M.Sc Applied Medical Biotechnology and Clinical Research

PROGRAM EDUCATIONAL OBJECTIVES(PEO)

1. To provide the detailed knowledge of key concepts are applied in areas of specific relevance to medical and pharmaceutical applications.
2. To explore and critically evaluate the technologies driving discovery and modification of natural compounds for use in medicine.
3. To develop the practical laboratory skills with various opportunities for hands-on experience in a range of current techniques and practices such as mammalian cell culture and fermentation.
4. To provide core science to the translation of a novel concept into a real world commercial venture with biomedical application and looks at how this impacts society.

PROGRAM OUTCOME (PO)

PO-1 Life Sciences knowledge: Successful candidates will acquire current/recent specific knowledge in the respective discipline with proficiency in practical skills and leadership skills for a successful career.

PO-2 Problem analysis: Successful candidates will be able to analyse, design standards, resolve and troubleshoot problems in implementation or standardization of Life sciences protocols.

PO-3 Design/development of solutions: Successful candidates will develop creative and cognitive thinking and cooperate with each other to solve problems in the field of Life sciences.

PO-4 Conduct investigations of complex problems: Successful candidates will acquire capabilities to plan and design protocols and utilize practical skills to validate hypothesis by executing experimental techniques independently coupled with the ability to assimilate, analyse, interpret and accurately evaluate subsequent data.

PO-5 Modern tool usage: Successful candidates will effectively be able to manage resources and time using ICT and other computer enabled devices.

PO-6 Ethics: Successful candidates will be aware of their role and responsibility in handling and use of microbes including genetically modified microorganisms.

PO-7 Communication: Successful candidates will have the ability to understand and communicate all ideas and concepts effectively.

PO-8 Environment sustainability: Successful candidates will get adequate knowledge to use information and implement solutions for environmental protection, safeguards and remediation.

PO-9 Lifelong learning: Successful candidates will carry on to learn, adapt and disseminate knowledge in a world of constantly evolving technology.

PROGRAMME SPECIFIC OUTCOME (PSO)

1. Biological reagents such as engineered monoclonal antibodies have substantially improved laboratory diagnostics. Improved diagnosis using molecular techniques to amplify DNA, RNA and identification of chromosomal changes at molecular level with FISH and SKY technique.
2. Improvement in vaccine technology and improved therapeutics such as a) humanized monoclonal antibodies, genetic ally engineered cytokines like interferons, hormones and growth factors, b) Newer drugs along with newer methods of assessment of drug efficacy and genetic manipulations to bypass multidrug resistance have gone a long way in reducing deaths due to communicable as well as non - communicable diseases.

M.Sc. – APPLIED MEDICAL BIOTECHNOLOGY AND CLINICAL RESEARCH
CURRICULUM

Total number of Credits : 85

Category	Code	Title of the Course	Hours Per week			Credits
			Lecture	Tutorial	Practical	
SEMESTER I						
Core	18MMB001	Applied Medical Biochemistry and Cell Biology	5	0	0	4
Core	18MMB002	Clinical Microbiology and Medical Record science	5	0	0	4
Core	18MMB003	Practical I- Lab in Biochemistry	0	0	5	2
Core	18MMB004	Practical II- Lab in Cell Biology	0	0	5	2
DSE	----------	Discipline Specific Elective I	4	0	0	4
DSE	----------	Discipline Specific Elective II	4	0	0	4
GE	----------	Generic Elective I	2	0	0	2
		Total	20	0	10	22
SEMESTER II						
Core	18MMB005	Statistics for Clinical Research and Research Methodology	5	0	0	4
Core	18MMB006	Genetic Engineering and Computational Biology	5	0	0	4
Core	18MMB007	Practical III-Lab in Genetic Engineering	0	0	5	2
Core	18MMB008	Practical IV- Lab in Clinical Microbiology	0	0	5	2
Core	18MMB009	Internship	0	0	0	2
DSE	----------	Discipline Specific Elective III	4	0	0	4
DSE	----------	Discipline Specific Elective IV	4	0	0	4
GE	----------	Generic Elective II	2	0	0	2
		Total	20	0	10	24

M.Sc. APPLIED MEDICAL BIOTECHNOLOGY AND CLINICAL RESEARCH
CURRICULUM

Category	Code	Title of the Course	Hours Per week			Credits
			Lecture	Tutorial	Practical	
SEMESTER III						
Core	18MMB010	Advanced Clinical and Molecular Diagnostic- Techniques	5	0	0	4
Core	18MMB011	Medical Immunology and Clinical Research	5	0	0	4
Core	18MMB012	Practical V - Lab in Advanced Clinical and Molecular Diagnostic- Techniques	0	0	5	2
Core	18MMB013	Practical VI - Lab in Medical immunology	0	0	5	2
DSE	----------	Discipline Specific Elective V	4	0	0	4
DSE	----------	Discipline Specific Elective VI	4	0	0	4
GE	----------	Generic Elective III	2	0	0	2
		Total	20	0	10	22
SEMESTER IV						
Core	18MMB014	Project /Dissertation and Viva-voce	0	0	0	17
		Total	0	0	0	17

List of Discipline Specific Elective Courses
(Any two paper / Semester from Semester 1-3)

18MMB101	Human Physiology
18MMB102	Human Genetics and Developmental Biology
18MMB103	Advanced Medical Biophysics and Biomedical instrumentation
18MMB104	Nano and Pharmaceutical Biotechnology
18MMB105	Tissue Engineering and Stem Cell Biology
18MMB106	Biomedical waste Management
18MMB107	Medical Coding & Pharmacovigilance and Safety Monitoring
18MMB108	Regulatory affairs, GLP, IPR, Entrepreneurship and Bioethics in Clinical Research
18MMB109	Project Management and Business Development
18MMB110	Clinical Operations & Clinical Data Management
18MMB111	Tools and Model Organisms in Biomedical Research

List of Generic Elective Courses
(Any one paper/ Semester from Semester 1-3)

18MMB151	Medical Transcription and Coding
18MMB152	Hospital Waste Management
18MMB153	Biotechnology and Human Welfare
18MMB154	Environmental Biotechnology
18MMB155	Entrepreneurship Development

18MMB001 Applied Medical Biochemistry and Cell Biology 5 0 0 4

Course Objective: -

- The course has been designed to expose the student to Medical biochemistry and to the structure and function of cell and its organelles.
- Cell - cell interaction, Signal transduction and Programmed cell death are some of the mechanism which will make a student to have better understanding of the cell.

Course Outcome:

CO – 1: To understand the basics of important bimolecular classification, structure and function

CO – 2: Also learn about the biological significance of different biomolecules.

CO – 3: Student learns about the disorders of carbohydrate metabolism (Eg: Diabetes mellitus – types, causes, diagnosis and treatment)

CO – 4: Disorders of aminoacid and lipid metabolism will also be learned by the students

CO – 5: Basic of enzymes, types and their catabolic activity will be known at the end of study

CO – 6: To know about the different hormones and their biological role and disorders in their deficiency

CO – 7: Students learn about the cell structure, organization and function.

CO-8: Student know about the importance of biomembrane, its importance in cell growth and cycle

CO – 9: Also to learn the structure and functions of cell organelles (eg: Mitochondria)

CO – 10: Student learnt about the Cell cycle and its regulation, Cell-Cell Interaction and detailed study about cell receptors.

UNIT I BIOMOLECULES 10

Classification of carbohydrates with examples. Structure and biological importance of sugar derivatives – glycosaminoglycans, glucoproteins, proteoglycans and lipopolysaccharides. Classification of amino acids and proteins. Structural organizations of proteins. Classification of lipids. Biological significance of phospholipids, spingomyelin, eicosanoids, glycosphingolipids and lipoproteins.

UNIT II METABOLIC DISORDERS 14

Disorders of carbohydrate metabolism: Outline of glycolysis, glycogenesis, glycogenolysis, conversion of glucose to fructose and galactose. Diabetes mellitus – types, causes, diagnosis and treatment, Fructosuria, hereditary fructose intolerance, Galactosemia and Glycogen storage diseases. Disorders of aminoacid metabolism: Outline of amino acid transamination, deamination and decarboxylation. Aminoacidurias – PKU, tyrosinemia, cystinuria , homocystinuria and maple syrup urine disease. Disorders of lipid metabolism: Outline of transport of fatty acids and beta oxidation. Carnitine transporter deficiency and deficiency of acyl co-A dehydrogenases. Gaucher’s disease, Tay-Sach’s disease, Niemann-Pick’s disease, Fabry’s disease, Wolman’s disease. lipoproteinemias and Atherosclerosis.

UNIT III ENZYMES AND HORMONES 12

Diagnostic enzymology: Enzymes and isoenzymes. Significance of SGOT, SGPT, LDH, Creatine kinase, gamma glutamyl transferase, lipase, amylase, acid and alkaline phosphatase, glucose -6-phosphate dehydrogenase, pyruvate kinase. Hormones: Pituitary gland hormones, Neurohypophyseal hormones, Thyroid gland hormones, Adrenal gland hormones – glucocorticoids and mineral corticoids, parathyroid hormones – parathormone and calcitonin, pancreatic hormones – Insulin and glucagon. Biological role and disorders.

UNIT IV STRUCTURAL ORGANIZAATION OF CELL 12

Cell: Structure and Organisation, Plasma Membrane, Structure of Plasma Membrane with special emphasis on various models, Functions of Plasma Membrane, Transport across membrane, Mechanisms of Endocytosis and Exocytosis, Cytoskeleton, Microfilaments: Structural organization, cell motility and cell shape,Microtubule: Structural and Functional organization, Intermediate filaments. Structure and Functions of Cell Organelles: Mitochondria, Ribosome, Golgi complex, Endoplasmic Reticulum, Peroxisomes and Lysosomes, Nucleus.

UNIT V CELL CYCLE AND CELL SIGNALLING 12

Cell cycle and its regulation, Cell-Cell Interaction, Cell adhesion molecules, Cellular Junctions, Extracellular matrix, Signal transduction, Intracellular receptor and cell surface receptors, Signalling via G-protein linked receptors (PKA, PKC, CaM kinase),Enzyme linked receptor signaling, Programmed cell death (Apoptosis).

Total: 60 hrs

TEXT BOOKS:

1. Bhagavan, N V, Ha. Chung-Eun. Essentials of medical biochemistry: with clinical cases, 2nd ed. Amsterdam; Boston: Elsevier Academic Press, 2015.
2. Alberts.B. D. Bray, K. Hoplein, A. Johnson, J. Lewis, M. Raff, K. Robert and P. Walter. Essential of cell Biology, 2nd edition, 2003.
3. Trevor Palmer, “Enzymes: Biochemistry, Biotechnology and Clinical Chemistry”, Harwood Publisher, 2001.
4. Verma, P.S. and Agarwal, V.K. “Cell Biology”. S. Chand Publication. 2008.
5. Arumugam N, R P Meyyan , “Cell Biology and Molicular Biology”, Saras publication, 2014.

REFERENCE BOOKS:

1. Lehninger. A.L., D.L. Nelson and M.M. Cox, "Principles of Biochemistry". Worth Publishers, New York. 1993.
2. Lodish, H. Berk, A., Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaria, P. "Molecular Cell Biology". Media connected, 6th edition. W. H. Freeman and company. 2008.
3. Mitchll Fry.Essential biochemistry for medicine, Mitchll Fry, John Wiley & sons Inc. 2010.
4. Allan haw, Michael J. Murphy, Robert A. Cowan, Denis St. J. O. Reilly, Michael J. Stewart and James shepherd. Clinical biochemistry, 4th edition, Churchill Livingstone, 2008.
5. Thomas D. Pollard, William C. Earnshaw and Jennifer Schwatny Saunders. Cell Biology, 2nd edition, 2007.
6. Geoffrey M. Cooper and Robert E. Hausman. The Cell: A Molecular Approach,

Fifth Edition. ASM Press and Sinauer Associates, Inc.2009.

7. Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 6thEdition

John Wiley and Sons. 2009.

18MMB002 Clinical Microbiology and Medical Record Science 5 0 0 4

Course Objective:

- This course aims to provide a comprehensive theoretical knowledge of clinical microbiology including the spread of disease and treatment of major diseases.
- To provide basic understanding of the medical record policies and functions.

Course Outcome:

CO – 1: Students knows different types of microbial pathogens.
CO – 2: Students understand the nature of infection, prevention and control of infections.
CO – 3: Students understand the different bacteria which induces disease and its causative effects.
CO – 4: Students will learn about the different form of infection caused by fungi.
CO-5: The knowledge on life history of viruses, types of disease and different type of parasitic virus will be introduced.
CO – 6: The microbial parasites and helminthes in inducing disease will be studied by students.
CO – 7: The importance of maintenance of medical records in human diseases will be learnt.
CO-8: The maintenance of medical records in different formats will be learnt by students.
CO-9: The importance of medical records in emergency, and administrative management of medical records will be learnt.
CO – 10: Ethics in maintenance of records, legal requirements and administration of records of medical importance will be learnt.

UNITI MEDICAL MICROBIOLOGY 12

Microbial pathogens(microorganisms)-bacteria, fungi, protozoa and viruses, reproducibility (growth) conditions, movement patterns; infection control-sources of infection, infection spread, routes of infection, nosocomial infection and cross infection. The prevention and control of infection.

UNIT II SYSTEMIC BACTERIOLOGY 12

Staphylococcus, Streptococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Enteronacteriaceae; Vibrios, Pseudomonas, Pasteurella, Haemophilus, Bordetella and Brucella. Mycobacteria, spirochaetes, Actinomyces, Mycoplasma, Ureaplasma, Rickettsiae, Chlamydiaen and Miscellaneous bacteria.

UNIT III MYCOLOGY, VIROLOGY AND PARASITOLOGY 12

Morphology, disease caused lab diagnosis and prevention of superficial mycoses, subcutaneous and systemic mycoses dermatophytes and opportunistic fungi. The pathogenicity ,diagnosis and prevention of viruses- Pox virus, Herpes virus, Adenoviruses, Picornaviruses, Orthomyxoviruses,Paramyxoviruses,Arboviruses,Rhabdoviruses,Oncogenic viruses, SARS and Rotaviruses. Morphology lifecycle and laboratory diagnosis of parasites-Entamoeba, Balantidium, Giardia, Taxoplasma and Leishmania. Helminthology-Cestodes, Trematodes and Nematotes.

UNIT IV MEDICAL RECORD SCIENCE 12

Introduction, Definition and History of development of medical records. Characteristics, responsibilities and values of good medical record forms and their content. Analysis of medical records. Ambulatory care records, clinical records and mental health records. Filling methods, storage and retention – numbering & filing systems-filing, storage-Microfilming and Disk storage, Registers and indexes.

UNIT V MEDICAL RECORD POLICIES AND ETHICS 12

Medical record policies, functions, space and layout and equipments. Medical records flow and processing. Duties and responsibilities of medical record administration management of medical records. Developing inter and intra departmental relationship with various departments of hospital. Medical ethics, legal implications of medical records. Rights and responsibilities of patients. Legal requirements in retention of medical records.

Total: 60 hrs

TEXT BOOKS:

1. Introduction to Medical Microbiology. Ananthanaryanan, Orient & Frongman, 2009.
2. Ananthnarayana, R. and C.E, Jayaram Panakar, 2005, Text book of Microbiology, 5th edition, Orient Longman.2005.
3. Edna K. Huffman, Rita Finnegan, Margaret K. Amatayakul, Medical Record Management, Physicians' Record Company, 1990.
4. Arumugam N. A.Mani, L.M.Narayanan, Dulsy Fatima,A.M.Selvaraj, "Immunology & Microbiology", Saras Publication,2015.
5. Mogli. GD. Medical Records Organisation and Management.Japee Publications, 2006.

REFERENCE BOOKS:

1. Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller. Medical Microbiology, 6th ed. Philadelphia: Elsevier/Mosby, 2009.
2. Churchill Livingston.Medical Microbiology. Elsevier.2002.
3. Mandell Gerald and Churchill Livingston. Atlas of infectious disease (Vol.10). Current Medicine.1998.
4. Roitt, P.I: Mims, C.J., Medical Microbiology.2013.
5. Thompson Haydan, Anatomy for the Medical Record Librarians Physician's Record Co.1956.
6. Dey, N.C and Dey, TK., Medical Bacteriology, Allied Agency, Calcutta, 17th
7. Edition. 1988
8. B.M.Sakharkar, Principles of Hospital Administration & Planning, Jaypee publishers,.2008.
9. C.M.Francis .Hospital Administration, Jaypee Publications, 2004
10. Sherris, John C, Ed, Medical Microbiology: an Introduction to infectious diseases. Elsevier Publication IInd edition.
11. Ingraham J.L. and C.A. Ingraham, "Essential of diagnostic Microbiology", 2nd edition by Brooks/cole, Thomson Learning, USA-2000.

18MMB003 Practical I- Lab in Biochemistry 0 0 5 2

Course Objective:

- The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized practical knowledge.

Course Outcome:

CO-1: To learn, the function, maintenance and application of balance.
CO-2: To learn, the function, handling, maintenance and application of micropipette.
CO-3: To know the preparation of buffer, solution with expected concentration, normality and standardization in preparation of laboratory reagents and solutions will be learnt.
CO-4: To know to use calorimetry in preparation of standard chemicals (eg. pH solutions).
CO-5:To know the operation and application of spectroscopy in evaluation of biomolecules.
CO-6: The students will learn about the estimation of protein through Lowry and Biuret methods.
CO-7: The assays of different enzymes and influence of time, temperature and pH will be learnt.
CO-8: The reaction kinetics of biomolecules will be learnt.
CO-9:Knowledge on protein purification will be gained.
CO-10: Application of TLC in separation of biomolecules will be learnt by the students.

List of Experiments Each Experiment : 5hrs

1. Introduction to measurements: balances and pipetting.
2. Preparation of solutions of given normality and its standardization.
3. Calorimetrically and to prepare buffer solutions in the pH range 1.0 to 14.0.
4. To find out the absorption spectrum of a given chromophere and/or oxidized and reduced forms (sodium nitrite and borohydrate). a. Hemoglobin and methemoglobin
5. Spectrophotometer absorption spectrum, activity of the fraction or 260/280 ratio.
6. Estimation of protein: Lowry, Biuret methods
7. Bradford methods, standard curves, linear regression and assessment of ranges and reliability.
8. Enzyme assays (LDH, β-galactosidase, acid phosphatase, arginase, succinic dehydrogenase) time, temperature, pH:
9. K_m and V_{max} and kinetic plots.
10. Protein purification: Ammonium Sulphate, acetone, TCA precipitation.
11. Thin Layer Chromatography: lipids,
12. Thin Layer Chromatography: amino acids.

Total: 60 hrs

TEXT BOOKS:

1. K S Dayananda, Protein Purification: Theory and Techniques, Viva Books, 2007.
2. M. Prakash, C.K. Arora, “Biochemical techniques”, Anmol Publications (I) Ltd New Delhi. 1998
3. Raymond P.W. Techniques and Practice of Chromatography (Chromatographic Science Series), CRC Press; 1st edition by Scott, 1995.

4. Jayaraman J, “Laboratory Manual in Biochemistry” (5th reprint) New Age International Publishers Mumbai, 1996.

REFERENCE BOOKS:

1. David T. Plummer, An Introduction to Practical Biochemistry”, 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Bruce A. White, Methods in Molecular Biology, Chapman and Hall, 1997.

18MMB004 Practical II - Lab in Cell Biology 0 0 5 2

Course Objective:

- To focus hands on experience in the techniques of microscopy for determine the structure of cell and cell counting and histology, embryogenesis and pathological studies.

LIST OF EXPERIMENTS:

1. Microscopy: a) Simple microscope. Compound microscope.
2. Fluorescence microscope.
3. Micrometry: calibration of stage and ocular micrometer and measurement of the given biological sample.
4. Haemocytometer counting of Red Blood Cells.
5. RBC-Osmotic fragility
6. Haemocytometer counting of White Blood Cells.
7. WBC: Differential counting.
8. Embryo development: Permanent mounts and experimental
9. Chick: Developmental stage and gastrulaiton (Permanent slides or fresh preparation).
10. Cytology and histology of major organs
11. Endocrine glands (permanent slides and fresh preparation).
12. Sectioning of tissues for Histopathology analysis using micro meter.

Total : 60 hrs

TEXT BOOKS:

1. Gunasekar, . P. 1995. “Laboratory Manual in Microbiology”. New Age International Private Ltd. Publishers, New Delhi, Chennai.
.
2. Poonam Bachheti and Aruna Singh. Histopathology, Vayu Education of India, 2012.

REFERENCE BOOKS:

1. Ian Freshney R. “Culture of Animal Cells: A Manual of Basic Technique”, Wiley-Liss, 2005.
2. Robert Weaver, “Molecular Biology”, 5th edition, McGraw-Hill, 2011.
3. David Specter and Goldman. Basic Methods in Microscopy: Protocols and Concepts from "Cells: a Laboratory Manual, Cold Spring Harbor Laboratory Press, U.S. 1st edition, 2005.

18MMB005 Statistics for Clinical Research and Research Methodology 5 0 0 4

Course Objective:

- To provide statistical knowledge about collection, analysis and interpretation of clinical data.

Course Outcome:

CO-1:Student learn about the types of data and collection of data
CO-2:Students will learn to apply basic statistics like mean, mode and median. Measuring central tendency, Kurtosis will also be learnt.
CO-3:Students will learn about percentiles, variability, standard deviation and application of the same in the sample data
CO-4:Sample distribution and its type will be learnt
CO-5:Students learn about data sampling procedure and interval estimation
CO-6:Properties of t-distribution, types and its application will be learnt.
CO-7:Generating hypothesis, decision making and writing conclusion will be learnt.
CO-8:Probability and p-value calculations and its significance will be learnt.
CO-9:Analysis of variance, one way ANOVA and two way ANOVA will be learnt.
CO-10:Test of independence, regression and co-relations will be learnt.

UNIT I INTRODUCTION TO BIOSTATISTICS 12

Introduction to biostatistics. Types of data and data collection. Measures of central tendency- sample mean mode and median.

UNIT II MEASURES OF DISPERSION 12

Percentiles and measures of variability sample variance, Standard deviation properties and parameters of normal and poison distribution. Sample distribution and central limit theory.

UNIT III SAMPLING 12

Introduction to sampling tech and interval estimation. 95% confidence interval. Introduction- properties of the t- distribution, uses of t- distribution. Two sample test and paired t-test.

UNIT IVINTRODUCTION TO HYPOTHESIS 12

Introduction to Hypothesis- testing-steps in hypothesis testing, decisions and conclusions. Probability, P- value, interpreting the p- value. Test for normality and equality of variance. Types of error- sample size calculations.

UNIT V INTRODUCTION TO ANALYSIS OF VARIANCE 12

Introduction to analysis of variance. ANOVA one way and two ways ANOVA. Randomized complete block design. Chi- square test. Test of independence linear regression-single and multiple linear regression and correlations.

Total : 60 hrs

TEXT BOOKS:

1. Ramakrishnan .N .Biostatistics, Ist Edition, Saras Publications, 2009.
2. Mariappan, P. Biostatistics: An Introduction [Kindle Edition], Pearson; 1 edition, 2013.
3. Vashisth, A.K,Textbooks Of Biostatistics, Neha Publishers & Distributors, 2008.

REFERENCE BOOKS:

1. S.C.Gupta and V.K.Kapoor, Fundamentals of mathematical statistics, 2010.
2. Helio S. Migon, Dani Gamerman, and Francisco Louzada, Statistical Inference: An Integrated Approach, Second Edition, Chapman and Hall/CRC, 2014.

18MM006 Genetic Engineering and Computational Biology 5 0 0 4

Course Objective:

- To develop the fundamental theoretical knowledge in the area of genetic engineering, genomics and proteomics with modern concepts and techniques.

Course Outcome:

CO-1:Students will gain knowledge about the basics of gene structure, genome organization, and construction of genetic maps

CO-2:They will learn about the genomic databases, to view genome map and mendelian inheritance.

CO-3:Students will have a theoretical and practical knowledge of web based server and application of software tools for genome analysis.

CO-4:The knowledge on genome browsers like, MUMMER, Blast Z, LAGON, AVID, VISTA, Pipe maker will be gained.

CO-5:The knowledge related to protein identification and characterization using software will be gained by the students

CO-6:The knowledge on Protparam, Find Mod, Peptide Cutter, Profound, Peptide mass and OMSSA and their application in proteomics will be gained.

CO-7:Gain knowledge on basics of gene, gene cloning, construction of genomic libraries.

CO-8:How to identify the right clone and various modern techniques used in rDNA technology.

CO-9:Provide theoretical background for the practical course.

CO-10:Make the students to apply the basics of gene cloning in various fields such as medicine and agriculture.

CO-10:Gain knowledge on theoretical aspects of expression vectors and protein production using cloned gene, their advantages and disadvantages

UNIT I GENOMICS 12

Definition of genome and genome sequencing, Genome map, Types of Genome maps and their uses. GDB- Genome databases, NCBI- Entrez Human genome map viewer, OMM- Online Mendelian Inheritance in Man.

UNITIIGENOMICSSOFTWARE'S 12

Web based server and software for genome analysis; Ensemble, Large genome alignments, whole genome browser, MUMMER, Blast Z, LAGON, AVID, VISTA, Pipe maker.

UNIT III PROTEOMICS 12

Proteomics: what are proteome, Protein identification and characterization tools; AA components, Protparam, Find Mod, Peptide Cutter, Profound, Peptide mass and OMSSA.

UNIT IV RECOMBINANT DNA TECHNOLOGIES 12

Gene cloning-Cloning strategies, construction of genomic libraries and cDNA libraries. Recombinant selection and screening. RFLP, DNA fingerprinting, DNA sequencing, Polymerase chain reaction, Ligase chain reaction, Site directed mutagenesis.

UNIT V APPLICATION OF RECOMBINANT DNA TECHNOLOGY 12

Application of genetic engineering in medicine and agriculture. Expression vectors, Production of protein from cloned genes.

Total : 60 hrs

TEXT BOOKS:

1. P.S. Verma and V.K. Agarwal, 2010 Genetic Engineering, S Chand & Co Ltd; 1 edition.
2. S.Ignacimuthu, S.J. 2013. Basic Bioinformatics.2nd edition. Narosa publishing House Private Limited.India.
3. Joao Meidanis, Carlos Setubal,Computational Molecular Biology, Cengage Learning 2007.
4. Lesk, Introduction to Bioinformatics, OUP. Bios Scientific Publishers Ltd. 2001.
5. Cynthia Gibas and Per Jambeck, Developing Bioinformatics Computer Skills, SPD. 2001
6. Atwood, Introduction to Bioinformatics, Pearson Education. 1999.
7. Tisdall, Beginning Perl for Bioinformatics, SPD. 1999.
8. Rastogi, S.C. N.Mendriratta and P.Rastogi.2008. Bioinformatics Methods and Applications. Genomics, Proteomics and drug discovery. 3rd edition. PHI Learning Private limited, New Delhi, India.

REFERENCE BOOKS:

1. Baxevanis A.D.The Molecular Biology Database Collection; updated compilation of biological database resources, 2001.
2. Bernhard Haubold , Thomas Wiehe, Introduction to Computational Biology: An Evolutional Approach, Springer, 2008.
3. David W.Mount. Bioinformatics Sequence and Genome analysis. Cold Spring Harbor laboratory Press. 2001.
4. S.R.Pennigton and M.J.Dunn.2002. Proteomics.. Viva books Private limited new Old.
5. Baxevanis, A.D., Quellette, B.F.F., Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley and Sons. 2004.
6. B.G.Curran, R.J.Walker and S.C.Bhatia.Bioinfromatics. 1st edition. CBS Publishers and Distributors Private Limited, New Delhi, India. 2010
7. Old.R.W and Primrose S.B. Principles of Gene manipulation: An introduction to genetic engineering, Blackwell Sciences, U.K. 1998.
8. Brown.T.A. Gene cloning and DNA analysis, 4th edition, Blackwell science, Japan. 2001.
9. Watson.J. Molecular biology of the gene, 5th edition Pearson education, Singapore. 2004.

18MMB007 Practical III -Lab in Genetic Engineering 0 0 5 2

Course Objective:

- This course begins by introducing students to the concept of genetic engineering it then examines the molecular cloning methods, the various cloning vectors and their hosts, and how to find the right vector for molecular cloning.
- CO-1:Aspects of DNA amplification and analysis techniques, cloning and expression of selected genes in bacteria and practical applications of genetic engineering

Course Outcome:

CO-1:Students have Hands on experience in isolation plasmid DNA
CO-2:Students have Hands on experience in isolation of RNA and other genetic material.
CO-3:To gain practical knowledge of blotting techniques and cloning experiments in *E.coli*.
CO-4:Preparation of vector, gene of interest and marker gene will be learnt.
CO-5:Students know to ligate the DNA.
CO-6:Students learn about the application of Polymerase chain reaction (PCR).
CO-7:Students learn about Electrophoreis in Isolation and characterization of genetic materials.
CO-8:Students learn to separate polypeptides using electrophoresis technique.
CO-9:Students will study the structure or make up of gene using RFLP
CO-10:Knowledge on SDS Page in separation of proteins will be gained.

LIST OF EXPERIMENTS:

1. Isolation of plasmid
2. Isolation of RNA
3. Purification and Quantization of nucleic acids.
4. Agarose gel electrophoresis.
5. DNA isolation
6. Restriction of DNA
7. In-vitro DNA ligation
8. Transformation of *E.coli*
9. RFLP technique
10. SDS PAGE
11. PCR (Demo)
12. Southern blotting

Total: 60 hrs

TEXT BOOKS:

1. Sadasivam. S and A. Manickam. Biochemical Methods.II nd Edition,New Age International (P) Ltd.,Publishers,2004.
2. P.Gunasekar, 1995. Laboratory Manual in Microbiology. New Age International Private Ltd. Publishers, New Delhi, Chennai.
3. Dube, R.C. Practical Microbiology, S. Chand & Company, 2009.

REFERENCE BOOKS:

1 Menze, Molecular and Cell Biology, Lab Manual, BIO 3120 – Sec I Spring, 2013.
2 Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual (Fourth Edition), 2014.
3 James G. Cappucino Natalie Sherman 1999. Microbiology - A Laboratory Manual 4th Edition - Wesley California, England.
4 William Wu, Michael J. welshpeter B. KaufmanHelen H. Zhang, 1997. Methods in Gene Biotechnology, CRC Press, New York.
5 Melody S. Clark 1997. Plant Molecular Biology - A Laboratory Manual, Springer Publication New York.
6 Bruce A. White, 1997. Methods in Molecular Biology, Chapman and Hall, London, New York.

18MMB008 Practical IV- Lab in Clinical Microbiology 0 0 5 2

Course Objective:

- The candidates should be able to carry out experiments in the various bacterial, viral, fungal, and parasitic pathogens in terms of their physiology, genetics, and molecular biology.
- Standardize the appropriate methods for the examination of microbiology specimens and for the presumptive and definitive identification of microbial pathogens.

Course Outcome:

CO-1:The knowledge about different Sterilization techniques using chemicals and physical methods will be gained.
CO-2:To gain the practical knowledge on collection of different clinical specimens.
CO-3:Hands on experience in the techniques of culturing of microbes for identification from clinical samples.
CO-4:Knowledge on detecting bacteriurea will be gained.
CO-5:To have an experience in estimating antimicrobial property of given sample against microbes.
CO-6:Experience in identifying fungal pathogens trough direct microscopy technique will be gained**.**
CO-7:Knowledge on culturing fungi, studying their morphology and identification of fungal pathogens will be gained.
CO-8:Knowledge on identifying the presence of parasites in faeces specimen will be gained.
CO-9:Preparation of clinical specimen for isolation of virus will be learned.
CO-10:Student will learn to prepare scientific report for the experiments carried.

LIST OF EXPERIMENTS

1. Collection of specimens for Microbiological investigations – blood specimen.
2. Collection of specimens for Microbiological investigations- Urine specimen.
3. Collection of specimens for Microbiological investigations -Throat swab and pus specimens.
4. Collection of specimens for Microbiological investigations -Stool specimen.
5. Plating of clinical specimens on media for isolation, purification, identification and quantitation.
6. Preparation, examination and interpretation of direct smears from clinical specimens, viz. Sputum for Acid Fast staining.
7. Quantitative analysis of urine by pour plate method and semi quantitative analysis by standard loop test for significant bacteriuria.
8. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing eg. Kirbybaur.
9. Direct examination of specimens from fungal infection by KOH and Lactophenol cotton blue stains.
10. Fungal slide culture techniques.
11. Examination of faeces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formol-ether methods).

12. Preparation of clinical specimens for isolation of viruses (Demo).

Total: 60 hrs

TEXT BOOKS:

1. Naigaonkar.A.V. and M.D.Burande. A manual of Medical Laboratory Technology,Nirali Prakasan,Third Edition,Pune,India.2004.
2. P.Gunasekar, 1995. Laboratory Manual in Microbiology. New Age International Private Ltd. Publishers, New Delhi, Chennai.
3. Dubey, R.C. Practical Microbiology, S. Chand & Company, 2009.

REFERENCE BOOKS:

1 Betty.A.F,Daniel.F.S and A.S.Weisfeld, Bailey and Scott's Diagnostic Microbiology, Mosby(Elsevier), 2002.

2 Baron, E.J., Color Atlas of Diagnostic Microbiology, 1st, Mosby, 1997.

3 James G. Cappucino Natalie Sherman 1999. Microbiology - A Laboratory Manual 4th Edition - Wesley California, England.

18MMB009 Internship 0 0 0 2

Course Objective:

- Students have to go for training in any medical biotechnology fields such as clinical research institutes, clinical diagnostic laboratories, Parma research industries, etc., to learn the hands on training in the relevant field. After getting the training, the students should submit the training certificate along with detailed report to the department.

Total: 30 hrs

18MMB010 Advanced Clinical and Molecular Diagnostic Techniques 5 0 0 4

Course Objective:

- To provide the analytical knowledge of clinical laboratory testing and its diagnosis.

Course Outcome:

CO-1:To understand the principle and various methods of collection, transport and storage of different clinical samples.
CO-2:Students will also learn the methods of hematology.
CO-3:Students will also learn the methods of identification of parasites in blood.
CO-4:Students will learn about diagnostic methods of clinical pathology specimens i.e.complete routine examination of blood, urine ,sputum, feces ,CSF and semen.
CO-5:To understand the principles and procedures of diagnostic serology and study the different serological tests.
CO-6:Students will gain the knowledge of the interaction between humans and microorganisms.
CO-7: Also to extend the student's understanding and appreciation of interactions between bacteria, Virus, fungi and parasitic microorganisms and the humans through principles and methods of diagnosis.
CO-8: Students will learn about the Clinical manifestation and laboratory diagnosis of bacterial, Viral, fungal and parasitic infections.
CO-9:To understand the principles and techniques of molecular diagnosis.
CO-10:Students will also study the ethics in molecular diagnosis.

UNIT I HEMATOLOGY 14

Specimen –definition, types. Collection and transport of specimen. Specimen preservation and storage. Hematology - Blood and its constituents, collection of blood various anticoagulants and their uses. Total Leukocyte Count(TC), Differential count(DC), Erythrocyte Sedimentation Rate(ESR) Red blood cells count(RBC), Platelet count, Packed cell volume(PCV), Mean cell volume(MCV), Hb estimation Bleeding time(BT), Clotting time(CT).Blood bank -Blood grouping(ABO system & Rh system),Identification of malarial *parasites.*

UNIT II CLINICAL PATHOLOGY 10

Complete urine routine examination –physical, chemical and microbiological examination of urine, Culture and sensitivity. Complete routine examination of sputum and feces. Semen analysis. Examination of CSF.

UNIT III CLINICAL SEROLOGY AND IMMUNOLOGY 12

Common serological tests - Rheumatoid arthritis, Pregnancy test, Widal (slide and tube test), VDRL, HBs antigen, carbohydrate reactive protein test. Clinical manifestations and lab immunological diagnosis of AIDS, MOTT, Legionellosis, Chicken guinea, *Helicobacter pylori* and SARS.

UNIT IV CLINICAL MICROBIOLOGY 12

Clinical manifestation and laboratory diagnosis of bacterial pathogens-Enteric pathogens (*E.coli*, *Shigella, Samonella* and *Vibrio*), pyogenic organisms (Staphylococcus and Streptococcus), Spirochetes (*Leptospira*), Mycobacterium, B. anthracis and Rickettsia. Virology, Mycology and Parasitology - Clinical manifestation and laboratory diagnosis of *Rabies* and *Poliomyelitis*, *Dermatophytes* and *E.histolytica*.

UNIT- V MOLECULARDIAGNOSTICS 12

Molecular techniques for analysis of biochemical disorders. Assays for the diagnosis of inherited diseases. Bioinformatics tools for molecular diagnosis. Antibody based diagnosis – monoclonal antibodies as diagnostic reagents. Diagnosis of diseases by using ELISA and Western blot.DNA diagnostics – PCR and array based diagnosis. Clinical proteomics - protein microarray for disease diagnosis. Ethics in molecular diagnosis.

Total: 60 hrs

TEXT BOOKS:

1. Naigaonkar.A.V. and M.D.Burande. A manual of Medical Laboratory Technology,Nirali Prakasan,Third Edition,Pune,India.2004.
2. Praful.B.Godkar.Clinical Biochemistry Principles and Practice. Bhalani Publishing House, Bombay, India.1994.
3. Textbook of Microbiology by R. Anathanarayan and C K Jayaram Paniker, 2013, Ninth Edition, Jain publications.
4. Pradeep Kumar N.S.Manual of Practical Pathology,CBS Publishers and Distributors Pvt Ltd, New Delhi.2011.

REFERENCE BOOKS:

1. Geo. F. Brooks, Janet S. Butel and Stephen A. Medical Microbiology, Morse Twenty Third Editions.2010.

4 Betty.A.F,Daniel.F.S and A.S.Weisfeld, Bailey and Scott's Diagnostic Microbiology, Mosby(Elsevier), 2002.

2. Prakash M & C.K. Arora, Biochemical techniques, Anmol publication (1) Ltd New Delhi.1998.
3. Lele Buckingham and Maribeth L. Flaws.Molecular Diagnostics: Fundamentals, Methods & Clinical applications,2007.
4. Lewin .B.Genes VIII , Oxford University Press.2004.
5. Watson, J. D, Tania A baker and Stephen P. Bell, Alexander.Molecular Biology of the Gene,2004.
6. David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Fundamentals of Molecular Diagnostics Saunders Group.2007.
7. Gann, Michael Levine, Richard Losick, Pearson Education Pte. Ltd. (Singapore).
8. M. Malacinski and D. Friefelder , Essentials of Molecular Biology, Jones & Bartlett publishers,1998.
9. R-DNA safety guidelines- Government of India, Ministry of Science and Technology, Dept.of Biotechnology, New Delhi.1990.
10. Rudin,N and Inman,K.,An Introduction to Forensic DNA Analysis , CRC Press.2002.
11. Forensic DNA Typing. Biology, Technology and Genetics of STR markers (2005).
12. George Patrinos, Molecular Diagnostics, Wilhelm Ansorge.2009.

18MMB011 Medical Immunology and Clinical Research 5 0 0 4

Course Objective:

- To provide the theoretical knowledge of immunological concepts and clinical research significantly related to the field of medicine.

Course Outcome:

CO-1: Students will get an idea about Fundamentals of immunity – immune response, tolerance.
CO-2: Students will also be introduced to the concept of antigens and immunoglobulin – Immune cells and organs.
CO-3:Students will learn about MHC – HLA and its significant aspects on typing relevant to organ transplantation.
CO-4: Students will get an idea about the relevance of HLA in medicine and its role in disease.
CO-5: Sudents will get detailed knowledge on the concept of active immumization and vaccines.
CO-6 Different aspects of immunoprophylaxis, immunotherapy along with types of immunopotentiators and immunosuppressant will also be learnt by the students.
CO-7: A fundamental knowledge about clinical research, drug approval and regulations will be gained by the students.
CO-8: Students will learn about various aspects of drug studies, preclinical toxicology and clinical trials with ethics.
CO-9: Students will learn about different types of clinical trials and their examples.
CO-10: Basic terminologies in Pharmacology and new drug development process will be introduced to the students.

UNIT I INTRODUCTION TO IMMUNOLOGY 12

Basic aspects of Immunity – Immune response - Immune tolerance - Immune cells and organs – Antigens, Haptens – Immunoglobulins – structure and function – Complement system – cytokines.

UNIT II IMMUNE COMPLEXES 12

MHC: History, concept and nomenclature of MHC - Genetic constitution of *human* HLA complex: HLA class I, class II and class III gene- Genetic characteristics and typing of HLA complex: genetic characteristics (Haplotype, Codominant inheritance, High polymorphism, Linkage disequilibrium), typing technology (serological typing, cytological typing, DNA typing) Significance of HLA in medicine: relevance to disease, organ transplantation.

UNIT III IMMUNOPROPHYLAXIS AND IMMUNOTHERAPY 12

Concept of artificial active immunization, types of vaccines - Concept of artificial passive immunization, types of immunoproducts for artificial passive immunization - Concept of adoptive immunization, commonly used methods of adoptive immunization (LAK, TIL, cytokine gene transfection of immune cells) - Types of immunopotentiators and immunosuppressant commonly used in clinic.

UNIT IV CLINICAL RESEARCH 12

Introduction to clinical research, history of clinical research and an over view. Scope of clinical research. GCP and ICH. Different phases of clinical research. Ethics to be followed in clinical research trails.

UNIT V CLINICAL TOXICOLOGY **12**

Drug studies - Pre clinical toxicology: General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Types of clinical trials, single blinding, double blinding, Open access, Randomized trials and their examples, interventional study, Basics terminologies in Pharmacology. New drug development process.

Total: 60 hrs

TEXT BOOKS:

1. Subhash Chandra Parija, "Textbooks of Microbiology and Immunology", Elsevier; Second edition, 2012.
2. Arumugam N. A.Mani, L.M.Narayanan, Dulsy Fatima,A.M.Selvaraj, "Immunology & Microbiology", Saras Publication,2015.
3. Arumugam N, "Immunology & Microbiology", Saras Publication, 2007.
4. Ramasamy, P and R.E.B. Hanna, "Immunity and inflammation", University of Madras publications, Pearl Press Ltd., 2002.
5. Ravindra B. Ghoojand Sachin C. Itkar. Essential of Clinical Research, Nirali Prakashan, Publications 2010.
6. Pal.T.K and Sangita Agarwal, Clinical Research, CBS publishers and Distribution, 2009.

REFERENCE BOOKS:

1. Tak W Mark and Mary Saunders, "The Immune Response Basic and Clinical Principles", 1st edition, AP. 2005.
2. Parslow, T.G, D.P. Sites, A.L.Terr, "Medical immunology", 10th edition by Mc Graw-Hill Publishing, 2001.
3. Zola H, "Monoclonal antibodies", Bios Scientific Publishers LTD., 2000.
4. Goldsby R.A., T.J. Kindt and B.A. Osborne, "Kuby Immunology", Freeman and company, 2000.
5. Roitt I, "Immunology", Blackwell Scientific Publications, 1996
6. Delves, Martin and Burton. Roitt's Essential Immunology, 11th Edition, 2006.
7. May Louise Turgeon, Immunology and Serology in Laboratory Medicine 3rd Edition 2003.
8. John I. Gallin and Frederick P. Ognibene, Principles and practice of clinical research,3rd edition,2012.
9. Vishal Bansal Parar, Clinical Research Fundamental and Practice,Medical Publisher, 2010.
10. Jaypee brothers.Basic Principles of Clinical Research and Methodology, Medical Publishers (P) Ltd., 2009.
11. Gupta, S.K.Basic Principles of Clinical Research and Methodology, 1st edition,2009.
12. Regulation of Clinical Trials, 1st edition, Career publication, 2007.

18MMB012 Practical V - Lab in Advanced Clinical and Molecular Diagnostic Techniques 0 0 5 2

CourseObjective:

- Ability to carry out the diagnostic Techniques of hematology, urology and serology standardizing the laboratory protocols responsible for diagnoses.

Course Outcome:

CO-1: Hands on experience in the techniques of Hematological study will be gained by the students.
CO-2: Students will gain experience in the practical analysis of Haemoglobin, RBC, WBC, Platelets count, blood grouping from the blood sample
CO-3: Students will also learnt about the biochemical analysis of Sugar (PP), Urea, Creatinine, Cholesterol, bilirubin, R.A factor from the blood.
CO-4: Blood analysis VDRL, Total Count (TC), Differential Count (DC), ESR (Erythrocyte Sedimentation Rate) will also be taught to the students.
CO-5: Blood analysis for detection of Salmonella infection, will be taught to the students.
CO-6: Determination of bleeding time clotting time will also be taught to the students.
CO-7: Students will gain practical knowledge of routine Urine analysis.
CO-8: Students will gain practical knowledge of sputum experiments for determination of presence of AFB bacilli.
CO-9: Students will learn to separate blood serum and analyse it for the presence of Hepatitis virus B (HBs Ag).
CO-10: Students will also be taught HIV detection by ELISA.

LIST OF EXPERIMENTS

1. Blood analysis I: Haemoglobin, RBC, WBC, Platelets count, blood grouping, Rh typing,
2. Blood analysis II: VDRL, HIV I, HIV II, and HBs AG.
3. Blood analysis III: Sugar (R), Sugar (PP), Urea, Creatinine, Cholesterol, bilirubin, R.A factor.
4. Blood analysis IV: TC, DC (Polymorpy, lymphocyte, Eosinophil)
5. Blood analysis V: ESR (30 mts 60 mts)
6. Bleeding time, clotting time,
7. Blood analysis VI: Widal reaction Salmonella typhi ‘O’ and Salmonella typhi ‘H’.
8. Urine analysis I: colour, reaction and albumin.
9. Urine analysis II: sugar (pp), deposits (pus cells, Epi cells, RBC’s and crystals).
10. Sputum – AFB (Ziehl Nelson stain method).
11. Serological tests ELISA for HIV.
12. Identification of HbsAg

Total : 60 hrs

TEXT BOOKS:

1. Naigaonkar.A.V. and M.D.Burande. A manual of Medical Laboratory Technology,Nirali Prakasan,Third Edition,Pune,India.2004.

2. P.Gunasekar, 1995. Laboratory Manual in Microbiology. New Age International Private Ltd. Publishers, New Delhi, Chennai.
3. Dube, R.C. Practical Microbiology, S. Chand & Company, 2009.
4. Praful.B.Godkar.Clinical Biochemistry Principles and Practice.Bhalani Publishing House, Bombay, India.1994.
5. Pradeep Kumar N.S.Manual of Practical Pathology,CBS Publishers and Distributors Pvt Ltd, New Delhi.2011.

REFERENCE BOOKS:

1. Betty.A.F,Daniel.F.S and A.S.Weisfeld, Bailey and Scott's Diagnostic Microbiology, Mosby(Elsevier), 2002.
2. Baron, E.J., Color Atlas of Diagnostic Microbiology, 1st, Mosby, 1997.
3. James G. Cappucino Natalie Sherman 1999. Microbiology - A Laboratory Manual 4th Edition - Wesley California, England.

18MMB013 Practical VI - Lab in Medical Immunology 0 0 5 2

Course Objective:

- The objective of this course will carry out the diagnostic Techniques of serology and educate the students to learn immunological methods for disease diagnosis.

Course Outcome:

CO-1: Students will gain hands on experience in the techniques of serological study.
CO-2: Students will gain practical knowledge of immunodiagnostic methods for determination of diseases.
CO-3: The technique of separation of the serum for determination of antibody and antigens will be learnt by students.
CO-4: The isolation and characterization of serum proteins will be learnt by students.
CO-5: Students will learn to separate different blood cells from whole blood.
CO-6: Study of blood groups and the rationale behind blood grouping will be learnt by students.
CO-7: Different clinical diagnostic tests such as the Widal test for diagnosis of typhoid and VDRL for diagnosis of syphilis will be taught to students.
CO-8: Students will be taught the principle of use of latex in manufacture of kits and will learn the diagnostic value of the CRP (C-reactive ProteinT test).
CO-9: Students will learn the diagnostic value of RPR.
CO-10: Diagnosis of pregnancy in the early months will be learnt by students.

LIST OF EXPERIMENTS

1. Serum separation
2. Separation of mononuclear cells by Ficoll hypaque method
3. Analysis of T cells by E-rosette technique
4. Widal test
5. RPR test
6. Latex serology test for detection of C-reactive protein
7. ELISA
8. SDS-PAGE
9. Western blotting
10. Pregnancy test
11. Blood grouping
12. VDRL test

Total: 60 hrs

TEXT BOOKS:

1. Myers, Mika, Klein, "Microbiology and Immunology Laboratory Manual", Pearson Learning Solutions; 4th edition, 2013.
2. May Louise Turgeon, Immunology and Serology in Laboratory Medicine 3rd Edition 2003.

REFERENCE BOOKS:

1. James G. Cappuccino, Natalie Sherman, "Microbiology: A Laboratory Manual" (10th Edition), 2013.

2. Ivan Lefkovits, "Immunology Methods Manual: The Comprehensive Sourcebooks of Techniques", 1996.
3. Bruce A. White, "Methods in Molecular Biology", Chapman and Hall, London, New York. 1997.
4. William Wu, Michael J. welshpeter B. KaufmanHelen H. Zhang, Methods in "Gene Biotechnology", CRC Press, New York. 1997.

18MMB014 Project /Dissertation and Viva-Voce 0 0 0 17

Course Objective:

- Students have to do the research work in the field of medical biotechnology based on their own interest or research guide interest in a particular topic for a period of 6 months duration from the university or any research industries or research laboratories. After the completion of project work, the student should submit the dissertation in the university prescribed format and then attend to the Viva-voce exam.

Total: 15 Weeks (30 Hrs /Week)

Syllabus
Discipline Specific Elective Courses

18MMB101 Human Physiology 4 0 0 4

Course Objective:

- This course covers the fundamental principles of human biology with emphasis on the morphology, physiology and disorder of body systems.

Course Outcome:

CO-1: Student will be able to understand the hierarchical architecture of the human body.
CO-2 Students gain knowledge about cell, tissues and membranes.
CO-3: Students will be able to understand circulatory system and composition of blood.
CO-4: Student will learn the blood clotting mechanism and the functions of lymphatic system.
CO-5: Students should be able to study the organs and organ structure of respiratory system and the mechanism of respiration.
CO-6: The structure and function of digestive system will be studied by the student in detail.
CO-7: The organs associated with digestive system and the functions of individual organs in digestion will be learnt.
CO-8:Structure, function and components of excretory system will be learnt by students.
CO-9: Structure, function and components of reproductive system and hormonal control of the same will be learnt by students.
CO-10: The students will understand the structure of Nervous system and senses of different types.

UNIT I MEDICAL TERMINOLOGY INTRODUCTION 08

Human body structure-Useful terms to describe body parts and activities Directional terms-Planes of the body-Body cavities- Cells, Tissues, and Membranes.

UNIT II HUMAN CIRCULATORY SYSTEM 08

Blood -Composition of blood- Plasma- Red blood cells-White blood cells: development and function- Bone marrow -Clotting pathway(s)-Functions of the lymphatic system.

UNIT III RESPIRATORY SYSTEM 08

Introduction to the respiratory system-Mechanics of ventilation- Respiratory volumes and capacities- Conducting airways-Nose and nasal cavities- Pharynx- Larynx and trachea- Bronchi, bronchial tree, and lungs.

UNIT IV DIGESTIVE SYSTEM 10

Functions of the digestive system-General structure of the digestive system-Organs of the digestive system-Mouth-Pharynx and esophagus-Stomach-Small and large intestines-Accessory organs (salivary glands, tongue, and pancreas, liver).

UNIT V HUMAN URINOGENITAL SYSTEM AND SENSES 11

Functions of the excretory system-Components and function of the - urinary system-Kidneys. **Nervous System -**Functions of the nervous system .**The Senses-** Vision -Taste-Touch-Smell- Pain Pathways - **The Reproductive System -**Male reproductive system - Hormonal control- Female reproductive system.

Total: 45 hrs

TEXT BOOKS:

1. Kenneth L.Jones,Louis.W.Shainberg and Curtis.O.Byer. The Human Body, Canfield Press, Harper and Row Publishers, Sanfrancisco.1971.
2. Peter Jones , The Complete Guide to Human Body,VIth Edition,2013
3. Unglaub Silverthorn, Human Physiology: An Integrated Approach Plus Mastering A&P with e - Text, University of Texas, Austin, 2011.

REFERENCE BOOKS:

1. Browder, Leon W., Carol A. Erickson, and William R. Jeffery. *Developmental Biology,* 3rd Ed. Philadelphia, PA: Harcourt College Publishing, 1991.
2. Saladin, Kenneth S. *Anatomy and Physiology*, 2nd ed. New York: McGraw-Hill, 2001.
3. Berne, Robert M., and Matthew N. Levy. *Physiology*,4thed. St. Louis,MO: Mosby, 1998.
4. Ganong, William F. *Review of Medical Physiology,* 19th ed. Stamford, CT: Appleton and Lange, 1999.

18MMB102 Human Genetics and Developmental Biology 4 0 0 4

Course Objective:

- Human Molecular Genetics is a vast field that provides information of Genetic Material, general principles and applications of cloning and molecular hybridization. The paper provides comprehensive knowledge on the structure, function and evolution of human genes and genome.

Course Outcome:

CO-1: Students will get an idea about Mendelian principles.
CO-2: Human genome and its organization will also be learnt by the students.
CO-3: Gene silencing, linkage and recombination in diploids will be taught to students.
CO-4: Students learn about population genetics, Hardy Weinberg and its applications.
CO-5: Students will learn about operons, Transposons and types of mutation.
CO-6: Mutational analysis of lac and arabinose operons will be learnt by students.
CO-7: Students will learn about the structure of DNA and RNA with transcription and translation – post transcriptional and post translational modifications.
CO-8: Students will learn about embryology.
CO-9: Students will get a detailed knowledge about blastulation, gastrulation and neural induction.
CO-10: A detailed knowledge on developmental aspects of Drosophila and mammals will be gained by students.

UNIT-I INTRODUCTION 08

Mendelian principles - Human Genome, Basic concepts of Human Genome, Organization of the human genes, Human gene expression, Gene Silencing, Repetitive DNA and its types, linkage, linkage group, recombination maps in diploids.

UNIT-II POPULATION GENETICS 12

Inheritance of quatitative traits, genetic basis and influence of environment. Principles of population genetics; Hardy-Weinberg law and its application for autosomal genes. Organization and mutational analysis of lac and arabinose operons. Transposons in Eukaryotes. Molecular basis of spontaneous and induced mutations.

UNIT- III NUCLEIC ACID 08

Structure and function, Physical and chemical structure of DNA, DNA Replication. Different types of RNA and their Structure. RNA transcription factors and gene expression, Post transcriptional RNA processing, Post Translational modifications.

UNIT-IV EMBRYOGENESIS 08

Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species specificity. Egg activation, early cleavages and blastocyst formation in mammals. Gastrulation in mammal's formation of primitive streak, morphogenetic movements and neural induction.

UNIT-V ORGANOGENESIS 09

Organogenesis and foetal development. Pattern forming genes and expression in Drosophila and mammalian embryos. Development of mammalian brain- cerebral cortex cell lineages Lens development – fiber differentiation, programmed morphogenetic histogenetical cell death (apoptosis). Erythropoeisis, Myelopoeisis. Ageing.

Total: 45 hrs

TEXT BOOKS:

1. Gilbert SF, Developmental biology, 7th ed. Sinauer, 2003.
2. Ricki Lewis. 2009. Human Genetics-Concepts and Application. Ninth Edition. McGraw-Hill College Publishers.
3. Phundan Singh, "Molecular genetics", Ibdc Publishers,2010.
4. Sabyasachi Roychoudhuri, "A Textbooks of Genetics and Molecular Biology", New Central Books Agency; 1 edition, 2011.
5. Sarin, "Genetics", - Tata McGraw hill, 1991.

REFERENCE BOOKS:

1. Nussbaum, Robert L., Roderick R. McInnes, and Huntington F. Willard. Genetics in Medicine. 7th ed. Philadelphia: Saunders, 2007.
2. Glossary." Genetics Home Reference. 14 Mar. 2008. U.S. National Library of Medicine.
3. Freeman, Scott, and Jon C. Herron. Evolutionary Analysis. 4th ed. Upper Saddle River: Pearson: Prentice Hall, 2007.
4. Wolpert L, Beddington R, Jessell T, Lawrence P, Meyerowitz E, Smith J (2002). *Principles of development* (2nd ed.). Oxford university press. pp. 304–307.
5. F Vogel A.G. Motulusky. Human Genetics: Problems arid Approaches. Third Completely Revised Edition, 2009, Springer-Verlag.
6. Peter.D. Snustad and Michael J.Simmons. 2009. Principles of Human Genetics. Fifth Edition. John Wiley & Sons, Inc.
7. Gardner, Simmons and Snustd, "Principles of Genetics", 1991.
8. Hartl D.L.G, "Basic genetics", Jones and publishers, 1991.
9. Date J.W. "Molecular Genetics of Bacteria", Wiley and sons, 1994.

18MMB103 Advanced Medical Biophysics and Biomedical Instrumentation 4004

Course Objective:

To provide detailed knowledge about advances in medical biophysics and medical instrumentations.

Course Outcome:

CO-1: Students learn about the origin of biopotency, electrode electrolyte interface with skin surface etc.
CO-2: Student learn about different types of electrodes.
CO-3: Students learn about the biosignals, frequency and amplitude ranges.
CO-4: Students gain the knowledge on ECG, EEG, EMG, ERG and EOG.
CO-5: The importance of bio amplifiers in ECG will be learnt.
CO-6: Types of bio-amplifiers and disturbances in recording the same will be learnt.
CO-7: Students learn about measurement of non-electrical parameter and its importance in monitoring human health.
CO-8: Measurement of temperature, blood pressure, blood flow will be learnt by the students**.**
CO-9: Knowledge on biochemical sensors in monitoring human health will be gained.
CO-10: The analysis and instruments used in biochemical sensors to monitor human health will be learnt.

UNIT - I BIO POTENTIAL ELECTRODES 09

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT - II ELECTRODE CONFIGURATIONS 08

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

UNIT - III BIO AMPLIFIER 08

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band passes filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT - IV MEASUREMENT OF NON-ELECTRICAL PARAMETER 12

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultator method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac

output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT - V BIO-CHEMICAL MEASUREMENT **08**

Biochemical sensors - pH, PO2 and PCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Total: 45 hrs

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

2. Veerakumari L.,Bioinstrumentation, Mjp Publishers; 1 edition, 2011.

3. Webster, Bioinstrumentation ,Wiley India Private Limited , 2007

REFERENCE BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
4. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, 2003.
5. Robyt F., Bernard J. White, Biochemical Technique: Theory and Practice, - Waveland Pr Inc; Reprint edition, 1990.
6. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual (Fourth Edition), 2014.
7. Wilson,K., Walker, J. E. J. Wood, K., Walker, J, Principles and techniques of practical biochemistry (5th Ed.): Cambridge University Press, Cambridge, 2000.

18MMB104 Nano and Pharmaceutical Biotechnology 4 0 0 4

Course Objective:

- To know about the advance (Nano) technology, and its application in Pharmaceutical industries.

Course Outcome:

CO-1: Student gain the basic knowledge and introduction about Nano technology. Learn about Nanostructures, Nanopolymers, Nanofibres and their uses.
CO-2: Knowledge on bone grafting, dental restoration and bone replacement using nanotechnology will be gained.
CO-3: Students learn about the DNA based artificial Nanostructures; Fabrication, properties and applications.
CO-4: Nanobased Protein patterning, sensor technology and polymeric gel and their applications in the field of medicine will be learnt.
CO-5: Importance of microbes in pharmaceutical technology will be learnt.
CO-6: Development of Microbe based biopharmaceutical formulation will be learnt.
CO-7: Protein engineering, Peptide chemistry and Peptidomimetics, Catalytic antibodies, Glycobiology and Biosensors will be learnt.
CO-8: Gene therapy – *ex vivo* and *in vivo* gene therapy and hematopoietic growth factors, will be learnt.
CO-9: Vaccine, development will be learnt.
CO-10: Knowledge on antibody based therapeutics and formulation of monoclonal antibody will be learnt.

UNIT –I INTRODUCTION TO NANOTECHNOLOGY 08

Nanostructures, Biointerface, Bioconjugation, and Biomatrix, Nanoclusters, Self – Assembly of Nano materials. Nanopolymers and Nanofibres. Bioactive nanomaterials in bone grafting and tissue engineering – Inorganic/ polymers Nanocomposites for dental restoration and bone replacement applications.

UNIT –II NANOMATERIALS 08

DNA based artificial Nanostructures; Fabrication, properties and applications. Nucleic acid engineered Nanomaterials and their applications. Protein pattering for application in Biomaterials and biodevices. Vesicles and liposomes in sensor technology – Self – Assembling Nanostructured injectable polymeric gels for drug delivery.

UNIT –III PHARMACEUTICAL BIOTECHNOLOGY 08

Introduction, Microbes in Pharmaceutical industry. Formulation of Biotech products including biopharmaceutical Considerations (Microbiological considerations). Site specific delivery of Protein Drugs.

UNIT –IV PEPTIDE CHEMISTRY 10

Protein engineering, Peptide chemistry and Peptidomimetics, Catalytic antibodies, Glycobiology and Biosensors. Impact of biotechnology on drug discovery. (Gene therapy – ex vivo and in vivo gene therapy). Hematopoietic Growth Factors, chemical description, pharmacology, Pharmaceutical Concerns, clinical and Practice aspects.

UNIT –V PHARMACOLOGY AND FORMULATIONS 11

Vaccines, Modern Vaccine Technologies, Pharmaceutical aspects. Monoclonal Antibody, Based Pharmaceuticals, Development of Antibody Based Therapeutics. Formulation of monoclonal antibody – Based Therapeutically.

Total: 45 hrs

Text Books:

1. Charles Poole, Frank Owens, 2007. Introduction to Nanotechnology Publisher: Wiley India Private Limited.
2. Leo Shargel, Andrew B. C. Yu, Susanna Wu-Pong and Yu Andrew B.C.2004.Applied Biopharaceutics and pharmacokinetics. McGraw – Hill companies.
3. Manasi Karkare, Nanotechnology: Fundamentals and Applications, I K International Publishing House Pvt. Ltd, 2008.
4. Charles Poole, Frank Owens, Introduction to Nanotechnology, Wiley 2007.
5. Sambamurthy K, Ashutosh Kar , Pharmaceutical Biotechnology, New Age International Pvt Ltd Publishers, 2006.
6. Chandrakant Kokate , Pramod H.J , SS Jalalpure , Textbooks of Pharmaceutical Biotechnology (Kindle Edition), Elsevier; First edition, 2011.

REFERENCE BOOKS:

1. Daniel Figeys (Ed.). Industrial proteomics; Applications for Biotechnology and Pharmaceuticals. Wiley and sons, Incorporated, 2005.
2. Kayser,O.and R.H. Muller. Pharmaceutical Biotechnology – Drug discovery and clinical applications. Wiley – VCH, 2004
3. Heonrich Klefenz, Industrial Pharmaceutical Biotechnology.2002.
4. Sefania Spada, Garywalsh, Directory of approved biopharmaceutical.2004.
5. Gatywalsh, Biopharmaceutical, biochemistry and biotechnology, 2003.
6. Thomas Lengauer (Ed). Bioinformatics – from Genomes to drugs. Vol I and II. Wiley – VCH,2002
7. JOHN F. Corpenter (Ed) Mark C. Manning. Rational design of stable formulation theory and practice (Pharmaceutical Biotechnology). Plenum, US. Ist edition.2002.
8. D.I.A Crommelin et al. Pharmaceutical biology. Amazon prome publications, 2002. Christof M. Niemeyer, Chad A. Mirkin. Nano biotechnology: Concepts, Applications and Perspectives, Wiley-VCH; 1 edition, 2004.
9. Claudia Nicolini. Nanobiotechnology Nanobiosciences. Pan Stanford Publishing Pte. Ltd, 2009.
10. Niemeyer, C.M. and Mirkin, C.A. Nanobiotechnology concepts, application and perspectives. WILEY-VCH, Verlag Gmb H & Co. 2004.
11. Kayser, O. R.H. Muller.. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH. 2004.
12. Heonrich Klefenz. Industrial Pharmaceutical Biotechnology. 2002.

18MMB105 Tissue Engineering and Stem Cell Biology 4 0 0 4

Course Objective:

- The objective is to introduce the student to educate with basics of tissue engineering and Stem Cell biology and its application in modern medicine.

Course Outcome:

CO-1: Knowledge on basics of tissue engineering – growth and differentiation of tissues will be learnt.
CO-2: Knowledge pertaining to the growth factors influencing tissue growth will be gained.
CO-3: Fabrication and tailoring of scaffolds, and reactors in tissue formation will be studied. CO-4: Development of Bioartificial organs like pancreas, renal system, and periodontal applications will be learnt.
CO-5:Knowledge on Stem cell – Definition, characterization, Pluripotent stem cells, Self renewal and differentiation will be learnt.
CO-6: Student will learn different types of stem cells.
CO-7: Cell cycle, pathway and signaling will be learnt by students.
CO-8: Knowledge on Stem cell communications – Gap junctions, Cell fusions will be gained.
CO-9: Application of Embryonic, Bone marrow, Adipose derived and Hematopoietic stem cells in heart regeneration and neural defects will be learnt.
CO-10: Ethics in human stem cell research will be learnt.

UNIT – I GROWTH AND DIFFERENTIATION 08

Basic biology of tissue engineering; the basis of growth and differentiation – Morphogenesis and Tissue Engineering. In vitro control of tissue developmental – Growth factors; Role of Basic Fibroblast Growth Factors and Angiogenesis. Biomaterials in tissue engineering. Cell-Based Therapies, Tissue Morphogenesis.

UNIT – II BIOMATERIALS 10

Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation, Bioreactor cultivation of functional tissues and its applications. Bio artificial pancreas, renal replacement devices. Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell – Periodontal applications – Artificial womb.

UNIT – III INTRODUCTION TO STEM CELL 08

Stem cell – Definition, characterization, Pluripotent stem cells, Self renewal and differentiation, Hierarchy, Stem cell niche, Niche specification of Drosophila germ line stem cells. Types of stem cells: Adult stem cell from amniotic fluid, cord blood and tooth primordial. Neural stem cells and its applications.

UNIT – IV CHARACTERISTICS OF STEM CELL 08

Cell cycle, Ras/ Raf pathways, P13K cell signaling, p53 check points, Role of LIF pathways in cell cycle control. Stem cell communications – Gap junctions, Cell fusions, HOX genes, upstream transcriptional factors.

Unit – V APPLICATION OF STEM CELLS 11

Therapeutics applications of Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in heart regeneration and neural defects. Ethics in

human stem cell research; Controversy surrounding human embryonic stem cell research, societal implications: Different religious views, Current Ethical Guidelines in India, Ethical views of other countries and how this affects advancement of science Policy.

Total: 45 hrs

TEXT BOOKS:

1. Robert P. Lanaza, Robert Langer and Joseph Vacanti.2002. Principles of tissue engineering. Second edition Academic Press.
2. Robert Lanza. "Essential of Stem Cell Biology" Academic Press (2005).
3. Jonathan Slack, Stem cells- A Very Short Introduction,Oxford, 2012.
4. Bernhard O. Palsson , Sangeeta N. Bhatia, Tissue Engineering, Prentice Hall; 1 edition, 2003.

REFERENCE BOOKS:

1. Micklem.H.S., Loutit John.F., tissue grafting and radiation, Academic Press, New York.2004.,
2. Penson.., Balducci.D., Tissue cultures in biological research, Elsevier, Amsterdam.2004.
3. Ann A.Kiessling"Human Embryonic Stem Cells" Jones and Bartlett Publishers, Inc., second edition, (2006)
4. Institute of Medicine (Corporate Author); "Stem cells and The Future of Regenerative Medicine" National Academy Press. (2002).
5. Kursad Turksen ; "Adult Stem Cells ; Humana Press, Inc (2004)
6. James Thomson et al; "Handbook of Stem Cells' Embryonic / Adult and Fetal Stem Cells" Vol I and II; Academic Press (2004).
7. Robert P. Lanaza, Robert Langer and Joseph Vacanti. Principles of tissue engineering. Second edition Academic Press. 2002.
8. Robert Lanza, John earhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut, Essentials of Stem Cell Biology (Second Edition, 2009.
9. Robert Lanza. "Essential of Stem Cell Biology" Academic Press, 2005.

18MMB106 Biomedical Waste Management 4 0 0 4

Course Objective:

- To provide basic knowledge about source, types, handling, collection, and disposal and also it is ensure the proper and safe management of biomedical waste.

Course Outcome:

CO-1: To understand the Scope and importance of biomedical wastes and also students will learn about the types of biomedical waste.
CO-2: The source and composition of biomedical waste will be learnt by students.
CO-3: Students will understand the health impact caused by biomedical wastes.
CO-4: Students will gain the knowledge on infectious agents, monitoring and controlling the cross infection due to biomedical wastes.
CO-5: Handling rules, segregation, collection, transportation, disposal of biomedical waste will be learnt.
CO-6: An understanding of the disposal techniques (sharp disposal pit, deep burial pit and secured land fill) of disposal of biomedical wastes will be acquired.
CO-7: Students will learn about the different technologies of treatment and management of biomedical wastes.
CO-8: Alternative treatment technologies on biowaste management will be learnt.
CO-9:Environment and legislation policies and rules for handling and management of biomedical wastes, CPCB guidelines. WHO guidelines will be learnt.
CO-10: Health and safety practice of biowaste management will be learnt.

UNIT-I INTRODUCTION 11

Definition, Scope and importance of biomedical waste. Categories of biomedical wastes(Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste , Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).Categorization and composition of biomedical wastes. Sources of biomedical wastes.

UNIT-II HEALTH IMPACTS 08

Health impacts of biomedical wastes. Direct and Indirect hazards. Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices).

UNIT-III DISPOSAL TECHNOLOGY 08

Biomedical waste – Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT-IV TREATMENT TECHNOLOGY 10

Treatment and management of biomedical wastes-on site - pre treatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration) and alternative treatment technologies (microwave, Autoclave, hydroclave, ETP, EBT, plasma pyrolysis and gasification systems).treatment of non – infectious wastes by composting.

Unit-V ENVIRONMENTAL POLICY **08**

Environment and legislation policies and rules for handling and management of biomedical wastes. CPCB guidelines .WHO guidelines for biomedical wastes. Components of a hazardous waste management plan – minimization, recycling and re – use. Management of non – clinical support devices. Health and safety practices in Indian hospitals.

Total: 45 hrs

TEXT BOOKS:

1. Bhide, A.D and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
2. Sharma – Holistic approach to Hospital Waste Management published by Dept. of Hospital Administration – AIIMS, New Delhi, 2006.

REFERENCE BOOKS:

1. Hosetti, B.B. Prospects and perspective of solid waste management, .2006.
2. Glynn Henry.J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice
3. Hall of India, 2004.
4. Bhide. A.D and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2008.
5. Environmental Policy. Forest Policy. Bare Acts – Government Gazette Notification. 2006.
6. Environmental Laws of India-C.P.R. Environmental Education Centre.2011.
7. Glynn Henry.J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.
8. S.L. Goel. Hospital Management, 2009.
9. ISHA. Current Issues in BMW Waste Handling, Bangalore, 2011.

18MMB107 Medical Coding and Pharmacovigilance & Safety Monitoring 4004

Course Objective:

- The paper is designed to provide basics in medical coding and to learn importance Pharmacovigilance for Clinical research students.

Course Outcome:

CO-1: Students learn the basics in Medical Coding and transcription.
CO-2: Students are introduced to ICD, CPT and Coding accuracy.
Co-3: Students learn about how CPT codes are used in medical coding.
CO-4: Categories of CPT codes and coding rituals are taught to stdents.
CO-5: Students learn the importance of Pharmacovigilance study for clinical researchers.
CO-6: Plans, procedures, scope of Pharmacovigilance study. Pharmacovigilance study in India will also be learnt.
CO-7: Student learn about how monitoring boards function and their responsibilities.
CO-8:The basics of pharmacogenomics will be taught to students.
CO-9: Students will be introduced to good reporting practices and safety signals.
CO-10: International drug monitoring procedures will also be learnt.

UNIT-I INTRODUCTION TO MEDICAL CODING 10

Professional over view and specific responsibilities. Strandardization of coding and coding over view. History ICD and CPT. ICD – 9, ICD – 9CM, ICD -10. ICD – 9 - CM versus ICD – 10 – CM. Coding accuracy.

UNIT-II CPT CODE 08

CPT – Medical coding, structure of CPT codes. Three categories of CPT codes. Absence of codes and special cases. Coding rituals and modifiers.

UNIT-III PHARMACOVIGILANCE 08

Introduction, definition, aim and objective of Pharmacovigilance study. Method, Plans, procedures, scope of Pharmacovigilance study. Pharmacovigilance study in India.

UNIT-IV SAFETY MONITORING 08

Basics in pharmacogenomics process of monitoring. Safety monitoring boards. Monitoring of quality assurance. Introduction to GPP. Risk management, guidance, assessing adverse and serious adverse events. Reporting of AE & SAE.

UNIT-V PRACTICES AND SAFETY SIGNALS 11

Introduction to good reporting practices and safety signals. Case reports, Case series, data mining, and causality report. International drug monitoring procedures. Health care information for comprehensive Pharmacovigilance surveillance.

Total: 45 hrs

TEXT BOOKS:

1. Linda Campbell. Medical Transcription Fundamentals and Practice, Prentice Hall-Gale, 1993.

2. Gupta S.K.Textbook of Pharmacovigilance, Japee publications, India, 2011.
3. Ravi N Humbarwadi,Quick Learner's Pharmacovigilance,Amazon,2003.

REFERENCE BOOKS:

1. Eric T Herfindel, Dick R. Gourley. Textbook of Therapeutics Drug and Disease management, 6th edition, 2012.
2. Janet woodcock, Frederick Ognibene, john overbeke ,Assuring data quality and validity in clinical trials for regulatory decision making, 2003.
3. Marilyn takahashi Fortney Otis Diehl, Medical transcription guide: do's and dont's, 2003.

18MMB108 Regulatory Affairs, GLP, IPR, Entrepreneurship and Bioethics In Clinical Research **4 0 0 4**

Course Objective:

- To understand the mechanism of regulatory affairs, GLP, IPR, entrepreneurship and bioethics in clinical research studies.

Course Outcome:

CO – 1: At the end of the course the students will have an understanding of the overview of regulation affairs.
CO – 2: Students will also learn aboutdrug act, schedules to drugs and perenealties for offence regarding sale of drugs. schedule Y clinical trials.
CO – 3: Students will learn about the regulatory authorities in India, Indian FDA, DCGI, ICMR, GEAC, AERB, DGFT, DTAM, DBT guidelines and provisions.
CO – 4: To understand the Indian regulatory approval process.
CO – 5: Students will be introduced to IPR, laws of IPR, patents.
CO – 6: To learn the Bioethics, ethical issues in preclinical (animal) studies, & clinical studies.
CO – 7: Students will knowing the Ethical principles, Institutional Review Board, special issues in research.
CO – 8: To learn Ethical guidelines-ICMR,
CO – 9: To understand Institutional Ethics committees, Institutional review board, ethics-sops ethical issues based on methodology of clinical research.
CO –10: The ethics of clinical research in developing countries will also be learnt by the students.

UNIT-I INTRODUCTION **08**

Overview of regulation affairs. The rights and obligation of a medical professional of patient and code of medical ethics.

UNIT-II DRUG ACT **08**

Introduction to drug act, schedules to drugs and perenealties for offence regarding sale of drugs. Schedule Y clinical trials. Amendments of schedule Y.

UNIT-III REGULATORY BODY **12**

Regulatory authorities in India, Indian FDA, DCGI, ICMR, GEAC, AERB, DGFT, DTAM, DBT guidelines and provisions. Indian regulatory approval process. ICH and process of harmonization. Categories of ICH guidelines, quality, safety, and efficacy guidelines. Introduction to food & drug administration (FDA).

UNIT-IV IPR **07**

IPR, laws of IPR, patents. The WHO, TRIPS agreement, copyrights, IP protection. Impact of IP technology transfer contracts & agreements.

UNIT-V BIOETHICS **10**

Introduction to bioethics, ethical issues in preclinical (animal) studies, & clinical studies-Ethical principles, Institutional Review Board, special issues in research. Ethical guidelines-ICMR, Institutional Ethics committees, Institutional review board, ethics-sops ethical issues based on methodology of clinical research. The ethics of clinical research in developing countries.

Total: 45 hrs

TEXT BOOKS:

1. Vyawahare NS and Sachin Itkar, 2007. Drug Regulatory Affairs.Nirali Prakashan Publication.
2. Murthy, CSV, Entrepreneurship development. Himalaya publishing House,2012

REFERENCE BOOKS:

1. Seller.J.P, Good laboratory practice, the why and the how. Springer Publication.2007.
2. Sharma, P.P. How to practice GLP. Vandana publications.2000.
3. Gupta.C.B and N.P Srinivansan, Entrepreneurial Development. Sultan Chand and Sons Publication,2007
4. Saikishore and Sai Kishore, Drug regulatory affairs. 2012.
5. Tobin. J.J and Gary Walsh, Medical product regulatory Affairs: Pharmaceuticals, Diagnostics and Medical Devices. Kinlle Edition Publication. 2008.

18MMB109 Project Management and Business Development 4 0 0 4

Course Objective:

- To provide the concepts of Project Management and Business Development

Course Outcome:

CO – 1: At the end of the course the students will have an understanding of project management – frame work; concept of a project, capital expenditure.
CO – 2: Students will also learn about resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.
CO – 3: Students will learn aboutscouting for project idea, preliminary screening and project rating index.
CO – 4:Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule will also be learned by the students.
CO – 5: Students will be introduced to thetriple constraints in project management,
CO – 6: At the end of the course the student will have an idea about project management & clinical trials, role of project management in clinical trials.
CO – 7: Students will learn about Business plan preparation- sources of product for business.
CO – 8: At the end of the course the student will have an idea about matching the entrepreneur with the project- Feasibility report preparation and evaluation criteria. .
CO – 9: Students will learn aboutIntroduction& stages of business development-start-up phase, growth phase, maturity phase, decline phase.
CO–10: Outsourcing in clinical research, reasons for outsourcing to contract research organization will also be learnt by the students.

UNIT-I INTRODUCTION TO PROJECT MANAGEMENT 08

Project management – frame work; concept of a project, capital expenditure, Importance& difficulties, Phase of capital budgeting, feasibility study: overview. Resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.

UNIT-II FINANCIAL FORMULATION 12

Financial identification& formulation- scouting for project idea, preliminary screening and project rating index. Market & demands analysis- market survey, characterization of market, forecasting & planning, profit potential of industries; porter model. Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.

UNIT-III INTRODUCTION TO BUSINESS PLAN 08

Business plan preparation- sources of product for business -pre feasibility study-criteria for selection of products- ownership-capital- budgeting project profile preparation- matching entrepreneur with the project- Feasibility report preparation and evaluation criteria.

UNIT-IV INTRODUCTION TO PROJECT MANAGEMENT 08

The triple constraints in project management, project management activities, project management objective, project management documents, project control variables, project management & clinical trials, role of project management in clinical trials, major roles of a project manager in a CRO , ensuring project success.

UNIT-V INTRODUCTION TO BUSINESS DEVELOPMENT 09

Introduction & stages of business development-start-up phase, growth phase, maturity phase, decline phase. Outsourcing in clinical research, reasons for outsourcing to contract research organization, the India advantage, scope and future of CRO , list of clinical research organization in India , list of it companies offering service in clinical research. Role of business development manager.

Total : 45 hrs

TEXT BOOKS:

1. Richard A. Billows, Principles of project management, 2005.
2. Hisrich "Entrepreneurship", Tata McGraw Hill, New Delhi, 2001.

REFERENCE BOOKS:

1. Dennis Lock. The Essentials of Project Management, Gower Publishing Ltd.2006
2. Khanka S.S. Entrepreneurship development", S. Chand and company limited, New Delhi, 2001.
3. Clifford Gray and Erik W. Larson. Project management – The managerial approach, 2002.

18MMB110 Clinical Operations & Clinical Data Management 4 0 0 4

Course Objective:

- To make the student to understand the methodology of Clinical Operations and Clinical Data Management.

Course Outcome:

CO-1: Students would be educated on preclinical procedures and assessment methods in clinical studies.
CO-2: At the end of the course students would have learnt about GMP quality systems.
CO-3: Students will learn about how to design a protocol and report preparation
CO-4: Students will learn about how to get approval for various regulatory processes.
CO-5: Additionally students will know about various regulatory rules.
CO-6: Students will learn about US regulatory structure and Indian regulatory structure, schedule Y etc.
CO-7: Student learn about how to design a clinical research study.
CO-8: Monitoring methods and responsibilities will also be learnt by students.
CO-9: An idea about Clinical Trial Management System (CTMS) will be imparted to students.
CO-10: Students would have learnt how to manage the clinical data and software used.

UNIT-I PRE SCREENING OF CLINICAL TRIALS 08

Pre-screening of patients. Ride identification benefits risk assessment, review protocol compliance. Continuous review, investigator and staff qualifications, records confidentiality GMP quality systems.

UNIT-II PROTOCOL DESIGNING 08

Designing of protocol, CRF, e-CRF, IB, ICF, SOP. Report writing and publications. Clinical trials site and monitoring, document processing.

UNIT-III REGULATION OF CLINICAL RESEARCH 08

Regulation in clinical research, patents US regulatory structure, IND, NDA, ANDA, drug approval. EMEA organization and functions, India regulating systems, schedule Y- rules and regulations.

UNIT-IV CLINICAL MONITORING 11

Clinical study design – Treatment – Studies, Observational studies and seasonal studies. Clinical Monitoring and functional clinical monitor, monitoring activity.

UNIT-V CLINICAL TRIAL MANAGEMENT 10

Clinical Trial Management System (CTMS). Software for CTMS study, SaaS. Legal issues in managing clinical data Health care informatics. Effective data presentation.

TOTAL HOURS: 45

TEXT BOOKS:

1. Gupta SK, Basic Principles of Clinical Research and Methodology Institute of Clinical research (India), 2007.
2. Susanne Prokscha. Practical Guide to Clinical Data Management. 2nd Edition. Taylor & Francis,2007.

REFERENCE BOOKS:

1. RK Rondel, SA Varley, CF Web. 2000. Clinical Data Management. 2nd Edition. John Wiley and Sons.
2. Statistics for Clinical Research, Springer, 2006.

18MMB111 Tools and Model Organisms in Biomedical Research 4 0 0 4

Course Objective:

- This course has been designed to introduce the various tools and techniques in modern era of biology. It focuses on the principles of chromatography and various molecular biology and immunological techniques.
- This course also aims to give the students an introduction to different model organisms, what they are used for, which techniques that can be applied to modify their genome, and how the students may use these organisms employing modern technological approaches for research and understanding of biology.

Course Outcome:

CO-1: Students will be educated about various analytical tools and techniques in chromatography and centrifugation.
CO-2: Students learn about Flow Cytometry, Fluorochromes and its application to in Biomedical Research.
CO-3: Students will be educated about various molecular analytical methods such as PCR, RT PCR, Real time PCR; DNA sequencing-for biomedical research.
CO-4: Southern, Northern and Western blotting will also be learnt by students.
CO-5: Students will learn about monoclonal antibody generation, isolation of various immune cells and their functional assays.
CO-6: Students learn about immunological techniques such as ELISA - direct, indirect, competitive and sandwich ELISA.
CO-7: Students will have a definition of model organisms, Scope and importance of model organisms.
CO-8: Selection of suitable model organisms for research will also be learnt by students.
CO-9: Brief history of model organisms, life cycle, culture conditions/maintenance, advantages and disadvantages of the organism as a model will also be taught to students.
CO-10: Students will learn about different model organisms used in biomedical research: *Escherichia coli*, *Saccharomyces cerevisiae* (Baker's yeast), *Caenorhabditis elegans* (Nematode worm), *Drosophila melanogaster*.

UNIT I: ANALYTICAL METHODS 10

Chromatography: Principle and applications of affinity, gel filtration and ion exchange chromatography, HPLC, Centrifugation: Principle and different types of centrifugation-differential, density gradient and equilibrium. Flow cytometry: Flurochromes, fluorescent probe and principle, application in biomedical science**.**

UNIT II: MOLECULAR BIOLOGY METHODS 09

Isolation, purification and quantification of nucleic acids; Agarose and PAGE; Hybridization techniques- Southern, Northern and Western; Restriction enzymes, Gene cloning and RFLP; Principles of PCR, RT PCR, Real time PCR;DNA sequencing- Maxim Gilbert and Sanger Methods.

UNIT III: IMMUNOLOGICAL METHODS 08

Monoclonal antibody generation, isolation of various immune cells and their functional assays, generation and applications of nude mice. ELISA - direct, indirect, competitive and sandwich ELISA, Co-immune-precipitation for protein-protein interaction studies.

UNIT IV: INTRODUCTION TO MODEL ORGANISMS **08**

Definition of model organisms, Scope and importance of model organisms. Selection of model organisms for research.

UNIT V: DIFFERENT MODEL ORGANISMS **10**

Brief history of model organisms, life cycle, culture conditions/maintenance, advantages and disadvantages of the organism as a model, models: Escherichia coli, Saccharomyces cerevisiae (Baker's yeast), Caenorhabditis elegans (Nematode worm), Drosophila melanogaster (Fruit fly), Daphnia (Water flea), Daniorerio (Zebra fish) and Mus musculus (Mouse).

Total: 45 hrs

TEXT BOOKS:

1. Emerging Model Organisms: A Laboratory Manual, Volume 2, Lab manual edition (2010), Cold Spring Harbor Laboratory Press.
2. Gerald Karp .Cell and Molecular Biology: Concepts and Experiments, 6th edition, Wiley. 2009.
3. Benjamin A. Pierce. Genetics: A Conceptual Approach, 4th edition W. H. Freeman, 2010.
4. Wilson K and Walker J.Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambridge University Press, 2010.

REFERENCE BOOKS:

1. David Sheehan .Physical Biochemistry: Principles and Applications, 2nd edition, John Wiley, 2009.
2. T.A. Brown .Gene cloning and DNA analysis, 6th edition Wiley-Blackwell, 2010.
3. Principles of Gene Manipulation and Genomics, 7th edition (2006), Blackwell Scientific.
4. S.B. Primrose and R.M. Twyman. Human Molecular Genetics, 3rd edition, Tom Strachan and Andrew Read; Garland Science Publishers, 2003.
5. Kuby,J. Immunology, 6th edition, W.H. Freeman and Company, New York,2006.
6. Michael R. Green and Joseph Sambrook. Molecular Cloning: A Laboratory Manual, 4th edition, Three-volume set Cold Spring Harbor Laboratory Press, 2012.
7. William S. Klug, Michael R. Cummings, Charlotte A. Spencer and Michael A. Palladino. Concepts of Genetics, 10th edition, 2012.
8. David Freifelder, Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 2nd edition, W.H. Freeman and Company, 1982.

Syllabus

Generic Elective Courses

15MBT151 MEDICAL TRANSCRIPTION AND CODING 2 0 0 2

Course Objective: The paper designed to introduce and provide basics in Transcription and Coding to students.

Course Outcome:

- CO – 1 : To educate basics in Medical Coding and transcription
- CO – 2: At the end of the course the students will have an understanding of the basics in Medical Coding and transcription and ICT principles.
- CO –-3: To learn the importance of Reimbursement
- CO – 4: Students will also learn about importance and its applications in Healthcare Industry.
- CO – 5: To learn billing System.
- CO – 6: Students will learn about different approaches in medical transcription.
- CO – 7:Students will also learn about evaluation & management of coding
- CO – 8: Students will be introduced to the CPT codes used in medical coding
- CO – 9: To Understand the Absence of Code
- CO – 10. Student will receive knowledge about Emergency Department Services;

UNIT I Introduction to medical coding 6

Professional Overview; Specific Responsibilities, Medical Diagnosis, Standardization in Coding; Relative Value Units (RVUs); HIPAA Background and Explanation.

UNIT II ICD-9-CM coding and structure 6

ICD-9-CM: Overview; ICD-9-CM: General Structure; ICD-9-CM: Basic Operating Guidelines; V Codes; Categories of V Codes; Tips for Improving ICD-9-CM coding Accuracy.

UNIT III Reimbursement and Billing system 6

Reimbursement: Introduction; Reimbursement: Overview; Healthcare Industry Billing/Reimbursement Climate; Top Ten Coding and Billing Errors; Step to Avoid Coding Billing Errors; More Efficient Billing Systems.

UNIT IV CPT Medical Coding 6

CPT Medical Coding: Three Categories of CPT Codes; CPT Codes: Category I; General Guidelines for Using the CPT Manual; Coding Multi-Disciplinary Approach; Absence of Codes; Correlation between Coding and Time; Troublesome Modifiers: -25 & -59.

UNIT V Services and Evaluation & Management 6

Prolonged Services; Critical Care Services; Emergency Department Services; Cautionary CPT Coding Areas; Reasonable and Necessary; Documentation; Changes/Revisions to CPT Codes; National Correct Coding Initiative (NCCI); Evaluation & Management (E/M) Coding:- Evaluation and Management (E/M).

Total :30hrs

TEXT BOOKS

1. Marcy O. Diehl, Medical Transcription : Techniques and Procedures, 2007

2. Buck MS CPC CCS-P, Carol J. ,Step-by-Step Medical Coding, Edition, 1e Saunders , 2015

REFERENCE BOOKS

1. Linda Campbell, Medical Transcription Fundamentals and Practice, Prentice Hall- Gale. 1993.
2. Sally Crenshaw Pitman, John H. Dirckx, Ellen B. Drake. Medical Transcription: Fundamentals and Practice (3rd Edition), Prentice Hall. 2007.
3. Cynthia Destafano Bsba Rt(r), Fran M. Federman Msed. Essentials of Medical Transcription: A Modular Approach, Saunders Publishers. 2004.
4. Cindy Destafano, Fran M. Federman, Cynthia Destafano. Advanced Medical Transcription: A Modular Approach [with Cdrom], W.b. Saunders Company Publishers. 2003.

15MBT152 BIOMEDICAL WASTE MANAGEMENT 2 0 0 2

Course Objective: This course aims to provide knowledge about source, types, handling, collection, and disposal and also it is ensure the proper and safe management of biomedical waste.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the basics, the Scope and importance of biomedical wastes
- CO – 2 : students will learn about types of wastes and composition.
- CO – 3: Students will also learn about Potential health hazards of biomedical wastes.
- CO – 4 : To learn Direct and Indirect hazards
- CO – 5: Students will learn about different approaches and understand the principles and methods of disposal of biomedical wastes.
- CO – 6: To understand the secured land fill
- CO – 7: Students will also learn about the different technologies of treatment and management of biomedical wastes.
- CO – 8: To learn Conventional treatment technologies
- CO –9: Students will understand the rules, policies and guidelines of biomedical wastes.
- CO – 10. To understand the WHO guidelines for biomedical wastes

UNIT I Introduction to biomedical waste 8

Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes(Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste , Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).

UNIT II Health impacts biomedical waste 6

Health impacts of biomedical wastes. Direct and Indirect hazards. Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices)

UNIT III Handling of biomedical waste 6

Biomedical waste – Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT IV Treatment and management of biomedical waste 6

Treatment and management of biomedical wastes-on site - pre treatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration)

UNIT V Legislation policies and rules of biomedical wastes 4

Environment and legislation policies and rules for handling and management of biomedical wastes. CPCB guidelines .WHO guidelines for biomedical wastes.

Total : 30hrs

TEXT BOOKS

1. Sharma – Holistic approach to Hospital Waste Management published by Dept. of
2. Bhide A. D.and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
3. Goel S. L, Hospital Management, 2009.
4. Radhakrishnan R , Biomedical Waste Management ,Neha Publishers & Distributors, 2007.

5. Behera P K, Sustainable Bio-Medical Waste Management (2 Vols.)Dominant Publishers And Distributors 1993

REFERENCE BOOKS

1. Hosetti, B. B. Prospects and perspective of solid waste management, 2006.
2. Glynn Henry J and Gary. W. Heinke, “Environmental Science and Engineering”, Pretice Hall of India, 2004.
3. Bhide A. D and B.B.Sundaresan, “Solid Waste Management – Collection, Processing and disposal” Mudrashilpa Offset Printers, Nagpur, 2001.
4. Glynn Henry J and Gary. W. Heinke, “Environmental Science and Engineering”, Pretice Hall of India, 2004.

15MBT153 BIOTECHNOLOGY AND HUMAN WELFARE 2 0 0 2

Course Objective: This course has been designed to introduce the various techniques in modern era of biotechnology. It focuses on industrial biotechnology, agriculture and medical biotechnology and molecular techniques for forensic science.

Course Outcome:

- CO – 1: At the end of the course the students will be educated about the products of industrial biotechnology.
- CO –2: Students will also gain knowledge relevant to the applications of agriculture biotechnology.
- CO –3: Students learn about interaction between plants and microbes.
- CO–4: Students will learn about the various techniques involved in environmental biotechnology.
- CO–5: To know about the degradation of hydrocarbons and agricultural wastes
- CO – 6: Students will also learn about the molecular techniques of forensic science
- CO – 7: To learn various methods of DNA finger printing
- CO – 8: Students will understand about health care products
- CO – 9: Students will receive knowledge about human genome project.
- Co – 10: To learn recombinant live vaccines

UNIT I Industrial Biotechnology 4

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II Agricultural Biotechnology 6

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III Environmental Biotechnology 8

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV Biotechnology in Forensic science 6

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V Biotechnology in medicine 6

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

Total : 30hrs

TEXT BOOKS

1. Patnaik, “Textbooks of Biotechnology”, McGraw Hill Education (India) Private Limited. 2012.
2. Satyanarayana, U, “A Textbooks of Biotechnology”, Bookss and Allied (p) Limited, 2013.
3. Sateesh MK, “Bioethics and Biosafety”, I. K. International Pvt Ltd, 2010.
4. Sree Krishna V, “Bioethics and Biosafety in Biotechnology”,New age international publishers, 2007.
5. Purohit S.S. “Agricultural Biotechnology”, 3rd eds, Agrobios, 2010.
6. Kumaresan V,” Biotechnology P, Saras Publication, 2015

7. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
8. Sandhya Jadhav ,A Text Book of Environmental Biology and Biotechnology 2nd Edition Vision, Publications 2012

REFERENCE BOOKS

1. Ellyn Daugherty, "Biotechnology: Science for The New Millennium", EMC Publishing, 2006,
2. Clark DP and Pazdernik NJ. "Biotechnology-Applying the Genetic Revolution". Elsevier Academic Press, USA. 2009.
3. Alan Scragg, "Environmental Biotechnology", Oxford; Second edition, 2007.

15MBT154 ENVIRONMENTAL BIOTECHNOLOGY 2 0 0 2

Course Objective: The topic represents a stand-alone, progressive topic leading the student through the key aspects of environmental microbiology prior to its subsequent application within environmental biotechnology.

Course Outcome:

- CO – 1: At the end of the course the students will understand the importance of conventional fuels and their environmental impacts
- CO – 2: Students will also gain knowledge relevant to the applications of Bioremediation to the environment.
- CO – 3: To understand the degradation of lignin and cellulose using microbes.
- CO – 4: To learn water contaminated with oil spills
- CO – 5: Students will learn about the various techniques involved in Phyto-remediation
- CO – 6: To know about the pesticides and other toxic chemicals by micro-organisms.
- CO– 7: Students learnt about the various methods in waste water treatment.
- CO – 8: To understand the Algal and fungal biofertilizers
- CO – 9:Students will alsogain the knowledge about Bioleaching
- CO – 10:To learn the importance of Genetically modified microorganisms.

UNIT I Biofuels 6

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II Bioremediation 6

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

UNIT III Phyto-remediation 6

Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms-degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT IV Waste water treatment and biofertilizer 6

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT V Biomining 6

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Environmental significance of genetically modified microbes, plants and animals.

Total : 30hrs

TEXT BOOKS

1. Pradipta Kumar Mohapatra, "Environmental Biotechnology", I.K. International Publishing House; 1st Ed. Edition, 2007.
2. Satyanarayana, U, "A Textbook of Biotechnology", Books and Allied (p) Limited, 2013.
3. Purohit S.S. "Agricultural Biotechnology", 3rd edition, Agrobios, 2010.

REFERENCE BOOKS

1. Alan Scragg, “Environmental Biotechnology”, Oxford; Second edition, 2007.
2. Hans-Joachim Jordening and Jesef Winter, “Environmental Biotechnology – Concepts and Applications”, Wiley VCH, 2004.
3. Metcalf and Eddy, “Waste Water Engineering”, 4th edition, Tata McGraw hill, 2003
4. Alicia L. Ragout De Spencer, John F.T. Spencer. “Environmental Microbiology: Methods and Protocols”, Humana Press, 2004.
5. Milton Wainwright, “An Introduction to Environmental Biotechnology”, Springer, 1999.

15MBT155 ENTREPRENEURSHIP DEVELOPMENT 2 0 0 2

Course Objective: Formulate strategies that reflect the interdisciplinary nature of the biotechnology industry in the areas of science, regulation and enterprise. Create marketing strategies that achieve organizational goals and objectives. Formulate product launch strategies in the biotechnological products approval and marketing process.

Course Outcome:

- CO – 1: To learn the Entrepreneurship
- CO – 2: Students will also develop achievement motivation and entrepreneurial skill.
- CO – 3: Students will learn about Project formulation
- CO –4: To understand the various financial and funding strategies for enterprise under various economic situations.
- CO – 5 : Students gain knowledge about Indirect raw material s and its management
- CO – 6 : To learn how to move for loans for Entrepreneurship
- CO –7:Students will also gain the knowledge about various strategies of marketing management.
- CO –8: Students will gain the knowledge about marketing strategies of import and export of biotechnology products.
- CO – 9: To understand the Institutional support for exports
- CO – 10: To learn the Project Report on a selected product should be prepared.

UNIT I Introduction 6

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

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UNIT II Establishing an enterprise 6

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III Financing the enterprise 6

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw material s and its management.

UNIT IV Marketing Management 6

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V Entrepreneurship and international business 6

Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports. Project Report on a selected product should be prepared and submitted.

Total : 30hrs

TEXT BOOKS

1. Gupta CB, Khanka SS. “Entrepreneurship and Small Business Management”, Sultan Chand & Sons, 2000.
2. Naidu N.V.R., T. Krishna Rao, “Management and Entrepreneurship”, I K International Publishing House Pvt. Ltd, 2008
3. Janakiram B., “Management and Entrepreneurship”, Excel Books, 2009.

REFERENCE BOOKS

1. Jack M. Kaplan (Author), Anthony C. Warren, “Patterns of Entrepreneurship Management”, John Wiley & Sons; 4th Edition edition, 2013.
2. Holt DH. “Entrepreneurship” New Venture Creation. Prentice-Hall, 1998.