SAURASHTRA UNIVERSITY

RAJKOT

(ACCREDITED GRADE "A" BY NAAC)

FACULTY OF PHARMACY

Syllabus for

M. Pharm.

(PHARMACEUTICAL BIOTECHNOLOGY)

Choice Based Credit System

With Effect From: 2017-18

Program Outcomes

POs of M. Pharm (Pharmaceutical Biotechnology)

Students of all post undergraduate pharmacy degree programs at the time of graduation will be able to learn

PO1: Research and development

The students will be able to generate ideas for research, analyse them, execute them and publish the findings.

PO2: Domain knowledge

Students will be able to acquire knowledge and comprehension of the core and specialization subjects of the respective pharmacy specialization.

PO3: Communication skills

Students will be able to learn communication by giving seminars, journal club and other organizational activities. They will be able to comprehend and write effective reports, make effective presentations and documentation.

PO4: Planning skills

Students will be able to demonstrate effective planning abilities including time management, resource management, and organizational skills. They will be able to develop and implement plans and organize work to meet deadlines.

PO5: Problem analysis

Students will be able to develop, critical thinking and analytical skills while solving problems and making decisions in dissertation research.

PO6: Usage of contemporary research tools and techniques

Students will be able to learn, select, and apply appropriate current methods and procedures in modern pharmaceutical research with an understanding of the limitations.

PO7: Social responsibilities

Students will be able to understand, analyze and communicate the value of their professional roles in society (e.g. as health care professionals, promoters of health, educators, managers, employers, employees).

PO8: Continuous learning

They will be able to recognize the need for continuous up gradation of their knowledge and skills

Program Specific Outcomes

PSOs of M. Pharm (Pharmaceutical Biotechnology)

PSO1:

Pharmaceutical Biotechnology aims to address mismatch between 'knowledge' gained by students and appropriate skill set required for technology development and implementation including present contemporary needs of economy.

PSO2:

Theoretical inputs on both basic and applied aspects of microbial biochemistry, immunology, bioprocess engineering, cell and molecular biology, drug discovery and many more things.

PSO3:

Extensive practical hands-on training in recombinant DNA technology, basic molecular biology techniques, animal tissue culture, fermentation, proteomics, diagnostic tests (ELISA), Western blot etc.

PSO4:

Extensive literature surveys to identify research gaps, formulating a research problem, designing research protocols and implementing them to generate data followed by interpretation to arrive at conclusions for the defined research problem.

Course Structure and Scheme of Examination

M. Pharm Pharmaceutical Biotechnology (MPB)

Semester-1

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
MPB 101 T	Modern Pharmaceutical Analytical Techniques	4	4	25	75	100	3
MPB 102 T	Microbial and Cellular Biology	4	4	25	75	100	3
MPB 103 T	Bioprocess Engineering and Technology	4	4	25	75	100	3
MPB 104 T	Advanced Pharmaceutical Biotechnology	4	4	25	75	100	3
MPB 105 P	Pharmaceutical Biotechnology Practical I	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	100	100	-
Total		**26**				**650**	

Semester-2

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
MPB 201T	Proteins and protein Formulation	4	4	25	75	100	3
MPB 202T	Immunotechnology	4	4	25	75	100	3
MPB 203T	Bioinformatics and Computer Technology	4	4	25	75	100	3
MPB 204T	Biological Evaluation of Drug Therapy	4	4	25	75	100	3
MPB 205P	Pharmaceutical Biotechnology Practical II	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	100	100	-
Total		**26**				**650**	

Semester-3

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
MRM 301T	Research Methodology and Biostatistics*	4	4	25	75	100	3
-	Journal club	1	1	25	-	25	-
-	Discussion/Presentation (Proposal Presentation)	2	2	50	-	50	-
-	Research Work*	14	28	-	350	350	1
Total		**21**				**525**	

***** Non-University Exam

Semester-4

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weig Seme Exa
-	Journal club	1	1	25	
-	Discussion/Presentation (Proposal Presentation)	3	3	75	
-	Research Work and Colloquium	16	31	-	
Total		**20**			

SEMESTER I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course code: MPB 101T

Theory: 4 Hrs. /Week

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Course Outcomes

CO1: Principles and basic theory behind several analytical techniques

CO2: Apply these techniques successfully in practical situations.

CO3: Design experiments both in vivo and in vitro for elucidating drug targets.

Course content

Unit 1 **12 Hrs**

1. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy.
2. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy
3. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.
4. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

Unit 2 **12 Hrs**

NMR spectroscopy:

Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy

Unit 3 **12 Hrs**

Mass Spectroscopy:

Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of

Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy

Unit 4 **12 Hrs**

Chromatography:

Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:

a) Paper chromatography

b) Thin Layer chromatography

c) Ion exchange chromatography

d) Column chromatography

e) Gas chromatography

f) High Performance Liquid chromatograph

g) Affinity chromatography

Unit 5 **12 Hrs**

Electrophoresis:

Principle, Instrumentation, working conditions, factors affecting separation and applications of the following:

a) Paper electrophoresis

b) Gel electrophoresis

c) Capillary electrophoresis

d) Zone electrophoresis

e) Moving boundary electrophoresis

f) Iso electric focusing

X ray Crystallography:

Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder diffraction technique, Types of crystals and applications of X ray diffraction.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, 6th edition, John Wiley & Sons.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi.

5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS.

6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi.

7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

SEMESTER I

MICROBIAL AND CELLULAR BIOLOGY

Course code: MPB 102T

Theory: 4 Hrs. /Week

Scope

This subject is designed to provide the advanced knowledge to the biotechnology students in invaluable areas of advanced microbiology which plays a crucial role in determining its future use and applications in medicine, drug discovery and in pharmaceutical industry.

Objective

At the completion of this course it is expected that the students will get an understanding about the following aspects;

- Importance of Microorganisms in Industry
- Central dogma of molecular biology
- Structure and function of cell and cell communication
- Cell culture technology and its applications in pharmaceutical industries.
- Microbial pathogenesis and correlating it to rational use of antimicrobial agents.

Course Outcomes

CO1: Importance of Microorganisms in Industry

CO2: Various biological processes which regulate the growth of microbes

CO3: Basics of molecular biology

CO4: Animal based cell cultures system which will help them to take up biological research such as vaccine preparation as well as placement in the relevant biotech industry.

Course content

Unit 1 **12 Hrs**

Microbiology Introduction –

Prokaryotes and Eukaryotes. Bacteria, fungi, actionomycetes and virus - structure, chemistry and morphology, cultural, physiological and reproductive features. Methods of isolation, cultivation and maintenance of pure cultures. Industrially important microorganisms - examples and applications.

Unit 2 **12 Hrs**

Molecular Biology:

Structure of nucleus and chromosome, Nucleic acids and composition, structure and types of DNA and RNA. Central dogma of molecular biology: Replication, Transcription and translation.

Gene regulation Gene copy number, transcriptional control and translational control.

RNA processing

Modification and Maturation, RNA splicing, RNA editing, RNA amplification. Mutagenesis and repair mechanisms, types of mutants, application of mutagenesis in stain improvement, gene mapping of plasmids- types purification and application. Phage genetics, genetic organization, phage mutation and lysogeny.

Unit 3 **12 Hrs**

Cell structure and function

Cell organelles, cytoskeleton & cell movements, basic aspects of cell regulation, bioenergetics and fuelling reactions of aerobics and anaerobics, secondary metabolism & its applications. Cell communication, cell cycle and apoptosis, mechanism of cell division. Cell junctions/adhesion and extra cellular matrix, germ cells and fertilization, histology – the life and death of cells in tissues.

Cell Cycle and Cytoskeleton

Cell Division and its Regulation, G-Protein Coupled Receptors, Kinases, Nuclear receptors, Cytoskeleton & cell movements, Intermediate Filaments.

Apoptosis and Oncogenes

a) Programmed Cell Death, Tumor cells, carcinogens & repair.

b) Differentiation and Developmental Biology

c) Fertilization, Events of Fertilization, In vitro Fertilization, Embryonic Germ Cells, Stem Cells and its Application.

Unit 4 **12 Hrs**

Principles of microbial nutrition

Physical and chemical environment for microbial growth, Stability and degeneration of microbial cultures.

Growth of animal cells in culture

General procedure for cell culture, Nutrient composition, Primary, established and transformed cell cultures, applications of cell cultures in pharmaceutical industry and research. Growth of viruses in cell culture propagation and enumeration. In-vitro screening techniques- cytotoxicity, anti-tumor, anti-viral assays.

Unit 5 **12 Hrs**

Microbial pathology

Identifying the features of pathogenic bacteria, fungi and viruses. Mechanism of microbial pathogenicity, etiology and pathology off common microbial diseases and currently recommended therapies for common bacterial, fungal & viral infections. Mechanism of action of antimicrobial agents and possible sites of chemotherapy.

REFERENCES

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn, Industrial Microbiology, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. David Freifelder, Molecular Biology, 2nd edition, Narosa Publishing House.
5. R. Ian Freshney, Culture of animal cells – A manual of Basic techniques, 6th edition, Wileys publication house.
6. David Baltimore, Molecular cell biology, W H Freeman & Co publishers.
7. Cell biology vol-I, II, III by Julio E. Cells
8. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

SEMESTER I

BIOPROCESS ENGINEERING AND TECHNOLOGY

Course code: MPB 103T

Theory: 4 Hrs. /Week

Scope

This paper has been designed to provide the knowledge to the biotechnology students in invaluable areas of bioprocess technology to develop skills to modify, design and operate different types of fermenters, to understand and implement various fermentation procedures, to train students in scale up fermentation operations.

Objective

At the completion of this subject it is expected that students will be able to,

- Understand basics and design of fermentation technology
- Scale up and scale down processing of fermentation technology
- Bioprocessing of the industrially important microbial metabolites in industries and R & D organizations.
- Regulation governing the manufacturing of biological products
- Understand and conduct fermentation process kinetics.

Course outcome

CO1: Appreciate relevance of microorganisms from industrial context;

CO2: Give an account of design and operations of various fermenters;

CO3: Present unit operations together with the fundamental principles for basic methods in production technique for bio-based products

CO4: Calculate yield and production rates in a biological production process, and also interpret data

CO5: Give an account of important microbial/enzymatic industrial processes in food and fuel industry.

Course content

Unit 1 **12 Hrs**

Introduction to fermentation technology

Basic principles of fermentation, Study of the design and operation of bioreactor. Ancillary parts and function, impeller design and agitation, power requirements on measurements and control of dissolved oxygen, carbon dioxide, temperature, pH and foam. Types of bioreactor CSTR, tower, airlift, bubble column, packed glass bead, hollow fiber, configuration and application Computer control of fermentation process System configuration and application.

Unit 2 **12 Hrs**

Mass transfer

Theory, diffusional resistance to oxygen requirements of microorganisms, measurements of mass transfer co- efficient and factor affecting them, effects of aeration and agitation on mass transfer, supply of air, air compressing, cleaning and sterilization of air and plenum ventilation, air sampling and testing standards for air purity.

Rheology

Rheological properties of fermentation system and their importance in bioprocessing.

Unit 3 **12 Hrs**

Scale up of fermentation process

- Principles, theoretical considerations, techniques used, media for fermentation, HTST sterilization, advantage and disadvantage, liquid sterilization.
- Cultivation and immobilized culture system
- Cultivation system - batch culture, continuous culture, synchronous cultures, fed batch culture. Graphical plot representing the above systems.
- Introduction to immobilization, Techniques, immobilization of whole cell, immobilized culture system to prepare fine chemicals. Immobilization of enzymes and their applications in the industry. Reactors for immobilized systems and perspective of enzyme engineering.

Unit 4 **12 Hrs**

Scale down of fermentation process

Theory, equipment design and operation, methods of filtration, solvent extraction, chromatographic separation, crystallization turbidity analysis and cell yield determination, metabolic response assay, enzymatic assay, bioautographic techniques and disruption of cells for product recovery.

Isolation and screening

Primary and secondary, maintenance of stock culture, strain improvement for increased yield.

Unit 5 **12 Hrs**

Bioprocessing of the industrially important microbial metabolites

a) Organic solvents – Alcohol and Glycerol

b) Organic acids - Citric acids, Lactic acids,

c) Amino acids - Glutamic acids, Lysine, Cyclic AMP and GMP

d) Antibiotics - Penicillin, Streptomycin, Griseofulvin,

e) Vitamins - B12, Riboflavin and Vitamin C

Biosynthetic pathways for some secondary metabolites, microbial transformation of steroids and alkaloids

Regulation governing the manufacturing of biological products.

REFERENCES

1. Peter Stanbury, Allan Whitaker, Stephen Hall, Principles of Fermentation technology, Elsevier stores.

2. L.E. Casida, Industrial Microbiology, John Wiley & sons Inc.

3. F.M. Asubel, Current protocols in molecular biology, volume I and II, John Wiley Publishers.

4. Biotol Board, Bioreactor design and product yield, Butterworth and Helhemann Publishers.

5. H. Patel, Industrial microbiology, Macmillan India Limited

SEMESTER I

ADVANCED PHARMACEUTICAL BIOTECHNOLOGY

Course code: MPB 104T

Theory: 4 Hrs. /Week

Scope

This paper has been designed to provide the knowledge to the students to develop skills of advanced techniques of isolation and purification of enzymes, to enrich students with current status of development of vaccines and economic importance of biotechnology products.

Objective

At the completion of this subject it is expected that students will be able to

- Understand about the latest technology development in biotechnology technique, tools and their uses in drug and vaccine development.
- Identify appropriate sources of enzymes.
- Understand and perform genetic engineering techniques in gene manipulation, r-DNA technology and gene amplification.
- Understand the overview of pharmacogenomics.
- Learn the regulatory approval process and key regulatory agencies for new drugs, biologics, devices, and drug-device combinations.

Course Outcome

CO1: The impact of genetic engineering in modern society, the students should be endowed with strong theoretical knowledge of this technology.

CO2: The basics of enzyme technologies used in pharmaceutical industry

CO3: Understand the overview of pharmacogenomics

Course content

Unit 1 **12 Hrs**

Enzyme Technology

Classification, general properties of enzymes, dynamics of enzymatic activity, sources of enzymes, extraction and purification, pharmaceutical, therapeutic and clinical application. Production of amyloglucosidase, glucose isomerase, amylase and trypsin.

Unit 2 **12 Hrs**

Genetic Engineering

Techniques of gene manipulation, cloning strategies, procedures, cloning vectors expression vectors, recombinant selection and screening, expression in *E. coli* and yeast.

Site directed mutagenesis, polymerase chain reaction, and analysis of DNA sequences.

Gene library and cDNA

Applications of the above technique in the production of,

a) Regulatory proteins: Interferon, Interleukins

b) Blood products: Erythropoietin

c) Vaccines: Hepatitis-B

d) Hormones: Insulin

Unit 3 **12 Hrs**

Therapeutic peptides

- Study on controlled and site specified delivery of therapeutic peptides and proteins through various routes of administration.
- Transgenic animals
- Production of useful proteins in transgenic animals and gene therapy.
- Human Genome
- The human genome project-a brief study, Human chromosome – Structure and classification, chromosomal abnormalities – Syndromes

Unit 4 **12 Hrs**

Signal transduction

Introduction, cell signalling pathways, Ion channels, Sensors and effectors, ON and OFF mechanisms, Spatial and temporal aspects of signaling, cellular process, development, cell cycle and proliferation, neuronal signaling, cell stress, inflammatory responses and cell death, signaling defects and diseases.

Oncogenes, Introduction, definition, various oncogenes and their proteins.

Unit 5 **12 Hrs**

Microbial Biotransformation

- Biotransformation for the synthesis of chiral drugs and steroids.
- Microbial Biodegradation
- Biodegradation of xenobiotics, chemical and industrial wastes, Production of single-cell protein,
- Applications of microbes in environmental monitoring.
- Biosensors, Definition, characteristics of ideal biosensors, types of biosensors, biological recognition elements, transducers, application of biosensors.

REFERENCES

1. Biotechnology-The biological principles: MD Trevan, S Boffey, KH Goulding and P.F. Stanbury.
2. Immobilization of cells and enzymes: Hosevear Kennadycabral & Bicker staff
3. Principles of Gene Manipulating: RW Old and S. B. Primrose.
4. Molecular Cell Biology: Harvey Lodish, David Baltimore, Arnold Berk, S Lawence Zipursky, Paul Matsudaira, James Darnell.
5. Modern Biotechnology: S.B Primros.
6. Gene transfer and expression protocols-methods in Molecular Biology, vol. VII, Edit E.T. Murray
7. Current protocols in Molecular Biology, Vo1. I & II F.M. Asubel, John Wiley Publishers
8. Current protocols in cellular biology, Vo1.1 & II John Wiley publishers.
9. Principles of human genetics; by Curt Stern, published by W.H. Freeman

SEMESTER I

PHARMACEUTICAL BIOTECHNOLOGY PRACTICAL – I

Course code: MPB 105P

Theory: 12 Hrs. /Week

Course Outcome

CO1: The basic biochemical tests and analytical techniques in the field of pharmaceutical sciences

CO2: Identify proper research lab working in area of biotechnology interests

CO3: Able to handle sophisticated analytical equipment

CO4: Able to isolate, characterize and identify common bacterial organism.

Practical

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry
7. Isolation and Purification of microorganism from the soil
8. Microbial contamination of Water and biochemical parameters.
9. Determination of Minimum Inhibitory concentration by gradient plate technique and serial dilution method.
10. UV- survival curve and Dark repair
11. Sterility test for pharmaceutical preparations
12. Sub culturing of cells and cytotoxicity assays.
13. Construction of growth curve and determination of specific growth rate and doubling time
14. Fermentation process of alcohol and wine production
15. Fermentation of vitamins and antibiotics
16. Whole cell immobilization engineering
17. Thermal death kinetics of bacteria
18. Replica plating
19. Bio-autography.

20. Isolation and estimation of DNA

21. Isolation and estimation of RNA

22. Isolation of plasmids

23. Agarose gel electrophoresis.

24. Transformation techniques

25. SDS – polyacrylamide gel electrophoresis for proteins

26. Polymerase chain reaction technique.

SEMESTER II

PROTEINS AND PROTEIN FORMULATIONS

Course code: MPB 201T

Theory: 4 Hrs. /Week

Scope

This course is designed to impart knowledge and skills necessary for knowing fundamental aspects of proteins and their formulations is a part of drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of information for protein formulation and design are provided to help the students to clarify the various biological concepts of protein.

Objective

At the completion of this course it is expected that students will be able to understand,

- Various methods of purification of proteins
- Peptides in drug development
- Protein identification and characterization
- Protein based formulations
- Sequencing proteins

Course Outcome

CO1: Identify structural, function and membrane proteins and develop skills on various techniques used in functional proteomics such as mRNA expression and miRNA expression and Interpret data obtained through high throughput expression studies.

CO2: Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications

CO3: Bioinformatics tools to solve problems in biochemistry, molecular biology and biomedicine.

CO4: Different methodologies, techniques and tools commonly used in protein sequencing, assembly and annotation, interatomic and metabolomics

Course content

Unit 1 **12 Hrs**

Protein engineering

Concepts for protein engineering. Isolation and purification of proteins, Stability and activity-based approaches of protein engineering, Chemical and Physical Considerations in Protein and Peptide Stability, Different methods for protein engineering, gene shuffling, and direct evolution.

Unit 2 **12 Hrs**

Peptidomimetics

Introduction, classification; Conformationally restricted peptides, design, pseudopeptides, peptidomimetics and transition state analogs; Biologically active template; Amino acid replacements; Peptidomimetics and rational drug design; CADD techniques in peptidomimetics; Development of non-peptide peptidomimetics.

Unit 3 **12 Hrs**

Proteomics

Protein identification and characterization: Methods/strategies, protein identification, de novo protein characterization, Isotope labelling, N- and C-terminal tags

2-Dimensional gel electrophoresis

Methods including immobilized pH gradients (IPGs), resolution, reproducibility and image analysis, future developments

Unit 4 **12 Hrs**

Protein formulation

Different strategies used in the formulation of DNA and proteins, Analytical and biophysical parameters of proteins and DNA in pre- formulation, Liposomes, Neon-spears, Neon-particulate system, PEGylation, Biological Activity, Biophysical Characterization Techniques, Forced degradation studies of protein.

Unit 5 **12 Hrs**

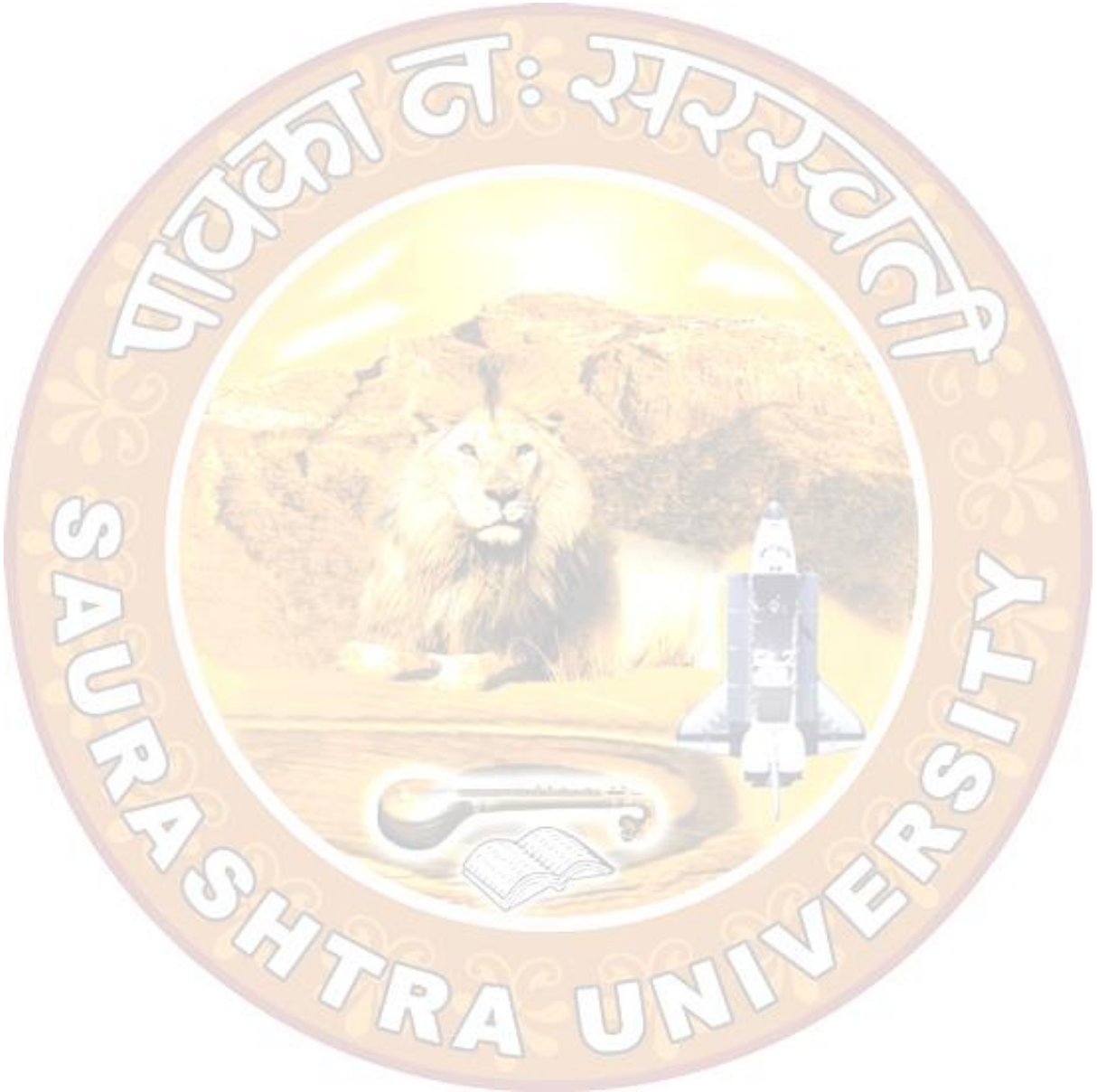
Methods of protein sequencing

Various methods of protein sequencing, characterisation, Edman degradation, Tryptic and/or Chymotryptic Peptide Mapping.

REFERENCES

1. H. Lodish Et. Al. Molecular Cell Biology, W. H. Freeman and Company
2. Protein Purification – Hand Book, Amersham pharmacia biotech
3. Engelbert Buxbaum, Fundamentals of Protein Structure and Function, Springer Science
4. Sheldon J. Park, Jennifer R. Cochran, Protein Engineering and Design, CRC press.
5. Robert K. Skopes. Protein purification, principle and practice, springer link.
6. David Whitford, Proteins-Structure and Function, John Wiley & Sons Ltd.
7. James Swarbrick, Protein Formulation and Delivery Informa Healthcare USA, Inc.

8. Rodney Pearlman, Y. John Wang Formulation, Characterization, and Stability of Protein Drugs, Kluwer Academic Publishers.



SEMESTER II

IMMUNOTECHNOLOGY

Course code: MPB 202T

Theory: 4 Hrs. /Week

Scope

This course is designed to impart knowledge on production and engineering of antibodies, the application of antigens, the design of (recombinant) vaccines, strategies for immune intervention, etc. The Immunotechnology - based techniques will be used for therapeutics and diagnostics, industries in the production, quality control and quality assurance, and in R&D.

Objective

After this course, the students will be able to:

- Understand the techniques like immunodiagnostic tests,
- Characterization of lymphocytes, purification of antigens and antibody, etc.
- Access health problems with immunological background;
- Develop approaches for the immune intervention of diseases.

Course Outcome

CO1: Evaluate the usefulness of immunology in different pharmaceutical companies

CO2: Identify the proper research lab working in the area of their own interests

CO3: Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.

Course content

Unit 1 **12 Hrs**

Fundamental aspects of immunology

Introduction, cells and organs of the immune system, cellular basis of Immune response, primary and secondary lymphoid organs, antigen antibody and their structure.

Types of immune responses, anatomy of immune response. Overview of innate and adaptive Immunity. Humoral Immunity

B – Lymphocytes and their activation. Structure and function of immunoglobulins, idiotypes and anti-idiotypic antibodies.

Cell mediated Immunity

Thymus derived lymphocytes (T cells) – their ontogeny and types, MHC complex, antigen presenting cells (APC), mechanisms of T cell activation, macrophages, dendritic cells, langerhans cells, mechanism of phagocytosis

Unit 2 **12 Hrs**

Immune Regulation and Tolerance

Complement activation and types and their biological functions, cytokines and their role in immune response.

Hypersensitivity

Types I-IV, Hypersensitivity reactions and treatment.

Autoimmune diseases

Unit 3 **12 Hrs**

Vaccine technology

Vaccine and their types, conventional vaccines, novel methods for vaccine production, antiidiotype vaccine, DNA vaccine, genetically engineered vaccine, ISCOMS, synthetic peptides, and immunodiagnostics.

Stem cell technology

Stem cell technology and applications to immunology

Unit 4 **12 Hrs**

Hybridoma Technology

Hybridoma techniques – fusion methods for myeloma cells and B- Lymphocytes, selection and screening techniques. Production and purification of monoclonal antibodies and their applications in Pharmaceutical industry.

Unit 5 **12 Hrs**

Immunological Disorder

Autoimmune disorders and types, pathogenic mechanisms, treatment, experimental models of auto immune diseases, primary and secondary immunodeficiency disorders.

Immunodiagnosis

Antigen antibody interaction – Precipitation reaction, Agglutination reactions, Principles and applications of ELISA, Radio Immuno Assay, Western blot analysis, immune-electrophoresis, immune fluorescence, chemiluminescence assay, complement fixation reaction.

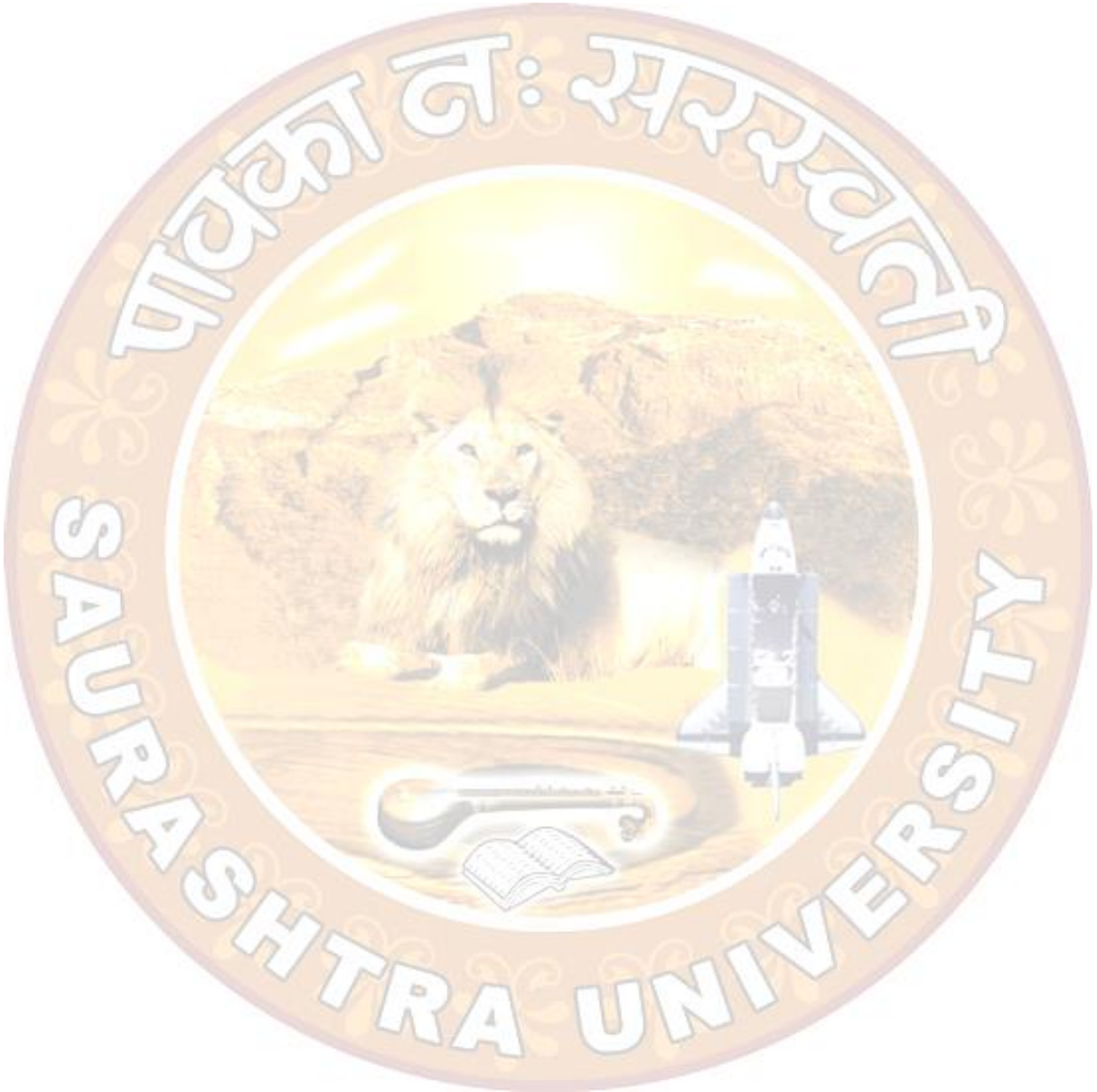
REFERENCES

1. J. Kubey, Immunology – an Introduction.

2. S.C. Rastogi, Immunodiagonstics, New Age International.

3. Ashim Chakravarthy, Immunology and Immunotechnology, Oxford University Press.

4. E. Benjamini, Molecular Immunology.



SEMESTER II

BIOINFORMATICS AND COMPUTATIONAL BIOTECHNOLOGY

Course code: MPB 203T

Theory: 4 Hrs. /Week

Scope

This paper has been designed to provide the advanced knowledge to the biotechnology students in invaluable areas of advanced bioinformatics which plays a crucial role in determining its future use and applications in medicine, drug discovery and in pharmaceutical industry.

Objectives

Upon completion of this course it is expected that the students will be able to understand,

- Use of computers in developing a new drug
- Biological concepts for bioinformatics
- Proteins and their diversity
- Various gene finding methods
- Searching the biological databases
- Target searching
- Various methods of drug designing

Course outcome

CO1: Develop an understanding of the basic theory of these computational tools

CO2: Develop required database extraction, integration, coding for computational tools and methods necessary for all Omics

CO3: Create hypothesis for investigating specific contemporary biological questions, provide help to experiment with or develop appropriate tools, Searching the biological databases and understanding various methods of drug designing

Course content

Unit 1 **12 Hrs**

Introduction to Bioinformatics

Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Applications of Data Mining to Bioinformatics,

Biological Database

Protein and nucleic acid databases. Structural data bases. Collecting and storing the sequence and Applications of Bioinformatics.

Unit 2 **12 Hrs**

Sequence analysis

Sequence alignment, pair wise alignment techniques, multiple sequence analysis, multiple sequence alignment; Flexible sequence similarity searching with the FAST3 program package, the use of CLUSTAL W and CLUSTAL X for the multiple sequence alignment. Tools used for sequence analysis.

Unit 3 **12 Hrs**

Protein informatics

Introduction; Force field methods; Energy, buried and exposed residues, side chains and neighbours; Fixed regions, hydrogen bonds, mapping properties onto surfaces; Fitting monomers, R & S fit of conformers, assigning secondary structures; Sequence alignment-methods, evaluation, scoring; Protein completion, backbone construction and side chain addition; Small peptide methodology, software accessibility, building peptides; Protein displays; Substructure manipulations, annealing.

Protein structure prediction

Protein folding and model generation; Secondary structure prediction, analyzing secondary structures; Protein loop searching, loop generating methods, loop analysis; Homology modeling, concepts of homology modeling, potential applications, description, methodology, homologous sequence identification; Align structures, align model sequence; Construction of variable and conserved regions, threading techniques, Topology fingerprint approach for prediction, evaluation of alternate models; Structure prediction on a mystery sequence, structure aided sequence techniques of structure prediction, structural profiles, alignment algorithms, mutation tables, prediction, validation, sequence based methods of structure prediction, prediction using inverse folding, fold prediction; Significance analysis, scoring techniques, sequence- sequence scoring.

Docking

Docking problems, methods for protein- ligand docking, validation studies and applications; Screening small molecule databases, docking of combinatorial libraries, input data, analyzing docking results.

Unit 4 **12 Hrs**

Diversity of Genomes

- Prokaryotic and Eukaryotic Gene Families. Genome Analysis: Introduction, Gene prediction methods,
- Gene mapping and applications- Genetic and Physical Mapping, Integrated map,
- Sequence assembly and gene expression.

- Completed Genomes
- Bacterium, Nematode, Plant and Human
- Evolution of Genomes
- Lateral or Horizontal Transfer among Genomes, Transcriptome and Proteome- General Account
- Phylogenetic analysis
- Evolutionary Change in Nucleotide Sequences, Rates and Patterns of Nucleotide Substitution, Models for Nucleotide Substitution, Construction of Phylogenetic Tree, Genome Annotation technique.

Unit 5 **12 Hrs**

Target searching and Drug Designing

Target and lead, timeline for drug development, target discovery, target modulators, In-silico gene expression, microarray, and lead discovery, libraries of ligands, active site analysis, and prediction of drug quality.

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1. David W. Mount, Bioinformatics Sequence and Genome Analysis, CBS Publishers and Distributors

2. S. C. Rastogiet. al. Bioinformatics- Concepts Skill and Applications, CBS Publishers and Distributors

3. T. E. Creighton, Protein Structure and Molecular Properties, W. H.Freeman and Company

4. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics; A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, Inc.

5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press.

6. Shui Qing Ye. Bioinformatics: A Practical Approach, Chapman & Hall/CRC.

7. David Posada, Bioinformatics for DNA Sequence Analysis, Humana press.

8. Lesk, A.M. Introduction to Bioinformatics. Oxford University Press.

9. Letovsky, S.I. Bioinformatics. Kluwer Academic Publishers.

10. Baldi, P. and Brunak, S. Bioinformatics. The MIT Press.

SEMESTER II

BIOLOGICAL EVALUATION OF DRUG THERAPY

Course code: MPB 204T

Theory: 4 Hrs. /Week

Scope

This paper has been designed to provide the knowledge to the biotechnology students to understand the importance of biological and evaluation of drug therapy of biological medicines.

Objective

At the completion of this subject it is expected that students will be able to,

- Understand about the general concept of standardization of biological.
- Understand the importance of transgenic animals and knockout animals.
- Understand the biological medicines in development of various diseases.
- Learn the biological evaluation of drugs in vitro and in vivo

Course Outcome

CO1: Knowledge to understand the importance of biological and evaluation of drug therapy of biological medicines.

CO2: Understanding about the general concept of standardization of biological.

CO3: Understanding the importance of transgenic animals and knockout animals.

CO4: Understanding the biological medicines in development of various diseases.

CO5: Biological evaluation of drugs in vitro and in vivo

Course content

Unit 1 **12 Hrs**

Biological Standardization

- General principles, Scope and limitation of bio-assay, bioassay of some official drugs.
- Preclinical drug evaluation
- Preclinical drug evaluation of its biological activity, potency and toxicity-Toxicity test in animals including acute, sub-acute and chronic toxicity, ED50 and LD50 determination, special toxicity test like teratogenecity and mutagenecity.
- Guidelines for toxicity studies

- Various guidelines for toxicity studies. Animal experiments assessing safety of packaging materials.

Unit 2 **12 Hrs**

Pyrogens

- Pyrogens: Sources, Chemistry and properties of bacterial pyrogens and endotoxins, Official pyrogen tests.
- Microbiological assay
- Assay of antibiotics and vitamins.
- Biological evaluation of drugs
- Screening and evaluation (including principles of screening, development of models for diseases: In vivo models / In vitro models / cell line study)

Unit 3 **12 Hrs**

Biologic Medicines in Development for various diseases - By Therapeutic Category

a) Genetic Disorders
b) Eye related Disorders
c) Digestive Disorders
d) Diabetes/Related Conditions
e) Cardiovascular Disease
f) Cancer/Related Conditions
g) Blood Disorders
h) Autoimmune Disorders
i) Infectious Diseases
j) Neurologic Disorders
k) Skin Diseases
l) Organ Transplantation

Biologic Medicines in Development for various diseases –by Product Category

a) Antisense
b) Vaccines
c) Recombinant Hormones/Proteins
d) Monoclonal Antibodies (mAb)

e) Interferons

f) Growth Factors

g) Gene Therapy

h) RNA Interference

Unit 4 **12 Hrs**

Regulatory aspects of drugs, biologics and medical devices

An introduction to the regulations and documents necessary for approval of a medical product.

Regulatory consideration

Regulatory consideration for pre-clinical testing and clinical testing of drugs, biologics and medical devices.

New Drug Applications for Global Pharmaceutical Product Approvals

Unit 5 **12 Hrs**

Bioavailability

- Objectives and consideration in bio-availability studies of Biopharmaceuticals, Concept of equivalents, Measurements of bio-availability.
- Determination of the rate of absorption, Bioequivalence and its importance, Regulatory aspects of bio-availability and bioequivalence studies for conventional dosage forms and controlled drug delivery systems of Biopharmaceuticals.

Pharmacokinetics

Basic consideration, Pharmacokinetic models, Application of Pharmacokinetics in new drug development of Biopharmaceuticals and designing of dosage forms and Novel drug delivery systems of Biopharmaceuticals.

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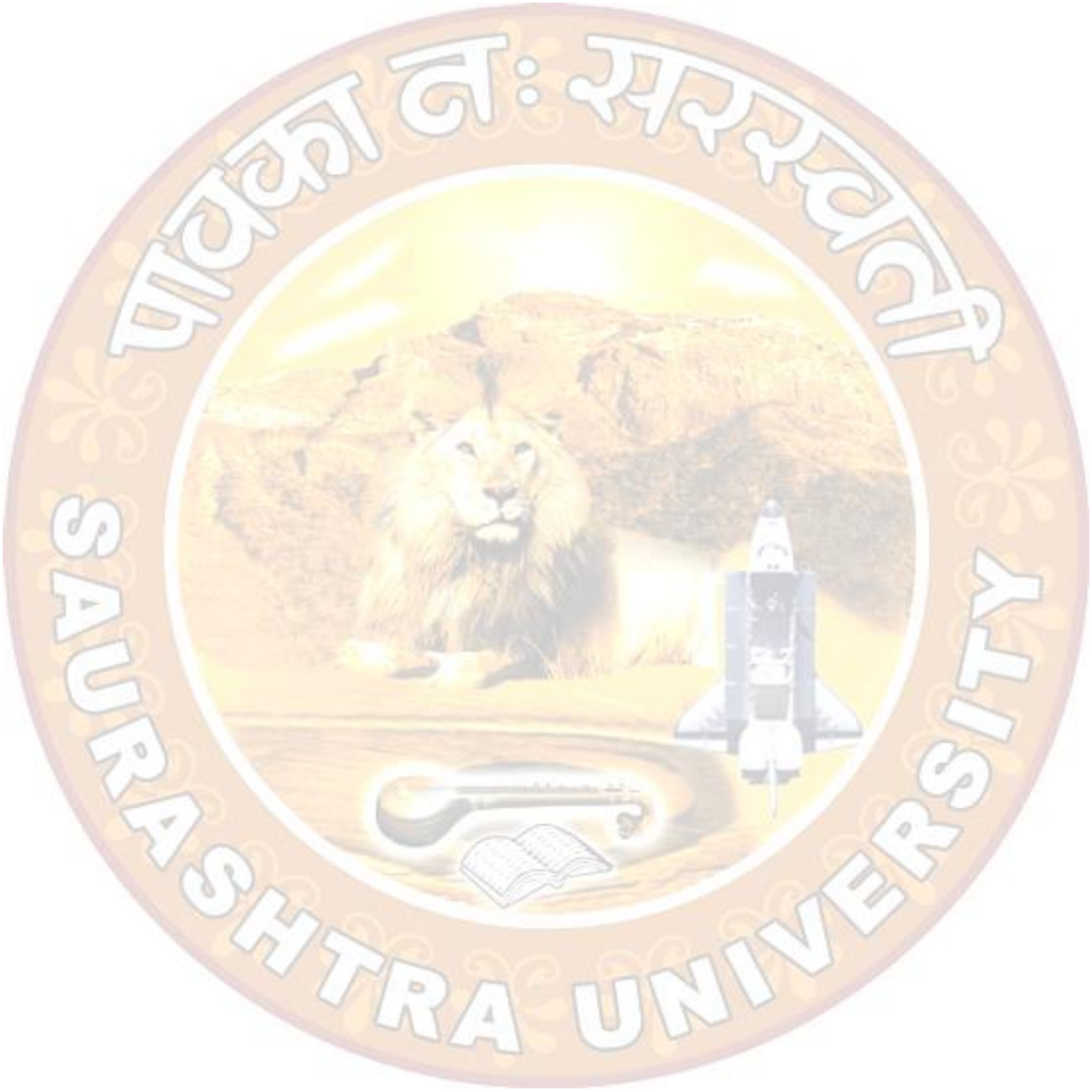
2. J.H. Burn., Biological Standardization, Oxford University Press
3. Drug Discovery and Evaluation in Pharmacology assay: Vogel
4. Chow, Shein, Ching, Design and analysis of animal studies in pharmaceutical development,
5. Nodine and Siegler, Animal and Clinical pharmacologic Techniques in Drug Evaluation.

6. Screening methods in pharmacology (vol I & II), R.A. Turner.



SEMESTER II

PHARMACEUTICAL BIOTECHNOLOGY PRACTICAL - II

Course code: MPB 205P

Theory: 12 Hrs. /Week

Course Outcome

CO1: Acquire basic microbiology techniques and principles;

CO2: Get first-hand experience that will coincide with what is taught in the lecture portion of the class

CO3: Gain hands-on experience in gene cloning, protein expression and purification.

Practical

1. Protein identification
2. Protein characterization
3. Protein biochemistry
4. Recombinant DNA Technology
5. Protein expression
6. Protein formulations
7. Database searching
8. Sequence analysis methods
9. Protein structure prediction
10. Gene annotation methods
11. Phylogenetic analysis
12. Protein, DNA binding studies
13. Preparation of DNA for PCR applications – Isolation, Purity and Quantification
14. Introduction to PCR – working of PCR, Programming.
15. Introduction to RT-PCR – working, programming.
16. Primer design using software.
17. Gene DNA amplification by random / specific primers.
18. Southern Hybridization
19. Western Blotting
20. Gene transformation

SEMESTER III

RESEARCH METHODOLOGY & BIOSTATISTICS

Course code: MRM 301T

Theory: 4 Hrs. /Week

Scope

The research methodology is the specification of method of acquiring the information needed to structure or solve the problem

Objectives

The purpose of research is to discover answers to questions through the application of scientific procedures.

Course Outcome

CO1: Students should know why educational research is undertaken, and the audiences that profit from research studies.

CO2: Students should be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.

CO3: To learn and develop skill in statistical tests and its application in research

CO4: Students should be familiar with how to write different components of good research paper

CO5: Knowledge about the CPCSEA guidelines for laboratory animal facility

Course content

Unit 1 **12 Hrs**

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

Unit 2 **12 Hrs**

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students 't' test, ANOVA, Correlation coefficient, regression), non-parametric tests (Wilcoxon rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

Unit 3 **12 Hrs**

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-

maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

Unit 4 **12 Hrs**

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

Unit 5 **12 Hrs**

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.