V Semester B.Pharm [Course and Examination Scheme with Credit Grade System]

Subject Code	Subject	Teaching Scheme				Examination Scheme								
		Hours per week			No. of Credits	Theory					Practical			
		L	T	P		Duration of Paper (Hrs.)	Max. Mark	Max. Marks Sessional	Total	Min Passing Marks	Max Marks	Max. Marks Sessional	Total	Min Passing Marks
BP501	Pharmaceutical Engineering-I	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 502	Pharmaceutical organic chemistry-III	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 503	Pharmacology-III	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 504	Pharmacognosy –III	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 505	Biotechnology	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 506	Biopharmaceutices	3	-	-	3	3	80	20	100	45	-	-	-	-
BP 507	Pharmaceutical Engineering-I	-	-	4	2	5	-	-	-	-	80	20	100	50
BP 508	Pharmaceutical organic chemistry-III	-	-	4	2	5	-	-	-	-	80	20	100	50
BP 509	Pharmacology-III	-	-	4	2	5	-	-	-	-	80	20	100	50
BP 5010	Pharmacognosy –III	-	-	4	2	5	-	-	-	-	80	20	100	50
BP 5011	Biotechnology	-	-	4	2	5	-	-	-	-	80	20	100	50
	Total	**18**	**0**	**20**	**28**				**600**				**500**	
Semester total						**1100**								

B.Pharm-III (Semester- V) PHARMACETICAL ENGINEERING-I (BP-501)		
SN	**Topics**	**Hrs**
01	**Size Reduction** Theories & objective of size reduction, advantage & disadvantage, mechanism, modes of stress applied in size reduction, classification of size reduction equipment, factor affecting size reduction.	**7**
02	**Size Separation** Definition, standard for powder, types of screen, modes of motion in size separation, equipment for size separation- shaking screen, air separator, cyclone separator, rotex screen, bag filter.	**8**
03	**Mixing** Types of mixture, factor influencing mixing, equipment used in mixing of powder, liquid & semisolid.	**6**
04	**Conveying (transportation of solid)** Classification of conveyor, Conveyor- principle, construction, working, application, advantage & disadvantage, storage of solid.	**6**
05	**Flow of fluid** Valves, transportation of fluid- reciprocating rotary pump, rotary & centrifugal pump, miscellaneous pump, fluid static, dynamics, flow rate measuring devices- orifice meter, venture meter, pitot tube rotameter.	**9**
06	**Centrifugation** Principle, classification of centrifuges, equipment's.	**3**
07	**Filtration** Mechanism & types of filtration, theories of filtration, factor influencing filtration, filter aid's ,study of filter press, meta filter, rotary drum filter & disc filter.	**6**

B.Pharm-III (Semester- V)

PHARMACETICAL ENGINEERING-I PRACTICALS (BP-507)

PRACTICALS:

1. To determine thickness area using batch settling method.
2. To study effect of centrifuge time on cake volume of the given suspension sample.
3. To study effect of centrifuge speed on cake volume of the given suspension sample.
4. To determine drag coefficient for particle settling method.
5. To determine hardness of water sample.
6. To study sedimentation behavior using suspending agent.
7. To study effect of ball mill on particle size.
8. To study particle sedimentation using stokes law.
9. To study filter aid on rate of filtration.
10. To study the particle size distribution.
11. To study of efficiency of pump.
12. To study factors affecting filtration process.

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2. E. Gonderton, "Pharmaceutical unit operation", Academic press.

3. Perry's ,"Handbook of chemical engineering", McGraw Hill,(1984)

4. A.R. Paradkar, "Introduction to Pharmaceutical Engineering", Nirali prakashan, 10th Ed.2007

5. K. Sambamurthy-"Pharmaceutical Engineering", New Age international Pvt Ltd.

6. G.G Brown- "Unit operation", CBS publishers & Distributers, New Delhi.

7. W.I. Badger and J.T. Banchero, "Introduction to Chemical engineering"; McGraw Hill, Tata-McGraw Hill Publishing Company Ltd, New Delhi.(1988)

8. N.G.Padya., C.S.Shaha-"Elements of Heat Engines", Charotar Book Stall, Tulsi Sadan, Anand (W. Rly), India.

9. Donald P. Eckman –"Industrial Instrumentation", Seventh Wiley Eastern, Reprint, 1983, Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi.

10. C.V.S Subramanyam- "Pharmaceutical Engineering principle & practices", Vallabh prakashan New Delhi.

11. Warren McCabe, Julian Smith and Peter Harriott, "Unit operations of chemical engineering", McGraw Hill Inc., Singapore.

B.Pharm-III (Semester- V) PHARMACEUTICAL ORGANIC CHEMISTRY-III (BP-502)		
SN	**Topics**	**Hrs**
01	**Heterocyclic compounds:** Structure, nomenclature, synthesis and properties including reaction mechanism, stereochemical considerations and pharmaceutical uses of the following heterocyclic compounds: Pyrrole, Furan, Thiophene, Imidazole, Oxazole, Pyridine, Pyrimidine, Quinoline, Isoquinoline, Indole, Purine and Phenothiazine.	10
02	**Polynuclear aromatic compounds:** Structure, nomenclature, synthesis, properties and stereochemistry of Naphthalene, Anthracene and Phenanthrene.	**05**
03	**Carbohydrate:** Classification, structure and reactions of Glucose, configuration of aldoses, cyclic structure of D-glucose, mutarotation and conformations, structure of Maltose, Sucrose, Starch.	**10**
04	**Amino acids and Proteins:** classification, isolation, and synthesis, of amino acids. Structure of natural amino acids, isoelectric point, peptide and polypeptides. Protein synthesis, methods of C-terminal and N- terminal amino acids determination in protein. Structures of proteins.	**10**
05	**Lipids:** Classification and general chemistry of lipids and fats, their properties and characterization, fatty acids and their Reactions. Glycoprotein, lipoprotein, Phospholipids, Spingolipids, fixed oils and waxes.	**10**

B.Pharm-III (Semester- V)

PHARMACEUTICAL ORGANIC CHEMISTRY-III PRACTICALS (BP-508)

1. Synthesis of following hetrocyclic compounds:
   - Benzimidazole from o-phenylenedimine and formic acid.
   - Quinoline from Aniline by Skraup method.
   - 2-phenyl indole from acetophenone and phenyl hydrazine.
   - 2,3- diphenyl Quinaxoline from Benzil and o-phenylenedimine
   - Eosin from phthalic anhydride and resorcinol
2. Analysis of fixed oils and fats (I.P. method)
   - Acid value
   - Saponification value
   - Iodine value
3. Quantitative determination of organic compounds via functional groups
   - Carboxyl group by alkalimetry.
   - Phenolic group by bromination method
   - Ester group by alkalimetry
   - Amino group by bromination method

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1. Bahal and B.S. Bahl, A Text Book of Organic Chemistry, S. Chand & Company Ltd., New Delhi
2. A.I. Vogel, Elementary Practical Organic Chemistry, Part III, Quantitative Organic Analysis, Second Edition, CBS Publishers and Distributors, Delhi.
3. G. Chatwal, Chemistry of Natural Product, Vol. I & II, Himalaya Publication, Bombay.
4. O.P. Agrawal, Chemistry of Natural Product, Vol. I & II, Krishna Publication, Meerut.
5. R.K. Bansal, Heterocyclic Chemistry, New Age International Publishers, New Delhi.
6. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice-Hall of India Pvt. Ltd, New Delhi,
7. L. Finar, Organic Chemistry, Vol. I & II, ELBS, London.
8. Indian Pharmacopoeia 2010

B.Pharm-III (Semester- V) Pharmacology-III (BP-503)		
SN	**Topics**	**Hrs**
	Study of Pharmacology of following classes of drug with respect to classification including recently available drugs, mechanism of action, receptors, adverse effects, Drug interaction, contraindication and therapeutic uses.	
01	**1 Pharmacology of drug acting on CNS** A. Introduction: cell signaling, neurotransmission, central neurotransmitters B. Alcohol and Alcoholism C. General anesthetics D. Sedatives and Hypnotics E. Anticonvulsants F. Antipsychotics, Antidepressants and Anxiolytics G. Drug dependence and drug abuse H. CNS stimulants I. Drugs for Neurodegenerative disorders J. Opoid Analgesic.	**24**
02	**Pharmacology of Local Anaesthetics**	**2**
03	**Pharmacology of drugs acting on Respiratory System** A. Drug therapy of asthma. B. Anti tussives, expectorant and mucolytic agent.	**6**
04	**Pharmacology of drugs acting on GIT** A. Drugs used in ulcers B. Drugs for treatment of diarrheoa and constipation. C. Emetic and anti-emetics.	**6**
05	**Clinical Research:** A. Clinical Trials: History, Terminologies, Various phases of clinical research, Role of clinical trial in new drug development. B. Documents in clinical study: Investigator Brochure (IB), Protocol and its amendment, case report form (CRF), Informed consent form (ICF). C. Ethical issues in clinical trial.	**7**

B.Pharm-III (Semester- V)

Pharmacology-III PRACTICALS (BP 509)

1. General introduction to CNS experimental pharmacology.
2. To study the analgesic activity using tail flick method in rats or mice.
3. To study the analgesic activity using hot plate analgesiometer in rats or mice.
4. To study the anti-inflammatory activity using plethysmometer in rats or mice.
5. To study the anticonvulsant activity using electroconvulsiometer in mice
6. To study hypnotic activity using pentobarbital induced loss of righting reflex in mice.
7. To study the antipyretic activity using telethermometer in rats.
8. To study the antidepressant activity using forced swim test in rats or mice.
9. To study the anxiolytic activity using in rats or mice.
10. To study the CNS Stimulant activity using actophotometer in rats or mice.
11. To study the CNS Depressant activity using actophotometer in rats or mice.

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4. Christopher H., Davidsons Principles and Practice of Medicine. Churchill Livingstone.
5. Girdwood R.H. Clinical Pharmacology.Varghese Publishing House, Bombay
6. James Crossland, Lewis Pharmacology. Churchil Livingston.
7. Maickel, Pradhan, Pharmacology in Medicines – Principles and Practice. SP Press International INC.
8. Rang, H.R. Dale, M. Pharmacology E.L.B.S., London
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11. Parrthsarthi G, Hansen Kavin Nytort & Nahata Milap C. A Textbook of Clinical Practice: Essential Concepts & skills, Orient Longman
12. Perry, W. L. M. Pharmacological Experiments on isolated preparations. E and S Livingstone, London. Pubications.
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15. Parrthsarthi G, Hansen Kavin Nytort & Nahata Milap C. A Textbook of Clinical Practice: Essential Concepts & skills, Orient Longman.

B.Pharm-III (Semester- V) Pharmacognosy III (BP-504)		
SN	**Topics**	**Hrs**
01	**Extraction, isolation and purification methods for phytopharmaceuticals.** a. Extraction: Theory of mass transfer, maceration, percolation, Soxhlet extraction and super critical fluid extraction. b. Chromatography isolation and purification: General principles and applications of adsorption, ion exchange, size-exclusion, affinity. Detailed study of thin layer chromatography, paper chromatography, column chromatography, high performance thin layer chromatography, high pressure liquid chromatography and gas liquid chromatography.	**10**
02	**General introduction of lipids, enzymes and proteins** Definition, classification , method of extraction, chemistry, biosynthetic pathways and method of analysis of above classes Biological source, collection, method of preparation, chemical constituent, chemical test for identification and uses of following: Almond oil, castor oil, cod liver oil, Sesame oil, cotton seed oil, peanut oil, bees wax, cocoa butter, olive oil, jojoba oil, shark liver oil, and wool fat. Bromelain, diastase, papain, pepsin, trypsin, pancreatin, Gelatin	**12**
03	**Terpenoids and volatile Oils** a. Introduction, occurrence, general properties, classification, chemistry, uses, methods of extraction and evaluation, general biosynthetic pathway of terpenoid. b. Pharmacognostic study of following drugs Hydrocarbon: Black Pepper Alcohol: Peppermint, Cardamom, Coriander, sandalwood Aldehyde: Cinnamon, Lemon Grass, Citronella Ketone: Caraway, Camphor, Dill Phenol: Clove, Tulsi Phenolic ether: Fennel, Nutmeg Oxide: Eucalyptus	**10**
04	**Biogenesis of Natural products** A brief introduction to biosynthesis A brief account of primary and secondary metabolite's production from carbon metabolism in plants. Production of Amino acid by shikimic acid pathway.	**6**
05	**A brief introduction to natural colours and dyes:** Heena, Saffron, Carotenoids.	**3**
06	**A brief account to Plant bitters and Sweeteners**	**4**

Pharmacognosy III (BP-5010)

PRACTICAL:

1. Isolation of volatile oil by hydro-distillation method using Clavenger's apparatus
2. Paper chromatography and TLC of natural products.
3. Thin layer chromatography of volatile oils.
4. Estimation of citral content from lemon grass oil
5. Study of morphological and microscopic characters of-
   Coriander, Cinnamon, Caraway, Dill, Clove, Fennel, Eucalyptus
6. Analysis of fixed oil: Determination of acid value, Iodine value and Saponification value.
7. Chemical tests for following drugs
   Sesame oil, cotton seed oil, gelatine, shark liver oil and wool fat.

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2. C.K. Atal & B.M. Kapoor: Cultivation & Utilization of Medicinal & Aromatic Plants, RRL, Jammu.
3.Pharmacognosy and Phytochemistry- Part I & Part II – V. D. Rangari, Career Publication, Nashik.
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15. Quality Standards of Indian Medicinal Plants, Vol. I-X, Indian Council of Medical Research, New Delhi.
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20. T.E. Wallis, 1960. Text Book of Pharmacognosy, CBS Publishers, New Delhi.
21. The Aurvedic Pharmacopoeia of India, 1999. Government of India, Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy, New Delhi.

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23. V.E. Tyler, L.R. Brady, J.E. Robbers, 1988. Pharmacognosy, 9th Edn., Lea and Febiger,Philadelphia.

B.Pharm-III (Semester- V) Biotechnology (BP-505)		
SN	**Topics**	**Hrs**
01	Definition and scope - potential and achievements	02
02	Fermentation technology and industrial microbiology Fermentation as a biochemical process, fermenter construction and working, downstream processing, fermentation monitoring, in-situ recovery of fermentation products, waste discharge and effluent treatment, definition of BOD and COD, safety and proof of efficacy of biotech products, general applications of fermentation in the manufacturing of antibiotics (Penicillin, streptomycin, tetracycline) dextran, vitamins (Vit.B2 and Vit.B12), microbial enzymes, microbial limit tests and assays (antibiotics, vitamins, amino acids etc.), standards of water used in fermentation, pharmaceutical and cosmetic industry.	14
03	Animal cell culture and genetic engineering Introduction to mammalian genome, genetic recombination of animal cells, purified DNA, vectors probing and cloning, strain and restrictional enzymes, gene machine, DNA hybridization, molecular engineering, polymerase chain reaction, genetic diseases, human gene therapy, tissue engineering.	08
04	Preparation and characterization of immunologicals Preparation and standardization of vaccines, sera, allergenic extracts, diagnostics, biologicals, Introduction to veterinary vaccines, immunomodulating substances, lymphokines, preparation of monoclonal antibodies, applications of monoclonal antibodies.	**07**
05	Biotechnology derived products (therapeutic proteins) Examples of biotechnology derived therapeutics products, production of human Insulin, interferon, somatostatin, somatotropin.	**04**
06	Plant Tissue Culture Development of plant tissue cultures, Cellular totipotency, Organ cultures, callus and suspension cultures, Organogenesis, somatic embryo genesis, Protoplast fusion. Germplasm storage including cryopreservation.	**10**

Pharmaceutical Biotechnology Practical (BP5011)

1. Standardization of water used in fermentation and pharmaceutical industry by MPN and IMViC
2. Microbial limit tests
3. Microbial assays
4. Preparation of plant cell culture media
5. Measurement of plant cell growth
6. Development of callus culture
7. Development of embryo culture
8. Production of secondary metabolites using any available plant cell
9. Fermentative production of antibiotics (penicillin) / Vitamins (Vit B12)
10. Estimation of Protein with standard curve by Ninhydrine method.
11. Estimation of Protein with standard curve by Biuret method.
12. Fermentative production of citric acid.

Reference Books:

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3. British Pharmacopoeia, 1993, London, HMSO.
4. Carter S. J., Cooper and Gunn's Tutorial Pharmacy, 6th Edition, 1996, CBS Publishers and
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21. Singh B. D., Biotechnology, 2001, Kalyani Publisher.
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24. Vyas, S. P., Dixit V. K., Pharmaceutical Biotechnology, 1st Edition, 1999, CBS Publishers and

B.Pharm-III (Semester- V) BIOPHARMACEUTICS (BP-506)		
SN	**Topics**	**Hrs**
01	**Concept, definition and introduction** to Biopharmaceutics, Pharmacokinetics, Pharmacodynamics and Plasma drug concentration time profile.	03
02	**Absorption of Drug:** Cell membrane, Mechanism of drug absorption, Factors affecting drug absorption (Pharmaceutical, Patient related), Non oral route of drug absorption (buccal, sublingual, nasal, transdermal, vaginal, rectal and parenteral).	10
03	**Drug Distribution:**Introduction, Factors affecting distribution of drugs, Concept of apparent volume of distribution, Protein binding of drugs, Kinetics of protein binding, Significance of drug protein binding, Factors affecting protein binding of drugs.	08
04	**Excretion & metabolism(Biotransformation)** Renal excretion, Concept of clearance, Factors affecting renal excretion, Non renal route of excretion, Factors affecting metabolism, Pathways of metabolism.	**08**
05	**Prodrug**	**03**
06	**Bioavailability and Bioequivalence:**Concept and definition of absolute and relative bioavailability, Purpose of bioavailability study, Measures of bioavailability (C_{max}, t_{max}, AUC etc), Bioequivalence study, Biopharmaceutics classification system, In vitro drug dissolution testing model, In vitro in vivo correlation.	**08**
07	**Pharmacokinetics:**Rate, Rate constants and order of reactions, Zero order, First order, Pharmacokinetics model.	**05**

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