Railway Pharmacist Syllabus 2024 | RRB Ministry of Railway

1. Professional Ability (Pharma Section)-70 % weightage

Post	Syllabus
Pharmacist	Human Anatomy and Physiology Pharmaceutical Analysis Pharmaceutics Pharmaceutical Inorganic Chemistry, Remedial Biology/Remedial Mathematics, Pharmaceutical Organic Chemistry, Biochemistry, Pathophysiology, Computer Applications in Pharmacy, Environmental sciences, Physical Pharmaceutics, Pharmaceutical Microbiology, Pharmaceutical Engineering, Medicinal Chemistry, Pharmacology, Pharmacognosy and Phytochemistry, Industrial Pharmacy, Pharmaceutical Jurisprudence, Herbal Drug Technology, Biopharmaceutics and Pharmacokinetics, Pharmaceutical Biotechnology, Quality Assurance, Instrumental Methods of Analysis, Pharmacy Practice, Novel Drug Delivery System, Biostatistics and Research Methodology, Social and Preventive Pharmacy, Pharma Marketing Management, Pharmaceutical Regulatory Science, Pharmacovigilance, Quality Control and Standardization of Herbals, Computer Aided Drug Design, Cell and Molecular Biology, Cosmetic Science, Experimental Pharmacology, Advanced Instrumentation Techniques, Dietary Supplements and Nutraceuticals

2. Common for all posts (General)- 30 % weightage

S. No.	Subjects	Syllabus
1	General Arithmetics	Number systems, BODMAS, Decimals, Fractions, LCM and HCF, Ratio and Proportion, Percentages, Mensuration, Time and Work, Time and Distance, Simple and Compound Interest, Profit and Loss, Algebra, Geometry, Trigonometry, Elementary Statistics, Square Root, Age Calculations, Calendar & Clock, Pipes & Cistern
2	General Intelligence	Analogies, Alphabetical and Number Series, Coding and Decoding, Mathematical operations, Relationships, Syllogism, Jumbling, Venn Diagram, Data Interpretation and Sufficiency, Conclusions and Decision Making, Similarities and Differences, Analytical reasoning, Classification, Directions, Statement – Arguments and Assumptions etc
3	General Awareness	Knowledge of Current affairs, Indian geography, culture and history of India including freedom struggle, Indian Polity and constitution, Indian Economy, Environmental issues concerning India and the World, Sports, General scientific and technological developments etc.
4	General Science	Physics, Chemistry and Life Sciences (up to 10th Standard CBSE syllabus)

Railway Pharmacist Syllabus-RRB 2024

Note: RRB Board has kept the syllabus of B.Pharma (semester system) course for Pharmacist recruitment

Semester	Subjects
1	[1] Human Anatomy and Physiology I [2] Pharmaceutical Analysis I [3] Pharmaceutics I [4] Pharmaceutical Inorganic Chemistry [5] Communication skills [6] Remedial Biology/ Remedial Mathematics
2	**[1] Human Anatomy and Physiology II** [2] Pharmaceutical Organic Chemistry I [3] Biochemistry [4] Pathophysiology [5] Computer Applications in Pharmacy [6] Environmental sciences
3	[1] Pharmaceutical Organic Chemistry II [2] Physical Pharmaceutics I [3] Pharmaceutical Microbiology [4] Pharmaceutical Engineering
4	[1] Pharmaceutical Organic Chemistry III [2] Medicinal Chemistry I [3] Physical Pharmaceutics II [4] Pharmacology I [5] Pharmacognosy and Phytochemistry I
5	[1] Medicinal Chemistry II [2] Industrial Pharmacy I [3] Pharmacology II [4] Pharmacognosy and Phytochemistry II [5] Pharmaceutical Jurisprudence
6	[1] Medicinal Chemistry III [2] Pharmacology III [3] Herbal Drug Technology [4] Biopharmaceutics and Pharmacokinetics [5] Pharmaceutical Biotechnology [6] Quality Assurance
7	[1] Instrumental Methods of Analysis [2] Industrial Pharmacy II [3] Pharmacy Practice [4] Novel Drug Delivery System
8	[1] Biostatistics and Research Methodology [2] Social and Preventive Pharmacy [3] Pharma Marketing Management [4] Pharmaceutical Regulatory Science [5] Pharmacovigilance

	[6] Quality Control and Standardization of Herbals [7] Computer Aided Drug Design [8] Cell and Molecular Biology [9] Cosmetic Science [10] Experimental Pharmacology [11] Advanced Instrumentation Techniques [12] Dietary Supplements and Nutraceuticals

1ST SEMESTER

[1] HUMAN ANATOMY AND PHYSIOLOGY I

Chapter	Topic
1	**Introduction to human body** **Cellular level of organization** **Tissue level of organization**
	Integumentary system **Skeletal system** **Joints**
3	**Body fluids and blood**
	Lymphatic system
4	**Peripheral nervous system**: **Special senses**
5	**Cardiovascular system**

[2] PHARMACEUTICAL ANALYSIS

Unit	Topic
1	**(a) Pharmaceutical analysis** **(b) Pharmaceutical analysis** (c)Pharmacopoeia, Sources of impurities in medicinal agents,limit tests.
2`	**Acid base titration** **Non aqueous titration**
3	**Precipitation titrations** **Complexometric titration** **Gravimetry** diazotisation titration
4	**Redox titrations**
	Electrochemical methods of analysis • **Conductometry** • **Potentiometry** • **Polarography**

[3] PHARMACEUTICS- I

Unit	Topic
1	**Historical background and development of profession of pharmacy** **Dosage forms** **Prescription** **Posology**
2	**Pharmaceutical calculations** **Powders** **Liquid dosage forms**
3	**Monophasic liquids:** **Biphasic liquids: Suspensions & Emulsion**
4	**Suppositories**: **Pharmaceutical incompatibilities**
5	**Semisolid dosage forms**

[4] PHARMACEUTICAL INORGANIC CHEMISTRY

Unit	Topic
1	**Impurities in pharmaceutical substances**
2	**General methods of preparation**, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes • **Acids, Bases and Buffers** • **Major extra and intracellular electrolytes** • **Dental products**
3	**Gastrointestinal agents-** • **Acidifiers** • **Antacid** • **Cathartics** • **Antimicrobials**
4	**Miscellaneous compounds** • **Expectorants** • **Emetics**: • **Haematinics** • **Poison and Antidote:** • **Astringents**
5	**Radiopharmaceuticals**

[5] COMMUNICATION SKILLS

Unit	Topic
1	**Communication Skills**

	Barriers to communication **Perspectives in Communication**
2	**Elements of Communication** **Communication Styles**
3	**Basic Listening Skills** **Effective Written Communication** **Writing Effectively**
4	**Interview Skills** **Giving Presentations**
5	**Group Discussion**

[6] REMEDIAL BIOLOGY/ REMEDIAL MATHEMATICS

[6.1] REMEDIAL BIOLOGY

Unit	Topic
1	**Living world** **Morphology of Flowering plants**
2	**Body fluids and circulation** **Digestion and Absorption** **Breathing and respiration**
3	**Excretory products and their elimination** **Neural control and coordination** **Chemical coordination and regulation** **Human reproduction**
4	**Plants and mineral nutrition** **Photosynthesis**
5	**Plant respiration** **Plant growth and development** **Cell - The unit of life** **Tissues**

[6.2] REMEDIAL MATHEMATICS

Unit	Topic
1	**Partial fraction** **Logarithms** **Function** **Limits and continuity**
2	**Matrices and Determinant**
3	**Calculus**
4	**Analytical Geometry**
5	**Differential Equations** **Laplace Transform**

2ND SEMESTER

[1] HUMAN ANATOMY AND PHYSIOLOGY II

Unit	Topic
1	**Nervous system**
2	**Digestive system** **Energetics**
3	**Respiratory system** **Urinary system**
4	**Endocrine system**
5	**Reproductive system** **Introduction to genetics**

[2] PHARMACEUTICAL ORGANIC CHEMISTRY I

Unit	Topic
1	**Classification, nomenclature and isomerism**
2	**Alkanes*, Alkenes* and Conjugated dienes*** **E_1 E_2 reactions SP^2 SP^3 hybridiazation**
3	**Alkyl halides→ SN_1 versus SN_2 reactions** **Alcohols**
4	**Carbonyl compounds* (Aldehydes and ketones)**
5	**Carboxylic acids** **Aliphatic amines**

[3] BIOCHEMISTRY

Unit	Topic
1	Biomolecules **Bioenergetics**
2	**Carbohydrate metabolism** **Biological oxidation**
3	**Lipid metabolism** **Amino acid metabolism**
4	**Nucleic acid metabolism and genetic information transfer**
5	**Enzymes**

[4] PATHOPHYSIOLOGY

Unit	Topic
1	**Basic principles of Cell injury and Adaptation** **Basic mechanism involved in the process of inflammation and repair**
2	**Cardiovascular System** **Respiratory system** **Renal system**

3	**Haematological Diseases** **Endocrine system diseases** **Nervous system disorder** **Gastrointestinal system disease**
4	Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints** **Principles of cancer**
5	**Infectious diseases** STD

[5] COMPUTER APPLICATIONS IN PHARMACY

Unit	Topic
1	**Number system** **Concept of Information Systems and Software**
2	**Web technologies** Introduction to databases
3	**Application of computers in Pharmacy** Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System
4	**Bioinformatics**
5	**Computers as data analysis in Preclinical development**

[6] ENVIRONMENTAL SCIENCES

Unit	Topic
1	Multidisciplinary nature of environmental studies Renewable and non-renewable resources & Natural resources
2	Ecosystems
3	Environmental Pollution: Air pollution; Water pollution; Soil pollution

3RD SEMESTER

[1] PHARMACEUTICAL ORGANIC CHEMISTRY II

Unit	Topic
1	**Benzene and its derivatives**
2	**Phenols; Aromatic Amines, Aromatic Acids**
3	**Fats and Oils**
4	**Polynuclear hydrocarbons**
5	**Cyclo alkanes**

[2] PHYSICAL PHARMACEUTICS I

Unit	Topic
1	**Solubility of drugs**
2	**States of Matter and properties of matter** **Physicochemical properties of drug molecules**
3	**Surface and interfacial phenomenon**
4	**Complexation and protein binding**
5	**pH, buffers and Isotonic solutions:**

[3] PHARMACEUTICAL MICROBIOLOGY

Unit	Topic
1	Introduction & history of microbiology Introduction to Prokaryotes and Eukaryotes Identification, Classification, Nutritional, culture media, cultivation of bacteria Microscope
2	Staining techniques Methods of Sterilization & Sterility indicators
3	Fungi & Virus- morphology, classification, reproduction/replication and cultivation Disinfectants Evaluation of bactericidal & Bacteriostatic Sterility testing of products
4	Aseptic Area, Clean Area classification Microbiological Assay of Vitamin & Antibiotic
5	• Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. • Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. • Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. • Cell cultures in pharmaceutical industry and research.

[4] PHARMACEUTICAL ENGINEERING

Unit	Topic
1	**Flow of fluids** **Size Reduction** **Size Separation**
2	**Heat Transfer** **Evaporation** **Distillation**
3	**Drying** **Mixing**
4	**Filtration** **Centrifugation**
5	**Materials of pharmaceutical plant construction, Corrosion and its Prevention**

4TH SEMESTER

[1] PHARMACEUTICAL ORGANIC CHEMISTRY III

Unit	Topic
1	**Stereo isomerism, Optical Isomerism**
2	Geometrical isomerism
3	**Heterocyclic compounds**
4	Synthesis, reactions and medicinal uses of following compounds/derivatives • Pyrazole, Imidazole, Oxazole and Thiazole. • Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine • Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives
5	**Reactions of synthetic importance** • Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. • Oppenauer-oxidation and Dakin reaction. • Beckmanns rearrangement and Schmidt rearrangement. • Claisen-Schmidt condensation

[2] MEDICINAL CHEMISTRY I

Unit	Topic
1	**Introduction to Medicinal Chemistry** **History and development of medicinal chemistry** **Physicochemical properties in relation to biological action** **Drug metabolism**
2	**Drugs acting on Autonomic Nervous System** • **Adrenergic Neurotransmitters** • **Sympathomimetic agents: SAR of Sympathomimetic agents** • **Adrenergic Antagonists:**
3	**Cholinergic neurotransmitters** **Parasympathomimetic agents: SAR of Parasympathomimetic agents (Direct & Indirect acting agent)** **Cholinesterase reactivator** **Solanaceous alkaloids and analogues** **Synthetic cholinergic blocking agents**
4	**Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics** **B. Antipsychotics** **C. Anticonvulsants**
5	**Drugs acting on Central Nervous System** **General anesthetics** **Narcotic and non-narcotic analgesics**

[3] PHYSICAL PHARMACEUTICS II

Unit	Topic
1	**Colloidal dispersions**
2	**Rheology & Deformation of solids**
3	**Coarse dispersion**
4	**Micromeretics**
5	**Drug stability**

[4] PHARMACOLOGY -I

Unit	Topic
1	**General Pharmacology, Route of Drug Absorption &** Pharmacokinetics
2	Pharmacodynamics, ADR, Drug interactions, Drug Discovery & Clinical evaluation of New Drug & pharmacovigilance.
3	**Pharmacology of drugs acting on peripheral nervous system**
4	**Pharmacology of drugs acting on central nervous system**
5	**Pharmacology of drugs acting on central nervous system**

[5] PHARMACOGNOSY AND PHYTOCHEMISTRY I

Unit	Topic
1	**Introduction to Pharmacognosy** **Classification of drugs** **Quality control of Drugs of Natural Origin**
2	**Cultivation, Collection, Processing and storage of drugs of natural origin** **Conservation of medicinal plants**
3	**Plant tissue culture**
4	**Pharmacognosy in various systems of medicine** **Introduction to secondary metabolites**
5	Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primarymetabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes :** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids(Waxes, fats, fixed oils)** : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax **Marine Drugs:**

5TH SEMESTER

[1] MEDICINAL CHEMISTRY II

Unit	Topic
1	**Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)** • **H_1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium • **H_2-antagonists:** Cimetidine*, Famotidine, Ranitidin. • **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole • **Anti-neoplastic agents:** • **Alkylating agents:** Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa
2	**Anti-anginal**: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol **Anti-hypertensive Agents**: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide,Minoxidil, Reserpine, Hydralazine hydrochloride.
3	**Anti-arrhythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemic agents**: Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.
4	**Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl

	stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone **Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.
5	**Antidiabetic agents:** **Local Anesthetics:** SAR of Local anesthetics **Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **Amino Benzoic acid derivatives**: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous**: Phenacaine, Diperodon, Dibucaine.*

[2] INDUSTRIAL PHARMACY -I

Unit	Topic
1	**Preformulation Studies- Physical & Chemical Properties** BCS classification of drugs & its significant
2	**Tablets:** a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. b. Tablet coating c. Quality control tests: In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia
3	**Capsules:** a. ***Hard gelatin capsules*** b. ***Soft gelatin capsules*** c. **Pellet**
4	**Parenteral Products** Ophthalmic Preparations
5	**Cosmetics** **Pharmaceutical Aerosols** **Packaging Materials Science**

[3] PHARMACOLOGY II

Unit	Topic
1	**Pharmacology of drugs acting on cardio vascular system**
2	**Pharmacology of drugs acting on cardio vascular system** **Pharmacology of drugs acting on urinary system**
3	**Autocoids and related drugs** a. Introduction to autacoids and classification b. Histamine, 5-HT and their antagonists. c. Prostaglandins, Thromboxanes and Leukotrienes. d. Angiotensin, Bradykinin and Substance P.

	e. Non-steroidal anti-inflammatory agents f. Anti-gout drugs g. Antirheumatic drugs
4	**Pharmacology of drugs acting on endocrine system** a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones- analogues and their inhibitors. c. Thyroid hormones- analogues and their inhibitors. d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. d. Insulin, Oral Hypoglycemic agents and glucagon. e. ACTH and corticosteroids.
5	**Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus.
6	**6. Bioassay** a. Principles and applications of bioassay. b.Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT

[4] PHARMACOGNOSY AND PHYTOCHEMISTRY II

Unit	Topic
1	**Metabolic pathways in higher plants and their determination**
2	General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides:** Senna, Aloes, Bitter Almond **Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids
3	Isolation, Identification and Analysis of Phytoconstituents a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrhetinic acid & Rutin c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine d) Resins: Podophyllotoxin, Curcumin
4	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine
5	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

[5] PHARMACEUTICAL JURISPRUDENCE

Unit	Topic
1	**Drugs and Cosmetics Act, 1940 and its rules 1945** Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs Manufacture of drugs Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license
2	**Drugs and Cosmetics Act, 1940 and its rules 1945** Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs **Labeling & Packing of drugs** **Administration of the Act and Rules**- DTAB, CDL, DCC, Analyst, DI, ADA
3	**Pharmacy Act –1948** **Medicinal and Toilet Preparation Act –1955** **Narcotic Drugs and Psychotropic substances Act-1985 and Rules**
4	**Study of Salient Features of Drugs and Magic Remedies Act and its rules** **Prevention of Cruelty to animals Act-1960** **National Pharmaceutical Pricing Authority**
5	**Pharmaceutical Legislations-** Health survey and development committee, Hathi committee and Mudaliar committee **Code of Pharmaceutical ethics** D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath **Medical Termination of Pregnancy Act** **Right to Information Act** **Introduction to Intellectual Property Rights (IPR)**

6TH SEMESTER

[1] MEDICINAL CHEMISTRY III

Unit	Topic
1	**Antibiotics:** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β-Lactam antibiotics:** Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin **Tetracyclines:** Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline
2	**Antibiotics:** **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin. **Prodrugs:** Basic concepts and application of prodrugs design. **Antimalarials:** Etiology of malaria. **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil. **Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquone
3	**Anti-tubercular Agents** **Urinary tract anti-infective agents** **Quinolones** **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine **Antiviral agents**
4	**Antifungal agents** **Anti-protozoal Agents** **Anthelmintics** **Sulphonamides and Sulfones** **Sulphonamides and Sulfones**
5	**Introduction to Drug Design- QSAR** **Combinatorial Chemistry**

[2] PHARMACOLOGY III

Unit	Topic
1	**Pharmacology of drugs acting on Respiratory system** a. Anti -asthmatic drugs b. Drugs used in the management of COPD c. Expectorants and antitussives d. Nasal decongestants e. Respiratory stimulants **Pharmacology of drugs acting on the Gastrointestinal Tract** a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants.

	d. Digestants and carminatives. e. Emetics and anti-emetics.
2	**Chemotherapy** a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides
3	**Chemotherapy** a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e.Anthelmintics f. Antimalarial drugs g. Antiamoebic agents
4	**Chemotherapy** l. Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy **Immunopharmacology** a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars
5	**Principles of toxicology** **Chronopharmacology**

[3] HERBAL DRUG TECHNOLOGY

Unit	Topic
1	**Herbs as raw materials** **Biodynamic Agriculture** **Indian Systems of Medicine**
2	**Nutraceuticals** **Herbal-Drug and Herb-Food Interactions**
3	**Herbal Cosmetics** **Herbal excipients** **Herbal formulations**
4	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs **Patenting and Regulatory requirements of natural products** **Regulatory Issues-** ASU DTAB, ASU DCC), Schedule Z of Drugs & Cosmetics Act for ASU drugs
5	**General Introduction to Herbal Industry** **Schedule T – Good Manufacturing Practice of Indian systems of medicine**

[4] BIOPHARMACEUTICS AND PHARMACOKINETICS

Unit	Topic

1	**Biopharmaceutics- Absorption & Distribution** **PPB**
2	**Biopharmaceutics- Elimination** **Bioavailability and Bioequivalence**
3	**Pharmacokinetics**
4	***Multicompartment models***
5	**Nonlinear Pharmacokinetics**

[5] PHARMACEUTICAL BIOTECHNOLOGY

Unit	Topic
1	Introduction to Biotechnology with reference to Pharmaceutical Sciences Enzyme Biotechnology Biosensors Protein Engineering Use of microbes in industry. Production of Enzyme principles of genetic engineering
2	a) Study of cloning vectors, restriction endonucleases and DNA ligase. b) Recombinant DNA technology. Application of genetic engineering in medicine. c) Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. d) Brief introduction to PCR
3	Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications g) Blood products and Plasma Substituties.
4	a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting. b) Genetic organization of Eukaryotes and Prokaryotes c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. d) Introduction to Microbial biotransformation and applications. **e)** Mutation: Types of mutation/mutants.
5	a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. b) Large scale production fermenter design and its various controls. c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.

[6] QUALITY ASSURANCE

Unit	Topic

1	**Quality Assurance and Quality Management concepts** **Total Quality Management (TQM)** **ICH Guidelines** **Quality by design (QbD)** **ISO 9000 & ISO14000** **NABL accreditation**
2	**Organization and personnel** **Premises** **Equipments and raw materials**
3	**Quality Control** **Good Laboratory Practices**
4	**Complaints** **Document maintenance in pharmaceutical industry**
5	**Calibration and Validation** **Warehousing**

7TH SEMESTER

[1] INSTRUMENTAL METHODS OF ANALYSIS

Unit	Topic
1	**UV Visible spectroscopy** **Fluorimetry**
2	**IR spectroscopy** **Flame Photometry**
3	**Introduction to chromatography** • **Adsorption and partition column chromatography** • **Thin layer chromatography-** • **Paper chromatography** • **Electrophoresis**
4	**Gas chromatography** **High performance liquid chromatography (HPLC)**
5	**Ion exchange chromatography** **Gel chromatography** **Affinity chromatography**

[2] INDUSTRIAL PHARMACY- II

Unit	Topic
1	**Pilot plant scale up techniques**
2	**Technology development and transfer**
3	**Regulatory affairs** **Regulatory requirements for drug approval**
4	**Quality management systems**
5	**Indian Regulatory Requirements**

[3] PHARMACY PRACTICE

Unit	Topic
1	**a) Hospital and it's organization** **b) Hospital pharmacy and its organization** **c) Adverse drug reaction** **d) Community Pharmacy**
2	**a) Drug distribution system in a hospital** **b) Hospital formulary** **c) Therapeutic drug monitoring** **d) Medication adherence** **e) Patient medication history interview** **f) Community pharmacy management**
3	**a) Pharmacy and therapeutic committee** **b) Drug information services** **c) Patient counselling** **d) Education and training program in the hospital**

	e) Prescribed medication order and communication skills
4	**a) Budget preparation and implementation** **b) Clinical Pharmacy** **c) Over the counter (OTC) sales**
5	**a) Drug store management and inventory control** **b) Investigational use of drugs** **c) Interpretation of Clinical Laboratory Tests**

[4] NOVEL DRUG DELIVERY SYSTEM

Unit	Topic
1	**Controlled drug delivery systems** **Polymer**
2	**Microencapsulation** **Mucosal Drug Delivery system** **Implantable Drug Delivery Systems**
3	**Transdermal Drug Delivery Systems** **Gastroretentive drug delivery systems** **Nasopulmonary drug delivery system**
4	**Targeted drug Delivery**
5	**Ocular Drug Delivery Systems** **Intrauterine Drug Delivery Systems**

8TH SEMESTER

[1] BIOSTATISTICS AND RESEARCH METHODOLOGY

Unit	Topic
1	**Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency** **Measures of dispersion** **Correlation**
2	**Regression** **Probability** **Parametric test**: t-test, ANOVA, Least Significance difference
3	**Non Parametric tests** **Introduction to Research** **Graphs** **Designing the methodology**
4	Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels **Introduction to Practical components of Industrial and Clinical Trials Problems**: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach
5	**Design and Analysis of experiments** **Factorial design** **Response Surface methodology**

[2] SOCIAL AND PREVENTIVE PHARMACY

Unit	Topic
1	**Concept of health and disease** **Social and health education** **Sociology and health** **Hygiene and health**
2	**Preventive medicine**
3	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme
4	National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program
5	Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

[3] PHARMA MARKETING MANAGEMENT

Unit	Topic
1	**Marketing & Pharmaceutical market**
2	**Product decision**
3	**Promotion**
4	**Pharmaceutical marketing channels** **Professional sales representative (PSR)**
5	**Pricing** **Emerging concepts in marketing** Vertical & Horizontal Marketing

[4] PHARMACEUTICAL REGULATORY SCIENCE

Unit	Topic
1	**New Drug Discovery and development**
2	**Regulatory Approval Process** **Regulatory authorities and agencies**
3	**Registration of Indian drug product in overseas market**
4	**Clinical trials**
5	**Regulatory Concepts**

[5] PHARMACOVIGILANCE

Unit	**Topic**
1	**Introduction to Pharmacovigilance** **Introduction to adverse drug reactions** **Basic terminologies used in pharmacovigilance**
2	**Drug and disease classification** **Drug dictionaries and coding in pharmacovigilance** **Information resources in pharmacovigilance** **Establishing pharmacovigilance programme**
3	**Vaccine safety surveillance** **Pharmacovigilance methods** **Communication in pharmacovigilance**
4	**Safety data generation** **ICH Guidelines for Pharmacovigilance**
5	**Pharmacogenomics of adverse drug reactions** **Drug safety evaluation in special population** **CIOMS** **CDSCO (India) and Pharmacovigilance**

[6] QUALITY CONTROL AND STANDARDIZATION OF HERBALS

Unit	Topic
1	Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use
2	**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP

	WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants
3	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines
4	Stability testing of herbal medicines.Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions
5	Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products

[7] COMPUTER AIDED DRUG DESIGN

Unit	Topic
1	**Introduction to Drug Discovery and Development** **Lead discovery and Analog Based Drug Design** **Analog Based Drug Design**
2	**Quantitative Structure Activity Relationship (QSAR)** **SAR, QSAR, 3D-QSAR, COMFA, COMSIA**
3	**Molecular Modeling and virtual screening techniques** **Virtual Screening tec** **Molecular docking**
4	**Informatics & Methods in drug design**
5	**Molecular Modeling**

[8] CELL AND MOLECULAR BIOLOGY (ELECTIVE SUBJECT)

Unit	Topic
1	a) Cell and Molecular Biology: Definitions theory and basics and Applications. b) Cell and Molecular Biology: History and Summation. c) Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)
2	a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation
3	a) Proteins: Defined **and** Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis
4	a) Science of Genetics

	b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints
5	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning

[9] COSMETIC SCIENCE

Unit	Topic
1	Classification of cosmetic and cosmeceutical products Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients** **Skin** **Hair** **Oral Cavity**
2	**Principles of formulation and building blocks of skin care products** **Antiperspants & deodorants** **Principles of formulation and building blocks of Hair care products** Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash
3	Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skincream and toothpaste
4	Principles of Cosmetic Evaluation:Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps,and syndet bars. Evolution and skin benfits.
5	Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action

[10] EXPERIMENTAL PHARMACOLOGY

Unit	Topic
1	**Laboratory Animals:** Study of CPCSEA and OECD guidelines
2	**Preclinical screening models**

	a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. **Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's,antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease
3	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics
4	**Preclinical screening models:** for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.
5	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data

[11] ADVANCED INSTRUMENTATION TECHNIQUES

Unit	Topic
1	**Nuclear Magnetic Resonance spectroscopy** **Mass Spectrometry**
2	**Thermal Methods of Analysis** **X-Ray Diffraction Methods**
3	**Calibration and validation-**ICH and USFDA guidelines **Calibration of following Instruments-** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer Fluorimeter, Flame Photometer, HPLC and GC
4	**Radio immune assay** **Extraction techniques**
5	**Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS.

[12] DIETARY SUPPLEMENTS AND NUTRACEUTICALS

Unit	Topic
1	a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds
2	Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following

	a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Reservetrol d) Flavonoids- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans g) Tocopherols h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like
3	a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. b) Dietary fibres and complex carbohydrates as functional food ingredients.
4	a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing. b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α-Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention
5	a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals