	3
	Cell division and error in cell division; Non-disjunction, Structural and numerical chromosomal abnormalities- deletion, duplication, translocation, inversion.	3
	Genetic disorders due to chromosomes in human; determination of sex, Sex linked inheritance.	2
III	Mutations- type of mutations, frameshift mutation, mutagenic agents, mechanism of mutagenesis, Ames Test.	2
	Gene transfer in bacteria- Transduction, Conjugation, F transfer, Hfr mediated chromosome transfer.	2
	Transposable genetic elements in plant and animals.	2
IV	Molecular Biology of DNA Replication - DNA replication is semi-conservative, Meselson-Stahl expt., Multiple Origins & bi-directional DNA replication in Eukaryotes,	2
	Replication of Virus & Theta replication of Circular DNA molecules, Rolling Circle replication, Plasmid DNA using a Rolling Circle, Unwinding, Stabilization & Stress relief,	2
	Initiation by a Primosome complex, Chain elongation & Proofreading, discontinuous replication of the lagging strand, Terminator sequencing of DNA.	2
V	Molecular Biology of Recombination - Molecular mechanisms of Recombination, Gene conversion, Mismatch repair, the Holliday model of recombination, Single strand break & repair model.	2

Suggested Books:

The Science of Genetics: George W. Burns, Paul J. Bottino Maxwell Macmillan International Editions, New York

Concepts of Genetics : William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Pearson Prentice Hall, New Jersey

Gene – IX: Lewin Benjamin, Pearson Prentice Hall, Pearson Education, Inc., New Jersey

Theory and Problems of Genetics: Susan L. Elrod, William D. Stansfield, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Molecular Biology of the Cell: Bruce Alberts, Garland Science, Taylor and Francis Group, New York

Cell and Molecular Biology, concepts and experiments: Gerald Karp, John Wiley and Sons, Inc. New Jersey

Molecular Cell Biology: Lodish, W. H. Freeman and Company, New York

The Cell a Molecular Approach: Geoffrey M. Cooper, Robert E. Hausman, ASM Press and Sinauer, Washington

Cell and Molecular Biology: Phillip Sheeler, Donald E. Bianchi, John Wiley and Sons, Inc., New Delhi

Cell Biology – A Laboratory Handbook: Julio E. Celis, Academic Press, Harcourt Brace and Company Publishers, San Diego

Genomes: T. A. Brown, Wiley-Liss, John Wiley and Sons, Inc. New Jersey

Principles of Gene Manipulation : Sandy B. Primrose, Richard M. Twyman and R.W.Old, S. B. University Press.

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SEMESTER-I	BIOSTATISTICS, BIOINFORMATICS & COMPUTER	COURSE: IM-641
UNIT	TOPICS	LECTURES
I	Introduction to Biostatistics: Introduction to Biostatistics; Methods of representation of statistical data; Population and sample designs; Random and Non random sampling methods. Measures of central tendency: Mean, Median, Mode. Concept of probability. Concept of correlation and regression.	2 2 2
II	Statistical applications in biology: Experimental designs; measures of dispersion: standard deviation, standard error; test of significance: Student's t test, Paired and unpaired t test; Analysis of variance (ANOVA), Chi- square test.	2 2 2
III	Introduction to Computers: Fundamentals of computer; Major components: CPU, input and output devices, Memory; Operating systems: Windows and Unix. Hardware, software; Introduction to Internet: LAN, WAN.	2 2 1
IV	Software packages and applications in biology: Microsoft office: MS word, Excel, power point; Application of SPSS; Application of computers; Applications of internet: Multimedia network concepts, e-mail.	2 2 1
V	Introduction to Bioinformatics and its applications: Basics of bioinformatics; Biological Databases-Primary, Secondary and composite databases; Methods of Sequence alignment, BLAST and FASTA; Whole genome analysis; Microarray.	2 2 1

Suggested books:

1. Introductory Biostatistics, Chap T. Le, 2003
2. Bioinformatics an introduction. J. J. Ramsden, 2006
3. Introduction to Bioinformatics: A theoretical and practical approach. S.A. Krawetz and David D. Womble, 2003.
4. Bioinformatics: Sequence, structure and databanks, A practical approach. Des Higgins and Willie Taylor, 2003.
5. Bioinformatics: Genes, Proteins and computers. Orengo, Jones and Thornton, 2003
6. Bioinformatics, Sequence and Genome Analysis. David W. Mount, 2004
7. IBM PC and PCXT, User's Reference Manual. Gilbert Held, 2007
8. Introduction to Computer Science. Satish Jain, 2008.
9. Statistics in Biology, Bliss C.I.K. (1967): Vol. 1 Mc Graw Hill, New York.
10. Statistics for Biologists. Campbell R.C. (1974): Cambridge University Press, Cambridge.
11. Wardlaw, A.C. (1985): Practical Statistics for Experimental Biologists. John Wiley and Sons., Inc., New York.

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SEMESTER - I	BASIC MICROBIOLOGY	COURSE: IM -651
UNIT	TOPICS	LECTURES
I	**Introduction to Microbiology** Early Discoveries and experiments of Louis Pasteur Discoveries in Medical Microbiology Soil Microbiology and Plant pathology Microbes and molecular biology Structure of bacteria Methods of classification Major groups of bacteria Structure and life cycle of virus	 1 1 1 1 1 1 1 1 1
II	**Energy relations of microbes :** Basic principles of bioenergetics Respiration and fermentation Photosynthesis in bacteria Nitrogen cycle and biological nitrogen fixation Carbon cycle Sulphur and phosphorous cycles	 1 1 1 1 1 1
III	**Growth of microorganisms:** Phases of growth cycle, Determination of Generation time and Growth rate. Types of microbial cultures- Batch, Continuous and Synchronous cultures	1 2 2
IV	**Microbial growth measurement:** microbial growth based on cell number, cell mass and cell activity.	3
V	**Control of microorganisms:** Microbial death curve under adverse condition. Levels of control, Mechanisms action of physical agents- Heat, photochemical and ionizing radiations. Chemical control of microorganisms – Phenol coefficient, Mechanisms of various chemical agents used for control of microorganisms.	2 3 3

Recommended Books

1. Fundamental Principles of Bacteriology	Salle
2. Biology of Microorganisms	Brock, Madigan
3. Microbiology	Pelczar, Chan & Kreig
4. Text Book on Principles of Bacteriology, Virology & Immunology	Topley and Wilson
5. General Microbiology	Stainer, Ingharam, Wheelis
6. General Microbiology	Robert Boyd
7. An Introduction to Microbiology	Tauro, Kapoor, and Yadav
8. Introductory Practical Microbiology	Jayababu Mudili

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SEMESTER - II	PROTEINS, VITAMINS AND ENZYMES	COURSE: IM -602
UNIT	**TOPICS**	**LECTURES**
I	**Proteins:**	
	Amino acids and proteins	1
	Primary structure	1
	Determination of amino acid sequence	1
	Secondary structure	1
	α and β helix	1
	Constraints for polypeptide	1
	Tertiary and quaternary structure	1
	Protein hydrolysis and peptide maps	1
II	**Vitamins :**Role of vitamins in metabolism	1
	Discovery and classification	1
	Structure and function of Thiamine and riboflavin	1
	Structure and function of pyridine nucleotides and Coenzyme-A	1
	Structure and function of vitamins pyridoxine, biotin, folic acid	1
	Structure and function of lipoic acid, vitamin B-12 and ascorbic acid	1
	Structure and function of vitamin A and D	1
	Structure and function of Vitamin E and K	1
III	**Enzymes : Structure**	1
	Discovery, classification and nomenclature	1
	Chemical kinetics and catalysts	1
	Enzyme kinetics and Michaels – Menton equation	1
	Modifications of Michaels – Menton equation	1
	Reversible inhibition of enzymes	1
	Irreversible inhibition	1
	Substrate specificity	1
IV	**Regulation of enzyme activity :**	
	Allosteric regulation	1
	Cumulative and coordinated regulation	1
	Isozymes	1
	Regulation by covalent modification	1
	Regulation by separate protein molecules	1
	Zymogens	1

Suggested books

1. Introduction to protein structure - Branden and Tooze. Garland Publishing Company.
2. Principles of Biochemistry. - Lehniger, 3rd edition by Nelson and Cox (Worth) 2000
3. Biochemistry. - Stryer 5th edition W.H. Freeman 2001.
4. Harper's Biochemistry, 1999 (McGraw-Hill).
5. Principles of Biochemistry - Zubey GL. Parson WW and Vance DE (1994), WM.C. Brown Publishers, Oxford, England.

SEMESTER - II MOLECULAR BIOLOGY & GENETIC ENGINEERING COURSE: IM -612

UNIT	TOPICS	LECTURES
I	**Enzyme in recombinant DNA techniques**	
	Restriction endonucleases	2
	Reverse transcriptase	1
	DNA ligase	1
	Terminal transferases	1
	SI nuclease	1
	Exonuclease	1
	Polynucleotide kinase	1
	DNA polymerase I.	1
II	**Cloning vectors and Cloning strategies**	
	General characteristics of cloning vectors.	1
	Plasmid Vectors	1
	Phages and cosmid Vectors.	1
	YAC cloning vectors	1
	Construction of genomic and cDNA libraries.	1
	Screening and selection of specific DNA clones	1
III	**Molecular hybridization**	2
	In situ hybridization	1
	Southern Blots	1
	Northern and Slot blots	1
	Heteroduplex mapping	1
	DNA Microarray	
IV	**Gene amplification and Genetic engineering in eukaryotes**	2
	PCR	2
	Gene Sequencing	1
	Site directed mutagenesis	1
	Antisense and Ribozyme Technology Gene transfer in animal cell culture	1
	Transgenic organisms with examples from mice and *Drosophila.*	1
	Transfer of plant genes by Ti plasmids.	1
V	**Replication and Gene expression**	
	DNA replication	2
	Transcription	2
	Translation.	2
	Regulation in Eukaryotes- transcriptional and post-transcriptional control	4

Suggested books

1. Current protocols in molecular biology. 2000. Ausbel *et. al.*
2. Molecular cloning Vol. 1-III. Sambrook and Russel. 2001. CSH press.
3. Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publications.
4. Molecular Cloning. 3 volumes. Sambrose and Russell, 2000. CSH Press.
5. Genome analysis. Four volumes. 2000. CSH Press.
6. Principles and techniques of biochemistry and molecular biology, 6th Ed. - Wilson Keith and Walker John (2005) Cambridge University Press, New York.
7. Gene Cloning

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SEMESTER –II	BASIC IMMUNOLOGY	COURSE: IM - 622
UNIT	TOPICS	LECTURES
I	**Introduction to Immune Response** Origin of Immunology, Cells of the immune system, Organ of the Immune system Innate and Aquired immunity. Cellular and humoral immunity Toll receptors, and sensing of PAMP, signal transduction, NOD receptors	1 1 1
II	**Immunoglobulins** Structure of Immunoglobulins, immunoglobulin fold immunoglobulin superfamily, different classes of immunoglobulins idotypiç, isotypic, allotypic determinant theories of antibody formation, clonal selection theory generation of antibody diversity affinity maturation, allelic exclusion, class switching	2 2 2
III	**Antigen antibody reaction** Antigenic determinant and haptens, valence and affinities of antibodies specificity, quantitative preciptiin titration, precipitin reaction in gel, immunoelectrophoresis, agglutination, IF, immunoprecipitation, FACS, western blotting, cell seperation techniques ELISA, RIA	2 1 1 1
IV	**Complement pathways.** Classical, alternative and lectin pathway of complement activation, regulation, complement deficiency and complement fixation assay. **Monoclonal Antibody** Formation of monoclonal antibody. selection of hybrids in HAT media advantage of monoclonals and their use, Human monoclonals.	2 1 1 1
V	**The major histocompatibility complex.** Class I and Class II MHC molecules, gene map of MHC, tissue distribution, Tissue typing. **Recognition of antigen** Need of MHC participation in antigen recognition, processing of antigen T cell receptor, APC -T cell interaction, MHC restriction. T cell activation, Th1,Th2 cells. T cytotoxic cells, super antigen. Activation of B cells, type I, type II thymus independent and thymus dependent antigens.	1 1 1 2 2

Suggested books:

Kuby Immunology Thomas J Kindt Barbara A Oslorn, Richard A Goldsby

Immunology David Male, J Brostoff David Roitt, Ivan Roitt.

~~Cellular and Molecular Immunology A.K Abbas, Andrew H LitchmanShiv Pillai~~

Immunology Understanding Immune system. Kluas Erget.

Revised

SEMESTER –II	MICROBIAL METABOLISM	COURSE: IM- 632
UNIT	TOPICS	LECTURES
I	Transport systems in Bacteria: Types of transport systems, PEP system of transport, ABC superfamily of transporters, OMPs, Ionophore antibiotics	2 2 2
II	Nitrogen and Sulphur metabolism:Nitrogen cycle, N2 fixation, its mechanism and regulation at genetic level, assimilation and reduction of nitrate and sulphate	1 2 1
III	Protein metabolism: Genetic regulation of protein synthesis (Ara and Trp operon), regulation enzymatic level, types of feed back inhibition,	2 1 2
IV	Lipid metabolism and regulation: synthesis and degradation of lipids, Fatty acid synthase complex, Beta oxidation	2 1 2
V	Types of photosynthetic bacteria and pigments, types of bacterial reaction centres, electron transport chain, carbon fixation, ATP synthesis in Halobacteria	2 2 2 2 2

Suggested Books:

Microbial Metabolism & Biotechnology: E-Book http://www.twinamasiko.com/IOBB/Publications/Biotechnology_eBook.pdf

Physiology and Biochemistry of Prokaryotes: David White

Bacterial Physiology and Metabolism: BH Kim and GM Gadd

Bacterial Metabolism: Gerhard Gottschalk

Bacterial Metabolism: HW Doelle

Microbial Energetics: EA Dawes

24/11/13

SEMESTER – II	VIROLOGY	COURSE: IM - 642
UNIT	**TOPICS**	**LECTURES**
I	Principles of virology: Theories of virus evolution, General morphology and classification of viruses, Structural organization and chemistry of helical, icosahedral and complex viruses, plaque assay, TCID50, Virus-host cell interaction	2 2 1
II	Cultivation and purification of viruses: In vivo, in vitro and in ovo systems for virus growth, estimation of yields, methods for purification of viruses, Isolation and determination of virus titer, entry into host cell, replication of nucleic acid, lytic and lysogenic cycles, biosynthesis of virion.	2 2 1
III	Virus in diseases: Transmission of viruses with and with our vectors, Viremia, Animal viruses; pathogenesis, disease development and laboratory diagnosis of viruses Hepatitis and influenza virus, Dengue virus, HIV, SARS, H1N1. Oncogenic viruses, DNA and RNA viruses.	1 2 2 1
IV	Diagnostic methods in virology: Immnuodiagnosis, haemagglutination and haemagglutination-inhibition tests, Complement fixation test, neutralization, Western blot, Ristocetin Induced Platelet Aggregation (RIPA), flowcytometry and Imunohistochemistry, Nucleic acid hybridization, PCR, microarray and nucleotide sequencing.	2 2 1
V	Mechanism of host cell damage by virus: Host cell 'shut off', apoptosis, necrosis, stress response, alteration of signalling pathways, cellular basis of transformation, types of cenotaphic effects, ultrastructural, cytopathology, Inhibition and inaction of bacterial, plant and animal viruses.	2 2 1

Suggested books:

Microbiology. Nester, Roberts and Nester. 2005.
Alcamo's Fundamentals of Microbiology. Pommerville, 2004.
Clinical Microbiology. Srivastava, 2004.
The Short Textbook of Medical Microbiology Including Parasitology. Jaypee. 2010.
Introduction to Modern Virology (IV Edition) - Dimmock NJ. Primrose SB (1994), Blackwell Scientific Publications, Oxford.
Virology-III Edition - Conrat HF, Kimball PC and Levy JA, Prentice Hall, Englewood, Cliff, New Jersey.

SEMESTER – II FERMENTATION TECHNOLOGY		COURSE IM- 652
UNIT	TOPICS	LECTURES
I	History and development of industrial microbiology.	1
	Purposes for large scale cultivation of microorganisms.	1
	Concept of microbial strain, Sources of strains – Culture collections, Research laboratories, Industries.	2
	Screening program: Primary and secondary screening programs	1
II	**Primary screening :** Isolation of strains from natural resources- Isolation of strain producing growth inhibitory and growth promontory biochemicals, resistant strains, enzyme producers, starch, chitin, protein, lipid and hydrocarbon degraders.	2 1
	Secondary screening: Determination of identity of the fermentation product - Chromatographic (GC, HPLC) and Spectroscopic (UV, IR, Mass and NMR methods.	2 1
	Preservation and maintenance of industrial strains.	1
III	**Improvement of industrial strains:** Regulatory mechanisms in microorganisms	1
	Mutation and methods adopted for selection of desired mutant.	2
	Types of fermentation systems: Submerged and Solid State fermentations.	2
	Production of Mycoparasite *Trichoderma* and enzyme Pectinase under Solid state fermentation conditions.	1
	Development of Inoculums: Master culture and working culture. Detection and assay of fermentation products.	2
IV	**Fermentation equipments**: Levels of fermentation – laboratory, pilot and production fermentors, Design of fermentors- characteristics, monitoring and control of pH, aeration, agitation, temperature and foam.	1 2 2
	Industrial sterilization processes: Microbial death curve, bioburden, specific death constant and decimal reduction time. Batch and continuous sterilization of medium, sterilization of air.	1 2
V	**Media for industrial fermentation:** carbon, nitrogen and micronutrient sources.	2 2
	Scaling up of fermentation processes: Constant parameters- Power input and Oxygen Transfer Rate.	1

Suggested books:

Pinciples of Fermentation Technology (2nd Edn.), Stansbyry P.F, Whitaker, A and Hall, S, Pergamon Press,Elsevier, Oxford

Fermentation and Enzyme Technology, Ed. Wang, D.I.C, Cooney, C.L. et al, John Wiley & Sons

Fermentation : a practical approach, Ed. Mc Neil, B. and Harvey L.M., Oxford University Press, Oxford

Fermentation Biotechnology, O.P Ward, Open University Press

Industrial Microbiology, G.Reed, McMillan Press London

Overproduction of Microbial Products, V. Krumphanzi, B.Sikyta, Z.Vanek, Academic Press

Microbial Technology (Volume 1 & 2), H.J Pepler, D. Perlman, Academic Press

Fermentation and Enzyme Technology, D.I.C Wang and C.L Coolney, John Wiley and sons, New York

Computer control of fermentation processes,Ed. Omstead, CRC Press, Boca Raton, FL

SEMESTER – II INDUSTRIAL PRODUCTION PROCESSES COURSE IM -623		
UNIT	TOPICS	LECTURES
I	**Immobilization of enzymes and microbial cells:** Methods of immobilization, Changes in kinetic pattern after immobilization, Whole cell immobilization, Industrial applications of immobilized enzymes and cells.	6
II	**Production of steroid hormone intermediates:** Precursors for steroid hormones, C-17-side chain cleavage of cholesterol, Biotransformation of cholesterol to male and female sex hormone intermediates, C-1(2)-dehydrogenation and 11- . α hydroxylation of steroidal substrates.	6
III	**Detailed study of the fermentative production processes of the following:** Antibiotics : Penicillins and Semisynthetic Penicillins Vitamins: : Riboflavin , Cobamide and Ascorbic acid.	6
IV	Organic acids: : Lactic acid Enzymes : Amylases and Pectinases Amino acids : Lysine and Glutamic acid	6
V	Industrial Solvent : Ethyl Alcohol Microbes as fermentation product:Microbial insecticides and Baker's yeast	6

Suggested books:

Biotechnology – Edt. by H.J.Rehm & G.Reed, Vol 4. VCH Publications, Federal Republic of Germany
Industrial Microbiology, G. Reed (Editor), CBS Publishers (AVI Publishing Company)
Biology of Industrial Microorganisms. A.L. Demain.
Textbook of Industrial Microbiology, - A. H. Patel.
Industrial Microbiology - L. E. Cassida
Industrial Microbiology - G. Reed.
Principles of Fermentation Technology. Standbary P.F.A. Whitaker and Hall. 1995.
Pergaman. McNeul and Harvey. 1990.

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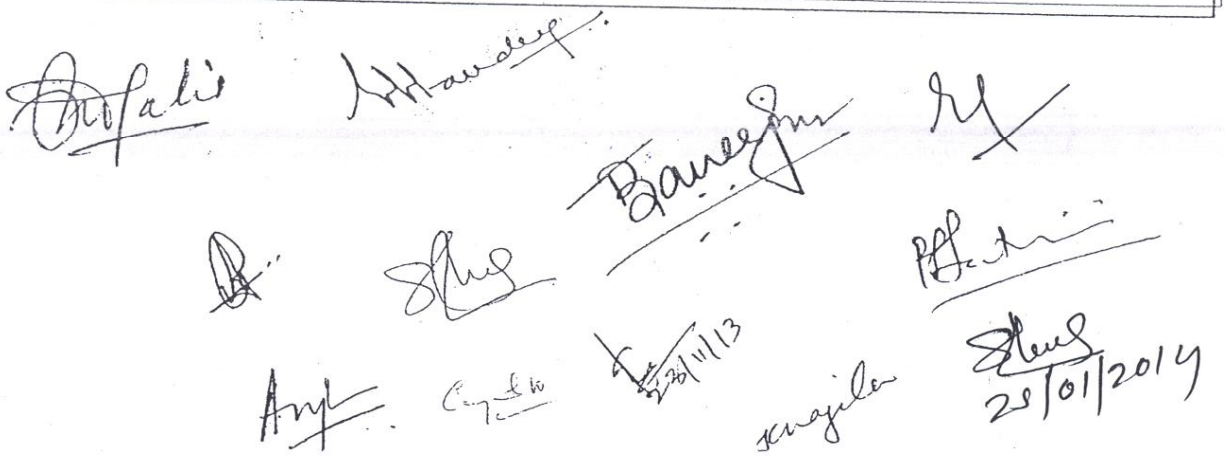
SEMESTER – II FOOD MICROBIOLOGY		COURSE IM -633
UNIT	TOPICS	LECTURES
I	**Food and Microbes** Food as a substrate for Microbial growth. Sources for food contamination. Biochemical changes in food by microorganisms. **Quality control of food products** Analytical methods and standards for raw, canned and fermented foods.	
II	**Food fermentations** Bread, malt beverages, Wine, vegetables, Milk tea, coffee, cocoa, vanilla,soysauce,tempeh and idli fermentations.	
III	**Microbes as source of food** SCP, Fat and Aminoacids. Mushroom production by solid state fermentation.	
IV	**Food Preservation Methods** Asepsis, High and Low temperature, Irradiation, Drying and food additives. Preservation of vegetables and fruits, Milk and Milk products and canned foods.	
V	**Food poisoning and food infections** Sources, symptoms and prevention of food borne bacterial and fungal diseases. **Seed microbiology and pathology** Introduction to seed borne pathogens, their morphology on the seed surface, methods for their rapid identification and control.	

Suggested books:

1. Food Microbiology. 2nd Edition By Adams
2. Basic Food Microbiology by Banwart George J.
3. Food Microbiology: Fundamentals and Frontiers by Dolle
4. Food Microbiology: Frazier, W.and Westhoff, D.
5. Fundamentals of Dairy Microbiology by Prajapati.
6. Essentials of Food Microbiology. Edited by John Garbult. Arnold International StudentsEdition.
7. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsiever Applied Science Publication.
8. Microbiology of Foods by John C. Ayres. J. Orwin Mundt. William E. Sandinee. W. H.Freeman and Co.
9. Dairy Microbiology by Robinson. Volume II and I.
10. Food Microbiology: Fundamentals and Frontiers. 2nd Edition by Michaell P. Doyle, Larry R. Beuchat and Thomas I. Montville (Eds.), ASM Publications.



SEMESTER – III	ENVIRONMENTAL & POLLUTION MICROBIOLOGY	COURSE IM- 603
UNIT	TOPICS	LECTURES
I	**Ecological principles:**	2
	Biosphere	1
	Energy transfer	2
	Ecosystem management and role of microbes.	2
	Microbial life in extreme environments. Types of microorganisms in air and techniques of their sampling.	2
II	**Biodegradation of organic compounds in soil and water:**	
	Degradation of xenobiotics and recalcitrant compounds.	2
	Lignin degradation.	1
	Carbohydrate degradation.	1
	Detergent degradation.	1
	Pesticide degradation.	2
	Aromatic compounds degradation.	2
	Fundamentals of Toxicology and Environmental carcinogens.	2
III	**Types of microbial population in soil**	2
	Mycorrhiza.	2
	Host fungus interaction and specificity.	3
	Role of microbes in N, P and S cycles. Symbiotic and non-symbiotic nitrogen fixation.	3
IV	**Bacteriological analysis of water and waste water**	
	Standard plate count.	1
	Isolation of microbes from polluted water.	2
	Water borne diseases in man.	2
	Algal blooms and eutrophication. Waste water treatment.	3

Suggested books:

Environmental Microbiology By Raina M. Maier, Jan L. Pepper and Charles P. Gerba (1999) Academic Press.

Environmental Science ; A Global Concern By William Cunningham and Saigo, B.W. (1995) Wm C. Brown Publishers USA.

Microbial ecology. - Alexander, M. (1971) John Wiley and sons, Inc., New York.

Introduction to soil microbiology. - Alexander. M. (1977), John, Wiley and Sons. Inc., NY

Bioremediation - Baker, KH. and Herson, D.S. 1994. Mc Craw Hill Inc. New York.

Advances in microbial ecology Vol-8, - K.C. Marshall, (1985) Plenum Press.

Experimental Microbial Ecology - Burns R.G. and Slater J.H. (1982) Blackwell Scientific Publications, Oxford, London.

Essays in agricultural and food microbiology - Norms, J.R. and Pettipher, G.L. (1987) John Wiley and Sons Singapore.

Soil Biology - Burges, A and Raw, F. 1967 Academic Press, London.

Introduction to soil Microbiology. - Martin Alexander, Wiley International edition, New York.

Introduction to environmental microbiology. - Michel R. 1999. ASM book.

Bioremediation - Baker, KH. and Herson, D.S. 1994. Mc Craw Hill Inc. New York.

SEMESTER-III	CLINICAL IUMMUNOLOGY	COURSE: IM- 613
UNIT	TOPICS	LECTURES
I	**Cytokines** Properties of cytokines, four families of cytokines, cytokine receptors. cytokine antagonist, cytokine related disease, cytokine based therapies. **Immunity to infection** Vaccines, classical and modern methods of vaccine production. Immunity to bacterial (TB/leprosy) , viral (HIV) and parasitic (malaria) infections. Escape mechanism. Congenital and acquired immunodeficiency.	1 1 2 2 2
II	**Hypersensitivity** Type I anaphylactic, Type II antibody dependent cytotoxic hypersensitivity Type III Immune complex mediated hypersensitivity, Type IV cell mediated delayed type hypersensitivity.	1 1 1 1
III	**Autoimmune Disorder** T cell differentiation in thymus, thymic selection and tolerance to self, mechanism of tolerance induction. Organ specific and systemic autoimmune diseases. Mechanism of autoimmunity. Treatment of autoimmune diosorders.	2 1 2 1
IV	**Transplantation** Mechanism of graft rejection, prevention of graft rejection, immunosuppresive drugs , GVH reaction.	1 2
V	**Tumor Immunology** Tumor antigens, Tumor evasion of the immune system Cancer immunotherapy.	2 1

Books:

Essentials of Clinical Immunology: Helen Chapel, Manesel Havey, Siraj Mishab, Neil Snowden

Immunobiology : Janeway and Travis

Immune System : Peter Parham

SEMESTER – III	MEDICAL MICROBIOLOGY	IM- 643
UNIT	**TOPICS**	**LECTURES**
I	Overview of Medical microbiology: Infectious diseases, Medically important microbes, Microbial diseases, sources, route of transmission	2
	Pathogenesis- adhesion, invasion, host cell damage, release of pathogens, Treatment, Prevention and control of microbial infections,	2
	infection and its types, opportunistic infection, Immunity to microbial diseases.	1
II	Microbial diseases: Bacterial: *Staphylococcus, Streptococcus, Haemophilus, Shigella, Salmonella, Clostridium and Micobacterium.*	2
	Mycotic: *Trichophytons and Epidermophytons* Parasitic: *Entamoeba histolytica, Trapanosoma, Plasmodium and Balantidium.*	2 2
III	Microbial Toxins: Microbial virulence and virulence factors- Signs and symptoms of microbial diseases, Toxins and poisons, Types of microbial toxins, Endotoxins, Exotoxins, LC_{50} of toxins, Effective dose of toxins, Assay of toxins, Mechanism of action of Diphtheria, cholera, Staphylococcal toxin and Clostridial neurotoxins.	2 2 2
IV	Diagnostic methods: Collection, transport and preliminary processing of clinical pathogens,	2
	Clinical; microbiological; immunological and molecular diagnosis of microbial diseases,	2
	Modern methods of microbial diagnosis.	1
V	Principle of Chemotherapy: Chemotherapeutic agents, Mechanism of action of antimicrobial agents,	2
	Synthetic compounds and antibiotics,	2
	Drug resistance, Mechanisms of drug resistance, MDR.	2

Suggested books:

Medical Microbiology. Greenwood, Slack and Peutherer, 2003.
Microbiology. Nester, Roberts and Nester. 2005.
Alcamo's Fundamentals of Microbiology. Pommerville, 2004.
Clinical Microbiology. Srivastava, 2004.
The Short Textbook of Medical Microbiology Including Parasitology. Jaypee. 2010.
Text of Microbiology, R. Ananthanarayanan and C.K. Jayaram Panicker, Orient Longman, 1997.
Medical Microbiology, Mackie and McCartney, Vol. 1 : Microbial Infection, Vol. 2 : Practical Medical Microbiology, Churchill Livingstone, 1996.
Microbiology in Clinical Practice, D.C. Shanson, Wright PSG, 1982.
Bailey and Scott's, Diagnostic Microbiology, Baron EJ, Peterson LR and Finegold SM, Mosby, 1990.

SEMESTER-III BIOPROCESS TECHNOLOGY & DOWNSTREAM PROCESSING		IM 653
UNIT	TOPICS	LECTURES
I	**Overview of bioprocess technology**	1
	Basic mass transfer concepts Determination of oxygen transfer rate	2
	Mass transfer across free surfaces Factors affecting volumetric mass transfer	1
	coefficient (K*l*a)	2
	Basic concepts of heat transfer.	1
II	**Removal of insolubles :**	
	Filtration - General theory for filtration	1
	Conventional filtration equipment Continuous rotary filters Microfiltration.	1
	Centrifugation - Settling of solids Tubular bowl centrifuges	1
	Disc type centrifuges.	2
	Cell disruption - Chemical and mechanical methods of cell disruption.	2
III	**Product isolation**	1
	Extraction	1
	Batch extraction	1
	Staged extraction	1
	Differential extraction	1
	Fractional extractions.	
	Adsorption	1
	Batch adsorption	1
	Continuous stirred tank adsorption	1
	Fixed bed adsorption	1
IV	**Product purification**	
	Elution chromatography	1
	Adsorbents	1
	Yield and purity	1
	Scaling up chromatography.	1
	Precipitation	1
	Precipitation with non-solvent	1
	Salt precipitation	1
	Temperature precipitation	1
V	**Polishing**	
	Crystallization - Basic concepts of crystallization	1
	Nucleation	2
	Crystal growth	2
	Crystal size distribution Recrystallization.	1
	Drying - Basic concepts of drying Conduction	1
	Adiabatic	1
	Spray drying methods.	2

Suggested books:

Biochemical Engineering Fundamentals, J.E Bailey & Ollis, DF. Mc.Graw Hill, India
Bioprocess monitoring and control, Pons. M.N., CarlHanser Verlag, Munich
Process Engineering in Biotechnology, A.T Jackson Open University Press
Bioprocess Engineering. – Michael Shiler and Kargi.