

NORTH MAHARASHTRA UNIVERSITY, JALGAON
STRUCTURE AND SYLLABUS
 (w. e. f. Academic year 2006-07)
M. PHARM. COURSE STRUCTURE
SPECIALIZATION: CLINICAL PHARMACY

Goal: To provide a knowledge base in core pharmacy practice subjects of pharmacotherapeutics, clinical pharmacy and hospital & community pharmacy to practice efficiently in the community and hospital settings to promote quality and safe use of medicines.

ANNEXURE

Semester	No. and Title of Paper	Scheme of Teaching Hours/week		Scheme of Examination		Total		
		Lectures	Practical	Hrs. Marks	Practical Hrs. Marks			
I	Advanced Analytical Techniques	3	6	3	100	6	100	200
	Advanced Clinical Pharmacy & Pharmacotherapeutics-I	3	6	3	100	6	100	200
	(Elective-I)	3		3	100	-	-	100
	Seminar	1 Per student		A/B/C/D				-
	Research work		15					
II	Advanced Clinical Pharmacy & Pharmacotherapeutics-II	3	6	3	100	6	100	200
	(Elective-II)	03		3	100	-	-	100
	Hospital and Community Pharmacy	03		3	100	-	-	100
	(Elective-III)	03		3	100	-	-	100
	Seminar	1 Per student		A/B/C/D				-
	Research work		15					
III	Seminar on research work done	1 Per student		A/B/C/D				
	Research work		35					
IV	Seminar on research work done	1 Per student		A/B/C/D				
	Dissertation and viva voce		35					300
GRAND TOTAL								1200

NOTE: (1) A/B/C/D indicates the grade secured by the student in the Seminar
 (2) Theory and Practical are separate heads
 * Elective II should be related to Branch of specialization
 (3) Distribution of Marks for dissertation and Viva-Voce shall be as under:

<u>Dissertation Work</u>		<u>Viva - Voce</u>	
(a) Reference work	= 30	(a) Scientific contents	= 20
(b) Experimental Work	= 60	(b) Presentation / Communications	= 20
(c) Scientific Contents	= 20	(c) Discussion	= 40
(d) Presentation/ Communication	= 40	(d) Report	= 40
(e) Result/ Conclusion	= 30		
Total Marks	= 200	Total Marks	= 100

Advanced Clinical Pharmacy and Pharmacotherapeutics-I
Theory (45 hrs) 3hrs/week

(1) Cardiovascular System

Hypertension, Congestive cardiac failure, Ischemic heart disease, Myocardial infarction, Arrhythmias, Hyperlipidemias

(2) Respiratory system

Asthma, Chronic obstructive airways diseases, Drug acting on pulmonary diseases

(3) Haematological diseases

Anaemia's, deep vein thrombosis, drug induced haematological diseases

(4) Arthritic diseases.

Rheumatoid arthritis, osteoarthritis, gout, systemic lupus erythematosus

(5) Gastrointestinal system

Peptic ulcer diseases, reflux oesophagitis, inflammatory bowel diseases, hepatitis, jaundice & cirrhosis, diarrhoea & constipation, drug induced liver diseases

(6) Pain management

Pain pathways, analgesics and NSAIDS, neuralgias including herpetic, trigeminal and glossopharyngeal neuralgia

(7) Immunology

Autoimmunity- Definition, classification, mechanism of autoimmune disease, pathogenesis of autoimmunity, immunoglobulins

(8) Prescribing guidelines for

Paediatric patients, Geriatric patients, Pregnancy and breast feeding

(9) Definition, development, Scope

(10) Introduction to daily activities of a clinical pharmacist

Drug therapy monitoring (medication chart review, clinical review, pharmacist intervention)

Ward round participation

Adverse drug reaction management

Drug information and poison information

Medication history, Patient counselling

Pharmaceutical care

Drug utilization evaluation (DUE) and review (DUR)

Quality assurance of clinical pharmacy service

(11) Patient data analysis

Patient case history, its structure and use in evaluation of drug therapy and understanding common medical abbreviation and terminologies use in clinical pharmacy.

Communication skill including patient counselling techniques, medication history, Interview presentation of cases, teaching skills.

Clinical laboratory tests used in evaluation of disease state, and interpretation of test result like: Haematological, Liver function, Renal function, Thyroid function test

Tests associated to cardiac disorders.

Fluid and electrolyte balance.

Microbial culture sensitivity test.

Pulmonary function test.

10) Statistics

Basic concept of biomedical statistics.

Descriptive and differential statistics.

Statistical test parametric and non parametric.

Sample size calculation.

Confidence intervals, Test of significance.

Advanced Clinical Pharmacy and Pharmacotherapeutics-I
Practical (6 Hrs per week)

Patient medication history interview, answering drug information questions, patient medication counselling, participation in ward rounds. Case studies related to laboratory investigations covering the topics dealt with in theory class.

Detail on the practical:

Following aspects should be studied in detail in each ward round. Case presentation should be done in the department. The cases being studied and the follow up studies should be recorded in the practical record books highlighting Subjective, Objective, Assessment and plan details on each case.

1. Answering drug information related questions (Queries related to dosage, administration, contraindications, adverse drug reactions, drug interactions, drug use in pregnancy and lactation, drug profile, efficacy and safety)
2. Patient medication counselling (common diseases like diabetes, Asthma, Hypertension, TB, COPD)
3. Case studies related to laboratory investigations (Haematology, thyroid, renal, cardiac enzymes) Patient medication interview, medication order review, detection and assessment of adverse drug reactions and their documentation.
4. The case presentations in the department should include cases of the following diseases.
 1. Diabetes Type-I
 2. Diabetes Type-II
 3. Hyperthyroidism
 4. Hypothyroidism
 5. Acute renal failure
 6. Chronic renal failure
 7. Schizophrenia
 8. Depression
 9. Anxiety
 10. Epilepsy
 11. Parkinsonism

References:

1. Clinical Pharmacy & Therapeutics- Roger & Walker, Churchill Livingstone publications.
2. Pharmacotherapy: A Pathophysiologic Approach- Joseph T. Dipiro et al, Appleton & Lange
3. Pathologic Basis of Disease-Robinson SL, WB Saunders Publications.
4. Pathology and Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice. Green and Harris, Chapman and Hall Publications.
5. Clinical Pharmacy & Therapeutics- Eric T Hefindal, Williams & Wilkins Publications.
6. Applied Therapeutics: The Clinical Use of Drugs. Lloyd Young and Koda-Kimble MA (ISBN-0333-65881-7)
7. Avery's Drug Treatment, 4th Edn 1997, Adis International Ltd
8. Basic skills in interpreting laboratory data- Scott L. T. American Society of Health System Pharmacists
9. Practice Standards and Definitions- The Society of Hospital Pharmacists-Australia, 1997

1. Clinical Pharmacokinetics- Rowland and Tozer, Williams and Wilkins Publications
2. Biopharmaceutics and Applied Pharmacokinetics- Leon Shargel, Prentice and Hall publications
3. Relevant review articles from recent medical and Pharmaceutical Journals

Journals:

British Medical Journal

Annals of Pharmacotherapy

New England Journal of Medicine

Lancet

Pharmaceutical Journal Royal Pharmaceutical Society, London

Journal of Pharmacy and Research Society of Hospital Pharmacists of Australia

International Journal of Pharmacy practice UK

Hospital Pharmacist, UK

Indian Journal of Hospital Pharmacy

Semester Practical Examination

Synopsis 20 marks

Major Experiment 35 marks

Minor Experiment 25 marks

Viva-voce 20 marks

Total 100 marks

Advanced Clinical Pharmacy and Pharmacotherapeutics-II (Theory)

(45 hrs) 3hrs/week

Pathophysiology and pharmacotherapy of diseases associated with following system

1. **Renal System:** Acute/Chronic renal failure, Renal dialysis and transplantation, Drug induced renal diseases
2. **Central Nervous System:** Ischemia, headache, epilepsy, Parkinsonism
3. **Endocrine system:** Thyroid disease , Oral contraceptives , Hormone replacement therapy, Osteoporosis
4. **Psychiatric diseases:** Schizophrenia ,depression , anxiety, sleep disorders, drug induced psychosis
5. **Infectious diseases:** General guidelines for the rational use of antibiotics, meningitis, respiratory tract infections, gastroenteritis bacterial endocarditis septicemia, Otitis media, urinary tract infection, tuberculosis, leprosy, malaria, helmentiasis, HIV and opportunistic infections, Fungal infections, Rheumatic fever.
6. **Neoplasia:** General principle of cancer chemotherapy , commonly use cytotoxic drugs , chemotherapy of lung cancer , cytological malignancy , management of nausea and vomiting
7. **Drug and poison information**

Introduction to drug information resource available.

Systemic approach in answering DI queries.

Critical evaluation of drug information and literature.

Preparation of return and verbal reports.

Establishing a drug information centre.

Poison information -organisation and information resources

8. Clinical pharmacokinetics

Clinical pharmacokinetics models.

Physiological determination of drug clearance and volume of distribution

Renal and non-Renal clearance.

Organ extraction and models of hepatic clearance.

Estimation and determination of bioavailability.

Multiple dosing.

Calculation of loading and maintenance dose.

Dose adjustment in renal failure, Hepatic dysfunction, Geriatric and paediatric patient, Therapeutic drug monitoring (general aspects)

9. Research design and conduct of clinical trials

Research support including planning and execution of clinical trials

Guidelines for good clinical research practise and Ethical requirements

Various phases of clinical trials

Categories of phase IV studies

Monitoring and auditing of clinical trials

Advanced Clinical Pharmacy and Pharmacotherapeutics - II

Practicals: (6 hrs per week)

Case presentations and patient counselling (at least 10 cases related to following diseases should be presented). During ward rounds and interactions with the clinical staff, students are expected to maintain the record of cases presented and the same should be submitted at the end of the course for the evaluation. A minimum of 10 cases should be studied in detail and recorded covering most of the common diseases. The list of clinical cases should include follow up of the cases from the admission till discharge.

References:

1. Clinical Pharmacy & Therapeutics- Roger & Walker, Churchill Livingstone publications.
2. Pharmacotherapy: A Pathophysiologic Approach- Joseph T. Dipiro et al, Appleton & Lange.
3. Pathologic Basis of Disease-Robinson SL, WB Saunders Publications.
4. Pathology and Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice- Green and Harris, Chapman and Hall Publications.
5. Clinical Pharmacy & Therapeutics- Eric T Hefindal, Williams & Wilkins Publications.
6. Applied Therapeutics: The Clinical Use of Drugs. Lloyd Young and Koda-Kimble MA (ISBN-0333-65881-7)
7. Avery's Drug Treatment, 4th Edn 1997, Adis International Ltd
8. Basic skills in interpreting laboratory data- Scott L T. American Society of Health System Pharmacists.
9. Practice Standards and Definitions- The Society of Hospital Pharmacists-Australia, 1997
10. Clinical Pharmacokinetics- Rowland and Tozer, Williams and Wilkins Publications
11. Biopharmaceuticals and Applied Pharmacokinetics- Leon Shargel, Prentice and Hall publications
2. Relevant review articles from recent medical and Pharmaceutical Journals

Journals:

British Medical Journal

Annals of Pharmacotherapy

New England Journal of Medicine

Lancet

Pharmaceutical Journal, Royal Pharmaceutical Society, London

Journal of Pharmacy and Research Society of Hospital Pharmacists of Australia

International Journal of Pharmacy practice, UK

Hospital Pharmacist, UK

Indian Journal of Hospital Pharmacy

Semester Practical Examination

Synopsis 20 marks

Major Experiment 35 marks

Minor Experiment 25 marks

Viva-voce 20 marks

Total 100 marks

Elective - Hospital & community pharmacy

(45 hrs) 3hrs/week

1) Hospital organisation:

Pharmacy and Therapeutics Committee and role of hospital pharmacist

2) Hospital drug policy:

Drug committee, Formulary and guide lines, other hospital committees such as infection control committee and research and ethics committee

3) Hospital pharmacy management:

Staff (professional, non-professional) materials (drugs, non-drugs and consumables), financial (drug budget, cost centre, source of revenue, revenue collection), policy and planning, infrastructure requirements (building, furniture, specialised equipment, maintenance and repairs), Workload statistics.

4) Drug distribution:

Purchasing, warehousing (storage condition, expiry date control recycling of drugs, stock tacking, drug recalls), Drug distributing methods (Ward stock, individual patient dispensing, unit dose), Specific requirements for in patient, out patients, casualty/Emergency. Operation theatres, ICU/CCU, Drugs of dependence, Hospital waste management.

5) Manufacturing:

Sterile and non sterile production, including total parental nutrition, cytotoxics, radiopharmaceutical IV additives service, pre-packaging and labelling, Quality control.

6) Education and training:

Training of technical staff, Training and continuing education for pharmacists. Pharmacy student. Medical staff and student, Nursing staff and student. Formal and informal meeting and lectures, Drug and therapeutics news letter.

Ethical issues in biomedical research - Principle of ethics in biomedical research, good clinical practice (ICH GCP guideline), ethical committee (institutional review board), its constitution and functions, Ethics of publication.

7) Community pharmacy:

1. The role of community pharmacy and its relationships to other local health care providers
2. Prescribed medication order - Interpretation and legal requirements
Communications skills- communications with prescribers and patients.
3. Over the counter (OTC) sales
4. Primary healthcare in hospital pharmacy
Family planning, first aid, Participation in primary health care programs.
Smoking cessation, screening programs
5. Services to nursing homes / clinics
6. Community pharmacy management
Financial materials, staff infrastructure, requirements. Drug information, resources and computers
7. Code of ethics for community pharmacist

8. Pharmacoepidemiology

Definition and scope, Methods (Sources of data, study design, drug utilisation studies, Meta analysis)

Social cultural, economic factor influencing drug use.

System for monitoring drug effects

Advantages and disadvantages of pharmacoepidemiology

9. Pharmacoeconomics: Definition and scope, Types of economic evaluation, cost models and cost effectiveness analysis.

References:

1. Hospital Pharmacy- Hassan W F, Lee and Febiger Publications.
2. Textbook of Hospital pharmacy- Allwood MC and Blackwell
3. Avery's Drug Treatment, 4th Edition, 1997, Adis International Ltd.
4. Remington's Pharmaceutical Sciences.
5. Relevant review articles from recent medical and Pharmaceutical Journals

Electives to be taken from already approved M.Pharm. Syllabus

LIST OF ELECTIVES

1. STERILE DOSAGE FORM TECHNOLOGY
2. NOVEL DRUG DELIVERY SYSTEMS
3. BIOPHARMACEUTICS AND PHARMACOKINETICS
4. INDUSTRIAL PHARMACY AND PRODUCTION MANAGEMENT
5. PACKAGING TECHNOLOGY
6. FERMENTATION TECHNOLOGY
7. COSMETICOLOGY
8. POLYMERS IN PHARMACEUTICALS
9. TECHNOLOGY OF BULK DRUG
10. IMMUNOASSAYS AND IMMUNOPHARMACOLOGY
11. TOXICOLOGY
12. THERAPEUTICS DRUG MONITORING
13. APPLICATION OF AGRICULTURE TECHNIQUES IN PHARMAC
14. PHARMA-MARKETING
15. PHARMACEUTICAL ADMINISTRATION
16. MEDICINAL PLANT BIOTECHNOLOGY
17. PHYTOPHARMACEUTICS
18. DRUG DESIGN
19. HERBAL DRUG TECHNOLOGY
20. ADVANCED PHARMACEUTICS-I
21. DRA, IPR & QA
22. ADVANCE IN NOVEL PHARMACOLOGICAL DRUGS TARGET
23. BIOTECHNOLOGY AND BIOINFORMATICS

NORTH MAHARASHTRA UNIVERSITY, JALGAON
STRUCTURE AND SYLLABUS
(w.e.f. Academic year 2006 -07)
M. PHARM. COURSE STRUCTURE
SPECIALIZATION: PHARMACEUTICAL BIOTECHNOLOGY

GOAL: The Course imparts knowledge in subjects of Biotechnology, Bioprocess Technology and Advanced Pharmaceutical Biotechnology so that the student is competent to work in Pharmaceutical companies and R & D Organizations to develop cost effective yet safe and quality Biomedicines and Pharmaceuticals.

OBJECTIVES: Postgraduates in Pharmaceutical Biotechnology are expected to-

1. Identify appropriate sources of drugs / medical information.
2. Develop cost and time effective methods to produce safe and quality biomedicines and pharmaceuticals.
3. Apply theoretical basis and practical applications of core Pharmaceutical Biotechnology subjects in concerned Industries and Organizations.
4. Retrieve efficiently relevant and current literature and evaluate them for future research.
5. Understand and analyse novel techniques of production, purification and characterization of enzymes, biotechnologically produced Biomedicines and Pharmaceuticals.
6. Understand and perform novel techniques of genetic engineering namely, recombinant DNA technology, enzyme immobilization, protoplast fusion etc.

ANNEXURE

Semester	No. and Title of Paper	Scheme of Teaching Hours/week		Scheme of Examination		Total
		Lectures	Practical	Theory Hrs. Marks	Practical Hrs. Marks	
I	Advanced Analytical Techniques	3	6	3 100	6 100	200
	Advanced Pharmaceutical biotechnology-I	3	6	3 100	6 100	200
	(Elective-I)	3		3 100	- -	100
	Seminar Research work	1 Per student -	15	A/B/C/D	- -	-
II	Advanced Pharmaceutical biotechnology-II	3	6	3 100	6 100	200
	Elective-II Branch related	03		3 100	- -	100
	Elective-III	03		3 100	- -	100
	Seminar Research work	1 Per student -	15	A/B/C/D	- -	-
III	Seminar on research work done	1 Per student		A/B/C/D	- -	
	Research work	-	35	- -	- -	
IV	Seminar on research work done	1 Per student		A/B/C/D	- -	
	Dissertation and viva voce	-	35	- -	- -	300
GRAND TOTAL						1200

NOTE: (1) A/B/C/D indicates the grade secured by the student in the Seminar

(2) Theory and Practical are separate heads

* Elective II should be related to Branch of specialization

(3) Distribution of Marks for dissertation and Viva-Voce shall be as under:

<u>Dissertation Work</u>		<u>Viva - Voce</u>	
(a) Reference work	= 30	(a) Scientific contents	=20
(b) Experimental Work	= 60	(b) Presentation / Communications	=20
(c) Scientific Contents	= 20	(c) Discussion	=20
(d) Presentation/ Communication	= 40	(d) Report	=40
(e) Result/ Conclusion	= 50		
Total Marks	= 200	Total Marks	=100

PHARMACEUTICAL BIOTECHNOLOGY-I

THEORY (45 hrs) 3hrs/week

1. Structure and Chemistry of microbial cell. [01]
2. Virus: Structure, chemistry and replication, their importance in fermentation industry. [02]
3. Classification of microbes: Species concept, Principles of microbial taxonomy, numerical taxonomy, new approach to taxonomy- comparison of bacterial genotypes by genetic analysis. [02]
4. Bacteria, Actinomycetes, Yeast and Fungi: Occurrence and distribution in nature, morphological, cultural physiological and reproductive features, methods for isolation, cultivation and maintenance, selective isolation techniques; nomenclature and general classification systems; identification of industrially important genera. [04]
5. a) Nutrition of micro-organism: General Considerations, substrate entry into the cell, translocation.
b) Growth and death of micro-organism: General considerations; Physical and Chemical environment for microbial growth; batch and continuous culture, synchronous growth, growth cycle, growth stability and degeneration of microbial cultures on repeated transfer. [05]
6. Metabolism: chemical links between energy yielding metabolism and biosynthesis, model of energy yielding metabolism, biochemistry of fermentations; aerobic respiration and anaerobic respiration, storage of energy, secondary metabolism-its importance in fermentation industry. [05]
7. Genetics of industrial micro-organisms: Bacteria, Streptomyces & fungi, Mutation and selection in strain improvement, Mechanisms of antibiotic resistance and role of plasmids and actinophages. [05]
8. Screening techniques, stock cultures, fermentation media, detection and assays of fermentation products. [05]
9. Detailed critical study of the process technology of the following industrially important microbial metabolites:
Organic solvents (Alcohol, acetone, butanol)
Organic acids (Citric, lactic and gluconic acids)
Wine & beer
Antibiotics: Penicillin, Streptomycin, Tetracyclines, Erythromycin, *Griseofulvin, Neomycin, Cephalosporins*, Amphotericin B*, Nystatin* , Bacitracin*, Gentamycin*, Kanamycin*, Licomycin Hel*, Rifampicin.
Antitumour antiviral and Ergot alkaloids
Vitamins (Vitamin C, Vitamin B12 and Riboflavin)
Amino acids (Glutamic acid and Lysine)
Nucleotides (Cyclic AMP,GMP)
Microbial transformation of steroids
Dextrose from starch and cellulose substrates, prostaglandins, Microbial polysaccharides and surfactants. [08]
Mixed culture fermentations: Production of single biochemical by plant and animal cell cultures applications of animal cell culture. [04]
10. Yeast's and its uses, production of single cell proteins, detailed considerations of the following microbiological assays: Streptomycin, vitamin B12 and lysine fermentation and pharmaceutical effluents; treatment & legal requirements [04]
11. Introduction to patents and secret processes. [01]

PRACTICALS PHARMACEUTICAL BIOTECHNOLOGY-I

(6hr/wk)

1. Study of Morphological features of bacteria, fungi, yeasts and actinomycetes.
2. Determination of cell-wall composition
3. Determination of yield constant.
4. Replica plating
5. Isolation of micro-organisms from soil and study of their biochemical properties.
6. Chromatographic identification of amino acids and sugars
7. Production of ethyl-alcohol.
8. Production of wine
9. UV Survival curve of micro organisms.
10. Test for coliform bacteria in water & milk.
11. Antibiotic assay by cup-plate method.

Text books:

1. Fundamental of microbiology by Frobisher et al (Cambridge University Press, Cambridge).
2. Chemistry and Biology of Yeasts by A.H.Cook (Academic Press, London)
3. Genetics of Antibiotics producing micro-organisms by G Sermonti (Academic Press, New York)
4. Principles of Industrial Microbiology by A.Rhodes and D.L.Fletcher (Pergamon Press, Oxford)
5. Industrial Fermentations by under koflu and Hickey (Chemical Publishing Co. Inc. New York)

Scheme of the examination:

Semester Practical Examination

Synopsis	20 marks
Major Experiment	35 marks
Minor Experiment	25 marks
Viva- voce	20 marks
Total	100 marks

Reference books:

1. Yeasts by A.H.Rose (Academic Press, London)
2. Genetics of industrial micro organisms, (Proceedings of III International symposium) edited by O.K. Sebek and A.I.Laskin.
3. Materials and Methods in Fermentations by G.L.Solomons (Pergamon Press, Oxford).
4. Advances in Applied Microbiology
5. Fermentation Advances by D.Perlman (Blackwell Scientific Publications, Oxford)

JOURNALS:

INDIAN:

1. Bioinformatics
2. Indian Journal of Experimental Biology.
3. Indian Journal of Biosciences
4. Indian Journal of Genetics.

FOREIGN:

1. Journal of Biological Chemistry
2. Journal of Applied Bacteriology

PHARMACEUTICAL BIOTECHNOLOGY-II
THEORY 45 hrs (3hr/wk)

1. **Enzyme technology:** Sources of enzymes; production; isolation and purification of enzymes, applications of enzymes in pharmaceutical industry, in therapeutics and in clinical analysis. Production of amyloglucosidase, glucose isomerases, amylase, cellulose, takadiastase, trypsin, streptokinase and urokinase. [07]
2. **Immobilized enzyme engineering:** Different techniques of immobilization of enzymes kinetics of immobilized enzyme, design and operation of immobilized enzyme reactors multi step immobilized enzyme systems, applications and future of enzyme engineering. [05]
3. **Computer control of fermentation process:** optimization of fermentation parameters. [06]
4. **Biosynthesis of microbial metabolites:** General consideration of metabolic pathways, biosynthesis of alcohol, citric acid, antibiotics (Penicillin, Streptomycin, ergot alkaloids, riboflavin, vitamin B12 [04]
5. **Genetic engineering:** A broad study of the techniques of genetic engineering and application of techniques of genetic engineering in biotechnology, Recombinant DNA techniques i) Hybrid DNA formation, ii) Protoplast fusion, Interferon, insulin, hepatitis-B vaccine, human growth hormone & interleukins production by micro organisms through genetic engineering techniques. [07]
6. **Monoclonal antibodies and other immunoreactive products of permanent immunoclonal antibodies.** Production & application of monoclonal antibodies. [05]
7. **Current developments in immunotechnology diagnostic kits for identifying infectious agents:** HIV, malaria, tuberculosis, VDRL and pregnancy test. Current status of development of vaccines for HIV and plasmodium. [08]
8. **Business management and economic importance of biotech products such as antibiotics, enzymes and vaccines in developing countries.** [03]
9. **Plant tissue culture; Phytochemicals from plant cell cultures.** [03]
10. **Bio-informatics: Information theory and biology , redundancy networking ,Network access, Internet & E-Mail Services, Use of data bases for comparisons.** [03]

PRACTICALS PHARMACEUTICAL BIOTECHNOLOGY-II
(6hr/wk)

1. Production, isolation & purification of an enzyme
2. Immobilization of enzyme by using various immobilization methods
3. Estimation of DNA & RNA.
4. T.L.C. of DNA & RNA
5. Plant tissue culture technique.
6. Determination of A, B, O and Rh blood groups in human beings
7. Handling of mice and rats.
8. Enzyme Linked Immunosorbent Assay (ELISA)
9. Dissection and identification of thymus, spleen and lymph nodes.
10. Diagnostic test for typhoid fever.
11. VDRL test.
12. Pregnancy test.
13. Qualitative analysis of proteins & estimation of molecular weight of proteins.

Text Books:

1. Principles of Gene Manipulation - An introduction to Genetic Engineering by R.W.Did and S.B. Primrose (Blackwell Scientific Publications, Oxford).
2. Text book of Immunology by S.T.Banot (Mesby (Cambridge University Press,Cambridge)
3. Immobilisation of Cells and Enzymes by Hosevear Kennedy cabral and Bicker staff.(Academic Press, London)
4. Physiology of Plants by Murashige T & Skoog. F(Pergamon Press,Oxford
5. Biochemistry of Industrial Microorganisms by C. Rainbow and A.H.Rose for Biosynthesis. (Academic Press, London)

Reference Books:

1. Chapter 1,2,7, in advances in Applied Microbiology Vol.13,1972 on Enzymes, Immobilized Enzymes
2. Recombinant DNA by Watson et al. (McGraw-Hill, New York)
3. Experiments in Plant Tissue Culture by Dodds J.H.Roberts L.W.(Pergamon Press,Oxford)
4. Selected Topics in Enzyme Engineering by Wingard Jr.L.R,Edited for item 1 & 2. (Academic Press, New York)

Scheme of the examination:

Semester Practical Examination	
Synopsis	20 marks
Major Experiment	35 marks
Minor Experiment	25 marks
Viva-voce	20 marks
Total	100 marks

JOURNALS:

INDIAN:

1. Bioinformatics
2. Indian Journal of Marine Sciences.
3. Indian Journal of Biosciences
4. Indian Journal of Genetics

FOREIGN:

1. Lancet. 2. Journal of Infectious Diseases
3. Journal of Medical Microbiology

ELECTIVE - BIO-PROCESS TECHNOLOGY (Electives)
THEORY 45hrs (3 hr/wk)

1. Detailed study of the design and operation of different types of fermenters, ancillary fittings like sampling point, aseptic transfer of spore suspension, transfer of inoculum from seed tank to fermented etc. impeller design and agitator power requirements, measurement and control of dissolved oxygen, CO₂, temperature, PH and foam. (06 hours)
2. Aeration, agitation and mass transfer in fermentation equipment, effects of aeration and agitation, oxygen requirements of micro organisms, mass transfer theories and diffusional resistance to oxygen transfer, measurement of mass transfer coefficients and factors affecting them. (05 hours)
3. Supply of air, air compression, cleaning and sterilization of air, plen ventilation, number of air charges, physiological effects of air movements, etc areas of biological factories, sampling of air, required standards of air pur methods of providing air, air compression, air sterilization methods, steriliza of air by filtration through fibrous filters theory and practice, modern commer filters, laminar flow stations, granular carbon filters. (06 hours)
4. Rheology of fermentation systems and its importance in fermented operation. (02 hours)
5. Fermentation process kinetics:
Reaction kinetics: Types of reaction, order of reaction, michaelis-menten constant, effect of temperature on reaction rate, activated complexes, catalysed reactions, thermal death of micro-organisms, enzyme inhibition Fermentation kinetics: continuous fermentation, advantages and limitations, theory of single and two stage continuous fermentation systems applications. (07 hours)
6. Scale up of fermentation process: Principles, theoretical considerations and techniques used. (03 hours)
7. Isolation and purification of fermentation and biological products (theory, equipment, design, operation and applications); filtration, solvent extraction, adsorption, partition, paper gas, thin, layer ion exchange & affinity chromatography, electrophoresis and counter- current distribution, crystallization turbidity analysis and cell yield determinations, metabolic response assays, enzymatic assays, bioautographic technique, disintegration of cells for product recovery. (09 hours)
8. Thermal death times inactivation of bacterial spores, theoretical justification HTST (High Temperature Short Time) Sterilization and its Practical in industrial scale batch and continuous liquid sterilization techniques. (05 hours)
9. General fermentation process economics. (02 hours)

Text Books:

1. Biochemical Engineering by F.C.Webb (McGraw Hill, New York)
2. Biochemical Engineering by R. Steel (Chemical Publishing Co.Inc..New York).
3. Biochemical Engineering by Fundamentals by Bailey and Ollis (McGraw Hill, New York.)
4. Biochemical Engineering by Aiba S., Humphrey, A.E and Milli N.F (Academic Press, NY)
5. Bioprocess Engineering Principles by Paulin M.Doran (Academic Press, London)

Reference Books:

1. Biochemical and Biological Engineering Science Vol-1 and 2, edited N. Blakebrough (Cambridge University Press, Cambridge).
2. Relevant articles published in Biotechnology and Bioengineering from time to time
3. Bioreactor design and product yield by Butterworth and Heinemann (Pergamon Oxford).
4. Fermentation and Biochemical Engineering. Handbook by Henry. C. (McGraw Hill, New York)

JOURNALS: INDIAN:

1. Bioinformatics.
2. Indian Journal of Experimental Biology.
3. Indian Journal of Biosciences.

FOREIGN:

1. Journal of chem. Tech. & Biotech.
2. Journal of Scientific Instruments.

Electives to be taken from already approved M.Pharm. Syllabus.

LIST OF ELECTIVES

1. STERILE DOSAGE FORM TECHNOLOGY
2. NOVEL DRUG DELIVERY SYSTEMS
3. BIOPHARMACEUTICS AND PHARMACOKINETICS
4. INDUSTRIAL PHARMACY AND PRODUCTION MANAGEMENT
5. PACKAGING TECHNOLOGY
6. FERMENTATION TECHNOLOGY
7. COSMETICOLOGY
8. POLYMERS IN PHARMACEUTICALS
9. TECHNOLOGY OF BULK DRUG
10. IMMUNOASSAYS AND IMMUNOPHARMACOLOGY
11. TOXICOLOGY
12. THERAPEUTICS DRUG MONITORING
13. APPLICATION OF AGRICULTURE TECHNIQUES IN PHARMACY
14. PHARMA-MARKETING
15. PHARMACEUTICAL ADMINISTRATION
16. MEDICINAL PLANT BIOTECHNOLOGY
17. PHYTOPHARMACEUTICS
18. DRUG DESIGN
19. HERBAL DRUG TECHNOLOGY
20. ADVANCED PHARMACEUTICS-I
21. DRA, IPR & QA
22. ADVANCE IN NOVEL PHARMACOLOGICAL DRUGS TARGET
23. BIOTECHNOLOGY AND BIOINFORMATICS