| Course Code | BP101T | Title of the Course | HUMAN ANATOMY & PHYSIOLOGY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 3 | 1 | - | 4 | |
| Course Objectives | 1. Structure and function of Human body at cellular level.<br>2. Describe the various homeostatic mechanisms and their imbalance.<br>3. Appreciate the coordinated working pattern of different organs of each system | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | *Understand* anatomical terminology and body organization based on structure, functions and regulation of cells, tissues, and membranes, using this knowledge in health-related contexts. |
| CO2 | *Explain* the role of skeleton system and joints on the basis of their structure and function. |
| CO3 | *Describe* the role of body fluids and blood in maintaining homeostasis on the basis of their composition, functions and their regulation. |
| CO4 | *Explore* the coordination reflexes and neurological health of nervous system on the basis of their functions and neural coordination. |
| CO5 | *Discuss* the significance of cardiovascular system on the basis of their structure and functions. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to human body Cellular level of organization Tissue level of organization** | Definition and scope of anatomy and physiology, levels of structural Organization and body systems, basic life processes, homeostasis, basic anatomical terminology.<br>Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, **Forms of intracellular signaling**: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine<br>Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues. | 10 | 1 | 3.3, 3.4, 3.b |
| 2 | **Integumentary and skeletal system** | Structure and functions of skin.<br>Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. Joints Structural and functional classification, types of joints movements and its articulation | 10 | 2 | 3.6, 3.b |
| 3 | **Body fluids and blood** | Body fluids, composition and functions of blood, haemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. Lymphatic system Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system | 10 | 3 | 3.3, 3.4, 3.b |
| 4 | **Peripheral nervous system Special senses** | Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system.<br>Origin and functions of spinal and cranial nerves. Structure and functions of eye, ear, nose and tongue and their disorders. | 8 | 4 | 3.4, 3.b |
| 5 | **Cardiovascular system** | Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart-beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart. | 7 | 5 | 3.4, 3.b |
| 6 | **Introduction to human body Cellular level of organization Tissue level of organization** | Definition and scope of anatomy and physiology, levels of structural Organization and body systems, basic life processes, homeostasis, basic anatomical terminology.<br>Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine | 10 | 1 | 3.3, 3.4, 3.b |

| | | | | | |
|---|---|---|---|---|---|
| | | Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues. | | | |

**Reference Books:**

Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA

Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.

Human Physiology (Vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata.

**e-Learning Source:**

https://www.academia.edu/40518139/Ross_willson_anatomy_and_physiology

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | 1 | 1 | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO2 | 3 | - | - | - | - | 2 | 1 | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO3 | 3 | - | - | - | - | 1 | 1 | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO4 | 3 | - | - | - | - | 1 | 2 | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO5 | 3 | - | - | - | - | 1 | 1 | 1 | 1 | - | 1 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP102T | Title of the Course | PHARMACEUTICAL ANALYSIS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the principles of volumetric and electro chemical analysis<br>2. Carryout various volumetric and electrochemical titrations<br>3. Develop analytical skills | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the use of various pharmaceutical analytical methods and related terms in analysis of drugs and pharmaceutical excipients |
| CO2 | Apply aqueous and non aqueous titration in analysis of drugs and excipients |
| CO3 | Apply precipitation and complexometric titration in analysis of drugs and excipients |
| CO4 | Apply redox titration in analysis of drugs and excipients |
| CO5 | Apply electrochemical methods of analysis in analysis of drugs and excipients |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Pharmaceutical analysis** | Definition and scope<br>Different techniques of analysis<br>Methods of expressing concentration<br>Primary and secondary standards.<br>Pre paration and standardization of various molar and normal solutions Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate<br>Errors: Sources of errors, types of errors, methods of minimizing errors,accuracy, precision and significant figures<br>Pharmacopoeia, Sources of impurities in medicinal agents,limit tests. | 10 | 1 | - |
| 2 | **Acid base titration Non-aqueous titration:** | Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves<br>Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl | 10 | 2 | - |
| 3 | **Precipitation titrations Complexometric titration Gravimetry** | Mohr's method, Volhard's, Modified, Volhard's, Fajans method, estimation of sodium chloride.<br>Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.<br>Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration. | 10 | 3 | - |
| 4 | **Redox titrations** | Concepts of oxidation and reduction<br>Types of redox titrations (Principles and applications): Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate | 08 | 4 | - |
| 5 | **Electrochemical methods of analysis: Conductometry Potentiometry Polarography** | Introduction, Conductivity cell, Conductometric titrations, applications.<br>Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometrititration and applications.<br>Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications | 07 | 5 | - |

**Reference Books:**

A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London

A.I. Vogel, Text Book of Quantitative Inorganic analysis

P. Gundu Rao, Inorganic Pharmaceutical Chemistry

Bentley and Driver's Textbook of Pharmaceutical Chemistry John H. Kennedy, Analytical chemistry principles

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|---|
| Indian Pharmacopoeia. |
| **e-Learning Source:** |
| https://www.academia.edu/40518139/Ross_willson_anatomy_and_physiology |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 3 | 2 | - | 1 | - | 2 | 1 | - | 1 | 3 | 2 | 2 |
| CO2 | 3 | 1 | 3 | 2 | - | 1 | - | 1 | 2 | - | 1 | 3 | 2 | 2 |
| CO3 | 3 | 1 | 3 | 2 | - | 2 | - | 2 | 1 | - | 1 | 3 | 2 | 2 |
| CO4 | 3 | 1 | 3 | 2 | - | 1 | - | 1 | 2 | - | 1 | 3 | 2 | 2 |
| CO5 | 3 | 1 | 3 | 2 | - | 1 | - | - | 1 | - | 1 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP103T | Title of the Course | PHARMACEUTICS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know the history of profession of pharmacy<br>2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and<br>3. pharmaceutical calculations<br>4. Understand the professional way of handling the prescription<br>5. Preparation of various conventional dosage forms | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Explain career opportunities in pharmacy, different types of dosage and dose calculation based on age, body weight and body surface area of the patient. |
| CO2 | Understand powder and liquid dosage forms, excipients used in liquid dosage forms and solubility enhancement techniques based on nature of dosage forms. |
| CO3 | Remember monophasic and biphasic liquid formulations along with their preparation methods based on nature of liquid dosage forms. |
| CO4 | Define and understand suppository, displacement value and pharmaceutical incompatibilities based on physical, chemical and therapeutic properties of the drug. |
| CO5 | Discuss semisolid dosage forms, its preparation methods and evaluation parameters based on type of semisolid dosage forms. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Historical background and development of Profession of pharmacy, Dosage forms, Prescription, Posology** | History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP,USP and Extra Pharmacopoeia.<br>Introduction to dosage forms, classification and definitions<br>Definition, Parts of prescription, handling of Prescription and Errors in prescription.<br>Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area | 10 | 1, 2 | |
| 2 | **Pharmaceutical calculations, Powders Liquid, dosage forms** | Weights and measures – Imperial & Metricsystem, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.<br>Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent,efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions<br>Advantages and disadvantages of liquid dosage forms.Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques. | 10 | 3, 4 | |
| 3 | **Monophasic liquids, Biphasic liquids, Suspensions, Emulsions** | Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.<br>Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.<br>Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. | 10 | 5, 6 | |
| 4 | **Suppositories, Pharmaceutical incompatibilities** | Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.<br>Definition, classification, physical, chemical and therapeutic incompatibilities with examples | 8 | 7, 8 | |
| 5 | **Semisolid dosage forms** | Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms | 7 | 9 | |
| **Reference Books:** | | | | | |

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|---|
| H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams andWalkins, New Delhi. |
| Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi. |
| M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh. |
| Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan. |
| Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi. |
| Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi. |
| E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA. |
| Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York. |
| Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York. |
| **e-Learning Source:** |
| https://drive.google.com/file/d/1uQvrQF 84rkbBTcMAbenkThi3VSi8a07/view |


| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | PO2 | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | PO9 | **PO10** | **PO11** | **PSO1** | **PSO2** | PSO3 |
| CO1 | 3 | 1 | 1 | - | 1 | 2 | 1 | - | 1 | - | 1 | 3 | 1 | 1 |
| CO2 | 3 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 1 |
| **CO3** | 3 | 1 | 1 | - | 1 | 2 | 1 | - | 2 | - | 1 | 3 | 1 | 1 |
| CO4 | 3 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 1 |
| CO5 | 3 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP104T | Title of the Course | PHARMACEUTICAL INORGANIC CHEMISTRY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals<br>2. Understand the medicinal and pharmaceutical importance of inorganic compounds | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Discuss the history of pharmacopoeia, monographs, impurities determination of inorganic compounds and pharmaceuticals through the understanding of pharmacopoeia editions and principles of limit test. |
| CO2 | Apply the concepts of acid, base, buffers, electrolytes and dental products for their use in pharmaceutical preparations. |
| CO3 | Express the properties, assay and medicinal uses of inorganic compounds based on the knowledge of Gastrointestinal tract and their mechanism of action. |
| CO4 | Illustrate the mechanism, method of preparation, properties, assay and medicinal importance of inorganic compounds based on their categories of expectorants, emetics, hematinics, poison antidote and astringents. |
| CO5 | Describe radioisotopes based on the understanding of different radiations along with their properties, measurement techniques, storage conditions, precautions and pharmaceutical applications. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Impurities in Pharmaceutical Substances** | **Impurities in pharmaceutical Substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate.<br>**General methods of preparation**, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes. | 10 | 1 | - |
| 2 | **Acids, Bases and Buffers, Major extra and intracellular electrolytes, Dental products.** | **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.<br>**Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*,Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.<br>**Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement. | 10 | 2 | - |
| 3 | **Gastrointestinal agents** | **Gastrointestinal agents**<br>**Acidifiers:** Ammonium chloride* and Dil. HCl.<br>**Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture.<br>**Cathartics:** Magnesium sulphate, Sodium orthophosphate Kaolin and Bentonite.<br>**Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations. | 10 | 3 | - |
| 4 | **Miscellaneous compounds** | **Miscellaneous compounds**<br>**Expectorants:** Potassium iodide, Ammonium chloride*.<br>**Emetics:** Copper sulphate*, Sodium potassium tartrate.<br>**Hematinics:** Ferrous sulphate*, Ferrous gluconate.<br>**Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333.<br>**Astringents**: Zinc Sulphate, Potash Alum. | 8 | 4 | - |
| 5 | **Radiopharmaceuticals:** | **Radiopharmaceuticals**: Radio activity, measurement of radioactivity, properties of α, β, γ radiations, half-life, radio isotopes and study of radio isotopes- Sodium iodide I131, storage conditions, precautions & pharmaceutical application of radioactive substances. | 7 | 5 | - |

| Reference Books: |
|---|
| A.H.Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition. |
| A.I. Vogel, Text book of quantitative Inorganic analysis. |
| P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd edition |
| M.L. Schroff, Inorganic Pharmaceutical Chemistry |
| Bentley and Driver's Textbook of Pharmaceutical Chemistry |
| Anand & Chatwal, Inorganic Pharmaceutical Chemistry |
| Indian Pharmacopoeia |
| **e-Learning Source:** |
| Impurities in Pharmaceuticals: https://drive.google.com/file/d/1rIsnjteYvocP6X29T06PjjPQeuqRzObF/view?usp=share_link |
| Acid, Base & Buffers: https://drive.google.com/file/d/1VvoJ8ocAlQHp2k0ymD12iKb19Q9z1Z1l/view?usp=share_link |
| Major Intra and Extra cellular electrolytes: https://drive.google.com/file/d/1QN5D9jpqTtsdfk2xerg0BP27Rk39eQJM/view?usp=share_link |
| Gastrintestinal Agents: https://drive.google.com/file/d/1y8eMrniHKwVcyO1ggMJWpY6wMEWESv48/view?usp=share_link |
| Dental Products: https://drive.google.com/file/d/1tB7LINZ81mxDzByLueRAcyUExcovQDSC/view?usp=share_link |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | 2 | - | - | 1 | - | - | 2 | - | 3 | 2 | 1 | 1 |
| CO2 | 3 | - | 1 | - | - | 2 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO3 | 3 | - | - | - | - | 2 | 2 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO4 | 3 | - | 1 | - | - | 1 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO5 | 3 | - | 1 | - | - | 2 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP105T | Title of the Course | COMMUNICATION SKILLS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 2 | - | - | 2 | |
| Course Objectives | 1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation<br>2. Communicate effectively (Verbal and Non Verbal)<br>3. Effectively manage the team as a team player<br>4. Develop interview skills<br>5. Develop Leadership qualities and essentials | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Discuss the basic concepts/ knowledge of the Communication process, its types, Barriers to communication and Perspectives in communication. |
| CO2 | Define the Elements of communication: Tone, body language, gesture, communication styles, Verbal and Non-verbal mode of communication |
| CO3 | Use Basic Listening skills: active listening, listening in difficult situations, Written communication: shades of meaning, complexity, Audience factor, organization of the message |
| CO4 | Operate the interview skills, do's and don'ts of an interview, and presentation skills: planning and structuring, delivery, and presentation techniques. |
| CO5 | Discuss about the Group Discussion and its aspects: role of communication skills in GD and Do's and Don'ts of GD |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Communication Skills** | Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context<br>Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers<br>Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment | 7 | 1 | 4.3 |
| 2 | **Elements of Communication** | Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication<br>Communication Styles: Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style | 7 | 2 | 4.3 |
| 3 | **Basic Listening Skills** | Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations<br>Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message | 7 | 3 | 4.3 |
| 4 | **Interview Skills** | Purpose of an interview, Do's and Dont's of an interview<br>Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery | 5 | 4 | 4.7 |
| 5 | **Group Discussion** | Introduction, Communication skills in group discussion, Do's and Dont's of group discussion | 4 | 5 | 4.7 |

**Reference Books:**

Andreja. J., Basic communication skills for Technology, Ruther Ford, 2nd Edition, Pearson Education, 2011

Gill Hasson., Brilliant- Communication skills, , 1stEdition, Pearson Life, 2011

Kumar, Sanjay and Pushp Lata, Communication Skills. Oxford University Press, Oxford, 2011.

Mitra, Barun K., Personality development and soft skills, 1stEdition, Oxford Press, 2011

**e-Learning Source:**

https://www.academia.edu/26711514/Basic_English_Grammar_Book_1

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | - | 1 | 1 | 3 | 1 |
| CO2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | - | 1 | 1 | 2 | 1 |
| CO3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | - | 1 | 2 | 1 | 2 |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | - | 1 | 1 | 2 | 1 |
| CO5 | 1 | 1 | 1 | 1 | 1 | - | 1 | 3 | 1 | - | 1 | 2 | 3 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP106RBT | Title of the Course | REMEDIAL BIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 2 | - | - | 2 | |
| Course Objectives | 1. Know the classification and salient features of five kingdoms of life<br>2. Understand the basic components of anatomy & physiology of plant<br>3. Know understand the basic components of anatomy & physiology animal with special reference to human | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Students will be able to learn about basic concept/ Knowledge of animal cell, Aminal Tissue, cell division and cell organelles' |
| CO2 | Students will be able to learn about basic concept/ Knowledge of plant respiration, plant growth and development, plant and mineral nutrition, photosynthesis |
| CO3 | Students will be able to learn about classifications & salient feature of five kingdoms of life Anatomy and Physiology human, anatomy and physiology of plant |
| CO4 | Students will be able to learn about circulatory, digestive, respiratory and excreatory system of human |
| CO5 | Students will be able to learn about Morphology of plant, Root, Stem, Leaf and its modification |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Living World<br>Morphology of flowering plants** | Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdom of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia, and plantae, virus, Morphology of different parts of flowering plants-Root, stem, inflorescence, flower, leaf, fruit, seed. General anatomy of Root, stem, leaf of monocotyledons and Di cotyledons | 7 | 1, 2 | - |
| 2 | **Body fluids and circulation<br>Digestion and Absorption<br>Breathing and respiration** | Composition of blood, blood groups, coagulation of blood. Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels Cardiac cycle, cardiac output, and ECG.<br>Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food<br>Human respiratory system Mechanism of breathing and its regulation Exchange of gases, Transport of gases and regulation of respiration Respiratory volumes. | 7 | 2, 3 | - |
| 3 | **Excretory products and their elimination Neural control and coordinating<br>Chemical coordination and regulation<br>Human reproduction** | Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotensin system.<br>Definition and classification of nervous system Structure of a neuron Generation and conduction of nerve impulse Structure of brain and spinal cord Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata Endocrine glands and their secretions Functions of hormones secreted by endocrine glands<br>Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle | 7 | 2, 3 | - |
| 4 | **Plants and mineral nutrition Photosynthesis** | Essential mineral, macro and micronutrients Nitrogen metabolism , Nitrogen cycle, biological nitrogen fixation<br>Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis. | 5 | 3, 4 | - |
| 5 | **Plant respiration<br>Plant growth and development Tissues** | Respiration, glycolysis, fermentation (anaerobic).<br>Phases and rate of plant growth, Condition of growth,<br>Introduction to plant growth regulators Cell - The unit of life Structure and functions of cell and cell organelles.Cell division, Definition, types of tissues, location and functions. | 4 | 2, 5 | - |

**Reference Books:**

Text books a. Text book of Biology by S.B.Gokhale b. A Text book of Biology by Dr.Thulajappa and Dr. Seetaram

A Text book of Biology by B.V.Sreenivasa Naidu, A Text book of Biology by Naidu and Murthy.

| |
|---|
| Botany for Degree students By A.C.Dutta. Outlines of Zoology by M.Ekambaranatha ayyer and T.N.Ananthakrishnan. |
| A manual for pharmaceutical biology practical by S.B.Gokhale and C.K.Kokate. |
| **e-Learning Source:** |
| https://biology.org.ua/files/lib/Raven_Johnson_McGraw-Hill_Biology.pdf |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | 1 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 |
| CO2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 | 2 | 1 |
| CO3 | 2 | - | - | - | - | 2 | 1 | 1 | 1 | - | 2 | 2 | 1 | 2 |
| CO4 | 2 | - | - | - | - | 1 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 |
| CO5 | 2 | - | - | - | - | 1 | - | 1 | 1 | - | 2 | 1 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP106RMT | Title of the Course | REMEDIAL MATHEMATICS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 2 | - | - | 2 | |
| Course Objectives | 1. Know the theory and their application in Pharmacy.<br>2. Solve the different types of problems by applying theory.<br>3. Appreciate the important application of mathematics in Pharmacy. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Students will be able to learn about basic skills and extend their knowledge as they prepare for more advanced work. |
| CO2 | Students will be able to learn about mathematical concepts and principles to perform computations for Pharmaceutical Sciences. |
| CO3 | Students will be able to learn about classifications & salient feature of basic mathematics such as Identifying numbers, arrange numbers into arrays, to find solution of pharmacokinetics equations, etc. |
| CO4 | Student shall be able to Know Trignometry, Analytical geometry, Matrices, Determinant, Integration, Differential equation, Laplace transform and their applications. |
| CO5 | Students will be able to learn to solve the problems of different types by applying theory and appreciate the important applications of mathematics in pharmacy. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Partial fraction** | **Partial fraction:** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics Logarithms.<br>**Logarithms:** Introduction, Definition, Theorems / Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.<br>**Limits and continuity:** Introduction, Limit of a function, Definition of limit of a function ($\epsilon - \delta$ definition)<br>$\lim_{x \to a} \frac{x^n - a^n}{x - a} = na^{n-1}, \lim_{\theta \to 0} \frac{sin\theta}{\theta} = 1$ | 6 | 1 | - |
| 2 | **Matrices and Determinant** | **Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices,Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharma cokinetic equations. | 6 | 2 | - |
| 3 | **Calculus Differentiation** | **Calculus Differentiation :** Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – Without Proof, Derivative of $x^n$ w.r.t x, where n is any rational number, Derivative of $e^x$, Derivative of loge x, Derivative of $a^x$, Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application. | 6 | 3 | - |
| 4 | **Analytical Geometry And Integration** | **Analytical Geometry:** Signs of the Coordinates, Distance formula.<br>**Straight Line:** Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line.<br>**Integration:** Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration | 6 | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| | | by parts, definite integrals, application. | | | |
| 5 | **Differential Equations and Laplace Transform** | **Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations.<br>**Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations. | 6 | 5 | - |

**Reference Books:**

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan.
. Higher Engineering Mathematics by Dr. B. S. Grewal.

**e-Learning Source:**

https://recnotes.com/wp-content/uploads/2023/01/remedial-mathematics.pdf

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/BP106RMT.pdf

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | 3 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| CO2 | - | - | 3 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| CO3 | - | - | 3 | - | 1 | - | - | - | - | - | 1 | 1 | 2 | 1 |
| CO4 | - | - | 3 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 2 |
| CO5 | - | - | 3 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | PMT113 | Title of the Course | MEDICAL TERMINOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | 2 | - | - | 2 | |
| Course Objectives | Correctly identify the roles of the four types of word parts in forming medical terms. Identify unfamiliar medical terms using their knowledge of word parts. Define anatomy and physiology and use anatomic reference systems to identify the anatomic position for all major organ systems. Understand disease terms as they relate to the diagnostic coding manual. Use basic prefixes, suffixes, and combining forms to build medical terms. Explain the rules for proper pronunciation and spelling. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Correctly identify the roles of the four types of word parts in forming medical terms. |
| CO2 | Identify unfamiliar medical terms using their knowledge of word parts |
| CO3 | Use basic prefixes, suffixes, and combining forms to build medical terms |
| CO4 | Explain the rules for proper pronunciation and spelling |
| CO5 | Relate the terminology to the names, locations, and functions of the major organs of the body systems |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Terminology/Basic Word Structure Introduction to the medical terminology** | **Introduction to the medical terminology:** Rationale for studying medical terminology Spelling and pronunciation of medical terms<br>**Basic word parts that form most medical terms**: word root, combining form, prefix, and suffix<br>Meaning and pronunciation of medical words | 6 | 1,2 | - |
| 2 | **Terms Pertaining to the Body as a Whole** | Terms applied to the structural organization of the body including building blocks of the body: cells, tissue, organs, systems Terms and abbreviations used to describe direction, planes, and cavities of the body Terms and abbreviations that locate anatomical division of the back and abdomen | 6 | 2,3 | - |
| 3 | **Prefixes and Suffixes** | Basic prefixes and suffixes used in medical terminology Prefixes of position, number, measurement, negation and direction | 6 | 2,3 | - |
| 4 | **Study of terminology used in specific body systems** | common medical terms, abbreviations and synonyms used for symptoms, diseases, disorders, procedures, treatments, and adverse effects of drugs associated with<br>For the following<br>Cardiovascular system<br>Respiration<br>Digestion<br>Urinary<br>Male Reproductive System<br>Female Reproductive System<br>Endocrine<br>Nervous Systems<br>The Senses<br>The Skeleton and Muscular Systems<br>The Skin | 6 | 3,4 | - |
| 5 | **Terminology related to drugs and their effects** | Terms related to causes, diagnosis and treatment of above systems and Cancer<br>Immunity<br>Behavioral disorders<br>Anesthesia | 6 | 2,5 | - |

**Reference Books:**

Betsy J. Shiland, MEDICAL TERMINOLOGY AND ANATOMY FOR ICD-10 CODING ISBN: 978-1-4557-0774-4

Barbara A. Gylys, Mary Ellen Wedding, MEDICAL TERMINOLOGY SYSTEMS A Body Systems Approach, 6th Edition

**e-Learning Source:**

http://www.frankshospitalworkshop.com/organisation/biomed_documents/Introduction%20to%20Medical%20Terminology.pdf

https://www.pittsburg.k12.ca.us/cms/lib/CA01902661/Centricity/Domain/1210/Medical%20Terminology%20for%20Health%20Professions%207th%20Edition%202012.pdf

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | 3 | 2 | 1 |
| CO2 | 2 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO3 | 2 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | 3 | 1 | 1 |
| CO4 | 2 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | 2 | 1 | 1 |
| CO5 | 2 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | 3 | 2 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP107P | Title of the Course | HUMAN ANATOMY & PHYSIOLOGY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 4 | 2 | |
| Course Objectives | 1. Structure and function of Human body at cellular level.<br>2. Describe the various homeostatic mechanisms and their imbalance.<br>3. Appreciate the coordinated working pattern of different organs of each system<br>4. Explain the gross morphology, structure and functions of various organs of the human body.<br>5. Identify the various tissues and organs of different systems of human body.<br>6. Perform the various experiments related to special senses and nervous system. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | To demonstrate the permanent slide of various tissues of the human body. |
| CO2 | Identification of skeletal framework with reference to axial and appendicular systems. |
| CO3 | To perform the hematological sample analysis for interpretation of the result. |
| CO4 | Determination of normal physiological parameters of the human body in context to pulse rate and heart rate. |
| CO5 | Determination of normal physiological parameters of the human body in context to blood pressure. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Microscope | Study of a compound microscope | 4 | 1 | - |
| | | Microscopic study of epithelial and connective tissue | 4 | 1 | - |
| | | Microscopic study of muscular and nervous tissue | 4 | 1 | - |
| 2 | Skeletal system | Identification of axial bones. | 4 | 2 | - |
| | | Identification of appendicular bones. | 4 | 2 | - |
| 3 | Blood & lymphatic system | Enumeration of white blood cell (WBC) count | 4 | 3 | - |
| | | Enumeration of total red blood corpuscles (RBC) count | 4 | 3 | - |
| | | Determination of bleeding time | 4 | 3 | - |
| | | Determination of clotting time | 4 | 3 | - |
| | | Estimation of hemoglobin content | 4 | 3 | - |
| | | Determination of blood group | 4 | 3 | - |
| 4 | Cardiovascular system | Determination of pulse rate and heart rate. | 4 | 4 | - |
| | | Record the blood pressure. | 4 | 4 | - |

**Reference Books:**

Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi

**e-Learning Source:**

https://books.google.co.in/books?id=gH_rS8tuz8wC&lpg=PP2&ots=sO5e-egFWY&dq=10.5005%2Fjp%2Fbooks%2F10024&lr&pg=PA13-IA3#v=onepage&q&f=false

https://colbournecollege.weebly.com/uploads/2/3/7/9/23793496/ross-and-wilson-anatomy-and-physiology-in-health-a.pdf

| Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 1 | - | - | 1 | 1 | 2 | - | 3 | 3 | 1 | 1 |
| CO2 | 3 | 2 | 3 | - | 1 | 2 | 1 | 1 | 2 | - | 3 | 3 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | - | 2 | 1 | 1 | 2 | 1 | 3 | 3 | 1 | 1 |
| CO4 | 3 | 2 | 3 | - | - | 2 | 1 | 1 | - | 1 | 2 | 3 | 1 | 1 |
| CO5 | 3 | 2 | 3 | - | - | 2 | 1 | 1 | - | 1 | 3 | 3 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP108P | Title of the Course | PHARMACEUTICAL ANALYSIS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 4 | 2 | |
| Course Objectives | 1. Understand the principles of volumetric and electro chemical analysis<br>2. Carryout various volumetric and electrochemical titrations<br>3. Develop analytical skills | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the knowledge on preparatory pharmacy and professional way of evaluating various conventional drugs, raw materials and formulations. |
| CO2 | Explain the theoretical basis of commonly used statistical methods & correctly analyze & interpret the results of statistical data from surveys, experiments & observational studies. |
| CO3 | Illustrate sources of errors in analytical techniques, methods to minimize them. |
| CO4 | Describe the various titrimetric and electrochemical methods of analysis and their application in quality control of pharmaceuticals |
| CO5 | Describe gravimetry and limit tests-principles and applications. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Limit Test** | Chloride Sulphate Iron | 4 | 1,2 | - |
| 2 | **Limit Test** | Arsenic | 4 | 1,2 | - |
| 3 | **Limit Test** | Chloride Sulphate Iron | 4 | 1,2 | - |
| 4 | **Limit Test** | Arsenic | 4 | 1,2 | - |
| 5 | **Preparation and standardization** | Sodium hydroxide | 4 | 3,4 | - |
| 6 | **Preparation and standardization** | Sulphuric acid | 4 | 3,4 | - |
| 7 | **Preparation and standardization** | Sodium thiosulfate | 4 | 3,4 | - |
| 8 | **Preparation and standardization** | Potassium permanganate | 4 | 3,4 | - |
| 9 | **Preparation and standardization** | Ceric ammonium sulphate | 4 | 3,4 | - |
| 10 | **Assay ofStandardization** | Ammonium chloride by acid base titration | 4 | 4,5 | - |
| 11 | **Assay of Standardization** | Ferrous sulphate by Cerimetry | 4 | 4,5 | - |
| 12 | **Assay of Standardization** | Copper sulphate by Iodometry | 4 | 4,5 | - |
| 13 | **Assay of Standardization** | Calcium gluconate by complexometry | 4 | 4,5 | - |
| 14 | **Assay of Standardization** | Sodium benzoate by non-aqueous titration | 4 | 4,5 | - |
| 15 | **Assay of Standardization** | Hydrogen peroxide by Permanganometry | 4 | 4,5 | - |
| 16 | **Assay of Standardization** | Sodium Chloride by precipitation titration | 4 | 4,5 | - |
| 17 | **Determination of Normality by electro-analytical methods** | Conductometric titration of strong acid against strong base | 4 | 1,2,5 | - |
| 18 | **Determination of Normality by electro-analytical methods** | Conductometric titration of strong acid and weak acid against strong base | 4 | 1,2,5 | - |
| 19 | **Determination of Normality by electro - analytical methods** | Potentiometric titration of strong acid against strong base | 4 | 1,2,5 | - |
| **e-Learning Source:** | | | | | |
| https://gtu.ge/Agro-Lib/Vogels_TEXTBOOK_OF_QUANTITATIVE_CHEMICAL_ANALYSIS_5th_ed_-_G_H_Jeffery.MsuCity.pdf | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP109P | Title of the Course | PHARMACEUTICS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 4 | 2 | |
| Course Objectives | 1. Know the history of profession of pharmacy<br>2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations<br>3. Understand the professional way of handling the prescription<br>4. Preparation of various conventional dosage forms | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Explain monophasic liquid formulation based upon their preparation methods. |
| CO2 | Describe biphasic liquid formulation based upon knowledge of their preparation and stability issues. |
| CO3 | Prepare powder and granules formulation using the knowledge of formulation composition. |
| CO4 | Estimate suppositories formulation on the basis of their calculation. |
| CO5 | Prepare semi-solid dosage forms using displacement value and its calculation. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Syrup | To prepare & submit 10 ml simple syrup IP' 66. | 4 | 1 | - |
| 2 | Syrup | To prepare and submit 20 ml Ferrous phosphate syrup BPC'68. | 4 | 1 | - |
| 3 | Elixir | To prepare and submit 20 ml Paracetamol pediatric elixir. | 4 | 1 | - |
| 4 | Elixir | To prepare and submit 20 ml Piperazine citrate elixir. | 4 | 1 | - |
| 5 | Linctus | To prepare and submit 10 ml Iodine throat paint. | 4 | 1 | - |
| 6 | Linctus | To prepare and submit 20 ml Turpentine Liniment. | 4 | 1 | - |
| 7 | Solutions | To prepare and submit 20 ml strong ammonium acetate solution. | 4 | 1 | - |
| 8 | Solutions | To prepare and submit 20 ml cresol with soap solution. | 4 | 1 | - |
| 9 | Solutions | To prepare and submit 10 ml Lugol's solution. | 4 | 1 | - |
| 10 | Suspension | To prepare and submit 20 ml calamine lotion. | 4 | 2 | - |
| 11 | Suspension | To prepare and submit 20 ml aluminium hydroxide suspension. | 4 | 2 | - |
| 12 | Suspension | To prepare and submit 20 ml magnesium hydroxide mixture. | 4 | 2 | - |
| 13 | Emulsion | To prepare and submit 20 ml Turpentine Liniment. | 4 | 2 | - |
| 14 | Emulsion | To prepare and submit 20 ml Liquid paraffin emulsion. | 4 | 2 | - |
| 15 | Powders & granules | To prepare and submit 10 gm of eutectic powder. | 4 | 3 | - |
| 16 | Powders & granules | To prepare and submit 10 gm of effervescent powder. | 4 | 3 | - |
| 17 | Powders & granules | To prepare and submit 10 gm of divided powder. | 4 | 3 | - |
| 18 | Powders & granules | To prepare and submit 10 gm of dusting powder. | 4 | 3 | - |
| 19 | Suppositories | To prepare and submit 6 Boric acid suppositories (calculate for 8) | 4 | 4 | - |
| 20 | Suppositories | To prepare and submit 6 zinc oxide suppositories (calculate for 8) | 4 | 4 | - |
| 21 | Semisolids | To prepare and submit 20 gm Sulphur ointment. | 4 | 5 | - |
| 22 | Gargles & Mouthwash | To prepare and submit 10 ml iodine gargle. | 4 | 1 | - |
| Reference Books: | | | | | |
| | | | | | |
| e-Learning Source: | | | | | |
| https://gtu.ge/Agro-Lib/Vogels_TEXTBOOK_OF_QUANTITATIVE_CHEMICAL_ANALYSIS_5th_ed_-_G_H_Jeffery.MsuCity.pdf | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 3 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP110P | Title of the Course | PHARMACEUTICAL INORGANIC CHEMISTRY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 4 | 2 | |
| Course Objectives | 1. Structure a Upon completion of the course the student shall be able to: - Know the theory and their application in the pharmaceutical industry<br>2. Solve the different types of problems by applying practical knowledge.<br>3. Understand the different strategies for the preparation of Inorganic Pharmaceuticals. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Judge the impurities present in the given samples based on the knowledge about the principles, techniques of performing limit test. |
| CO2 | Examine the given inorganic compounds based on the physical properties, chemical reactions and organoleptic properties of the given inorganic compounds |
| CO3 | Examine the swelling power, neutralizing capacity and potassium iodate and iodine presence in bentonite, aluminum hydroxide gel and potassium iodide respectively by following the procedure and principles for the same. |
| CO4 | Synthesis of boric acid and potash alum based on the knowledge of their physical properties and medicinal uses. |
| CO5 | Synthesis of ferrous sulphate based on the knowledge of their physical properties and medicinal uses. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Limit tests for following ions** | Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic | 20 | 1 | - |
| 2 | **Identification test** | Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate | 20 | 3 | - |
| 3 | **Test for purity** | Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide | 20 | 2 | - |
| 4 | **Preparation of inorganic pharmaceuticals** | Boric acid Potash alum Ferrous sulphate | 20 | 3 | - |

**Reference Books:**

**e-Learning Source:**

https://www.researchgate.net/publication/338447994_Practical_Manual_of_Pharmaceutical_Inorganic_Chemistry

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 2 | - | 3 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP111P | Title of the Course | COMMUNICATION SKILLS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 2 | 1 | |
| Course Objectives | 1. Develop a set of soft skills that will add value to the pharmaceutical operations.<br>2. Solve the different types of problems by applying practical knowledge.<br>3. Effectively interact with physicians, physiotherapists, and other health workers. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Identify the importance of interactive skills like meeting people, making friends, etc. |
| CO2 | Understand the usage of basic grammar like pronunciations, noun |
| CO3 | Understand the usage of basic grammar like nouns. |
| CO4 | Define Direct and Indirect Speech and, Figures of Speech. |
| CO5 | Define Effective Communication, Writing Skills and presentation skills. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Basic communication** | Meeting People, Asking Questions, Making Friends, What did you do? Do's and Dont's | 2 | 1 | - |
| 2 | **Pronunciations** | Pronunciation (Consonant Sounds), Pronunciation and Nouns, Pronunciation (Vowel Sounds) | 2 | 2 | - |
| 3 | **Advanced Learning** | Listening Comprehension / Direct and Indirect Speech, Figures of Speech, Effective Communication, Writing Skills, Effective Writing, Interview Handling Skills, E-Mail etiquette, Presentation Skills | 2 | 3 | - |

**Reference Books:**

Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc GrawHill Education, 2011

**e-Learning Source:**

https://www.academia.edu/26711514/Basic_English_Grammar_Book_1

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | - | 1 | 3 | 3 | 1 |
| CO2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | - | 2 | 3 | 1 | 1 |
| CO3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | - | 2 | 3 | 1 | 1 |
| CO5 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 1 | - | 3 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP112RBP | Title of the Course | REMEDIAL BIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | I | - | - | 2 | 1 | |
| Course Objectives | 1. Study of natural sources such as plant and animal origin.<br>2. This subject has been introduced to the pharmacy course in order to make the student aware of various naturally occurring drugs and its history, sources, classification, distribution and the characters of the plants and animals.<br>3. This subject gives basic foundation to Pharmacognosy. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Apply techniques for section cutting, mounting, and staining plant tissues |
| CO2 | Demonstrate the proper use and functions of a microscope for examining biological specimens |
| CO3 | Evaluate different tissues, blood groups, blood pressure, and tidal volume using appropriate techniques. |
| CO4 | Evaluate the quality and effectiveness of prepared permanent slides for microscopic analysis |
| CO5 | Identify cells and their inclusions, stem, root, and leaf structures, the anatomy of a frog, and bones. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Microscope** | Study of microscope | 3 | 2 | - |
| 2 | **Section cutting** | To study the techniques involve in section cutting, mounting and staining | 3 | 1 | - |
| 3 | **Permanent slide** | Preparation of permanent slide | 3 | 5 | - |
| 4 | **Cell** | Study of cell and its inclusions | 3 | 5 | - |
| 5 | **Stem** | Study of stem, root, leaf | 3 | 5 | - |
| 6 | **Frog** | Detailed study of frog | 3 | 5 | - |
| 7 | **Tissues** | Identification of different tissues | 3 | 3 | - |
| 8 | **Bones** | Identification of bones | 3 | 5 | - |
| 9 | **Blood group** | Determination of blood group | 3 | 3 | - |
| 10 | **Blood pressure** | Determination of blood pressure | 3 | 3 | - |
| 11 | **Tidal volume** | Determination of tidal volume | 3 | 3 | - |

**Reference Books:**

**e-Learning Source:**

https://pharmacyinfoline.com/remedial-mathematics-biology-pharm-d/

https://byjus.com/ncert-books-class-11-biology/

https://biology.org.ua/files/lib/Raven_Johnson_McGraw-Hill_Biology.pdf

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | 2 | - | 3 | 1 | 1 | 1 |
| CO2 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | 1 | - | 3 | 1 | 2 | 1 |
| CO3 | 2 | 1 | 2 | 1 | 2 | 1 | - | - | 1 | - | 3 | 2 | 1 | 2 |
| CO4 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | 2 | - | 3 | 1 | 1 | 1 |
| CO5 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | 1 | - | 3 | 1 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh | |
|---|---|
| **Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP201T | Title of the Course | HUMAN ANATOMY & PHYSIOLOGY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | 1 | - | 4 | |
| Course Objectives | 1. Structure and function of Human body at cellular level.<br>2. Describe the various homeostatic mechanisms and their imbalance.<br>3. Appreciate the coordinated working pattern of different organs of each system | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Given the anatomy and physiology of a neuron, demonstrate the anatomical and functional principles to categorize different components of the CNS and PNS and their roles in the body. |
| CO2 | Execute knowledge of the digestive system to predict the digestion, absorption of nutrient and abnormalities on digestive processes. |
| CO3 | Demonstrate the knowledge of the respiratory and urinary system to predict the potential effects of functional irregularities. |
| CO4 | Interpret the structure and functions of endocrine glands to analyse the hormonal regulation of physiological processes and homeostasis. |
| CO5 | Explain the physiological roles of the male and female reproductive systems in gamete production, hormone secretion, and sexual reproduction. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Nervous system** | Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.<br>Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity) | 10 | 1 | 3.4, 3.5, 3.b, 3.d |
| 2 | **Digestive system and Energetics** | Anatomy of GI Tract with special reference to anatomy and functions of stomach, ( Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.<br>Formation and role of ATP, Creatinine Phosphate and BMR. | 6 | 2 | 3.3, 3.4, 3.b, 3.d |
| 3 | **Respiratory system and Urinary system** | Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration<br>Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.<br>Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney. | 10 | 3 | 3.3, 3.b, 3.d |
| 4 | **Endocrine system** | Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. | 10 | 4 | 3.4, 3.b, 3.d |
| 5 | **Reproductive system and Introduction to genetics** | Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition<br>Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance | 9 | 5 | 3.3, 3.7, 3.b, 3.d |

**Reference Books:**

Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.

Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.

Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.

**e-Learning Source:**

https://training.seer.cancer.gov/anatomy/

https://www.sciencedirect.com/science/article/abs/pii/B9780122386626500057

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|---|
| https://medictests.com/units/introduction-to-a-p |
| https://www.registerednursing.org/teas/endocrine-system/ |
| https://www.kenhub.com/en/library/anatomy/human-body-systems |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | 2 | 1 | 1 | 1 | - | 1 | 3 | 1 | 2 |
| CO2 | 3 | - | - | - | - | 2 | - | 1 | 1 | - | 1 | 3 | 1 | 2 |
| CO3 | 3 | - | - | - | - | 2 | 2 | 1 | 1 | - | 1 | 3 | 1 | 2 |
| CO4 | 3 | - | - | - | - | - | 1 | 2 | 1 | - | 1 | 3 | 1 | 2 |
| CO5 | 3 | - | - | - | - | 2 | 2 | 1 | 1 | - | 1 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP202T | Title of the Course | PHARMACEUTICAL ORGANIC CHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | 1 | - | 4 | |
| Course Objectives | 1. Write the structure, name and the type of isomerism of the organic compound<br>2. Write the reaction, name the reaction and orientation of reactions<br>3. Account for reactivity/stability of compounds<br>4. Identify/confirm the identification of organic compound | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Demonstrate the ability to assign classification, nomenclature and structural isomerism to organic compounds based on the knowledge of classification, nomenclature and isomerism. |
| CO2 | Demonstrate the preparation and reactions of alkanes, alkenes and conjugated dienes based on their hybridization, stabilities, kinetics and order of reactivity |
| CO3 | Interpret the reactions, structures, qualitative test and uses of alkyl halides and alcohols based on their kinetics and order of reactivity. |
| CO4 | Demonstrate the synthetic reactions, qualitative test, structure and uses of carbonyl compounds based on their nucleophilic, electromeric mechanism and named reactions. |
| CO5 | Demonstrate the effect of substituents, qualitative test and uses of carboxylic acids and aliphatic amines based on their acidity and basicity respectively. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Classification, nomenclature and isomerism:** | Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds | 7 | 1 | 13.b |
| 2 | **Alkanes, Alkenes and Conjugated dienes** | sp3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, sp2 hybridization in alkenes.<br>E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.<br>Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement | 10 | 2 | 13.b |
| 3 | **Alkyl halides<br>Alcohols** | SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.<br>SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions<br>Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.<br>Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol | 10 | 3 | 13.a, 13.b |
| 4 | **Carbonyl compounds (Aldehydes and ketones)** | Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde. | 10 | 4 | 13.a, 13.b |
| 5 | **Carboxylic acids<br>Aliphatic amines** | Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester<br>Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid, Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine | 8 | 5 | 13.b |

**Reference Books:**

Organic Chemistry byMorrison and Boyd

| |
|---|
| Organic Chemistry by I.L. Finar , Volume-I |
| Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl. |
| Organic Chemistry by P.L.Soni |
| Practical Organic Chemistry byMann and Saunders. |
| Vogel's text book of Practical Organic Chemistry |
| Advanced Practical organic chemistry by N.K.Vishnoi. |
| Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz. |
| Reaction and reaction mechanism by Ahluwaliah/Chatwal. |
| **e-Learning Source:** |
| https://chem.libretexts.org/Bookshelves/Organic_Chemistry |
| https://www.masterorganicchemistry.com/ |
| https://www.google.co.in/books/edition/Advanced_Practical_Organic_Chemistry_Thi/lpv9D2hin6gC?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |
| https://www.google.co.in/books/edition/Intermediate_Organic_Chemistry/2YdxBgAAQBAJ?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO2 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO3 | 3 | 1 | 2 | - | - | 2 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO4 | 3 | 1 | 2 | - | - | 2 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO5 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP203T | Title of the Course | BIOCHEMISTRY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.<br>2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.<br>3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the relationship and biological significance of biomolecules using bioenergetics principles. |
| CO2 | Apply the knowledge of metabolism of carbohydrates in relation to their impact on physiology and related metabolic disorders. |
| CO3 | Apply the knowledge of metabolism of ketone bodies, fatty acids, amino acids and neurotransmitters in relation to their impact on physiology and related metabolic disorders. |
| CO4 | Apply the knowledge of genetics and metabolism of nuleeotides, DNA and RNA in relation to their impact on physiology and related disorders. |
| CO5 | Apply the knowledge of enzymes activity, kinetics and inhibition in relation to normal physiology, metabolism, therapeutics and diagnostic application |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Biomolecules Bioenergetics** | Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.<br>Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.<br>Energy rich compounds; classification; biological significances of ATP and cyclic AMP | 8 | 1,2,3,4,5,6 | 3.4, 3.b |
| 2 | **Carbohydrate metabolism Biological oxidation** | Glycolysis – Pathway, nergetic and significance<br>Citric acid cycle- Pathway, nergetic and significance, HMP shunt and its significance;Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, Glycogen metabolism Pathways and glycogen storage diseases (GSD),Gluconeogenesis- Pathway and its significance, Hormonal regulation of blood glucose level and Diabetes mellitus<br>Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substratePhosphorylation. Inhibitors ETC and oxidative phosphorylation/Uncouplers level | 10 | 1,2,3,4,5,6 | 3.4, 3.b |
| 3 | **Lipid metabolism Amino acid metabolism** | Formation and utilization of ketone bodies; ketoacidosis<br>ß-Oxidation of saturated fatty acid (Palmitic acid) De novo synthesis of fatty acids (Palmitic acid), Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.<br>General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders<br>Catabolism of phenylalanine and tyrosine and their metabolic disorders(Phenyketonuria, Albinism, alkeptonuria, tyrosinemia)<br>Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenalineCatabolism of heme; hyperbilirubinemia and jaundice | 10 | 1,2,3,4,5,6 | 3.3, 3.4, 3.b |
| 4 | **Nucleic acid metabolism and genetic information transfer** | Biosynthesis of purine and pyrimidine nucleotidesCatabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome<br>Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis<br>Genetic code, Translation or Protein synthesis and inhibitors | 10 | 1,2,3,4,5,6 | 3.1, 3.3, 3.b |
| 5 | **Enzymes** | Introduction, properties, nomenclature and IUB classification of enzymes, Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)<br>Enzyme inhibitors with examples, Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation.<br>Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions | 7 | 1,2,3,4,5,6 | 3.1, 3.3, 3.4, 3.b |

| Reference Books: |
|---|
| Principles of Biochemistry by Lehninger. |
| Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell. |
| Biochemistry by Stryer. |
| Biochemistry by D. Satyanarayan and U.Chakrapani |
| Textbook of Biochemistry by Rama Rao. |
| Textbook of Biochemistry by Deb. |
| Outlines of Biochemistry by Conn and Stumpf |
| Practical Biochemistry by R.C. Gupta and S. Bhargavan. |
| Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition) |
| Practical Biochemistry for Medical students by Rajagopal and Ramakrishna. |
| Practical Biochemistry by Harold Varley. |
| **e-Learning Source:** |
| https://www.researchgate.net/publication/347983332_Biochemistry_Basics |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | 3 | 1 | 1 | 1 | - | - | 1 | 1 | 1 | 3 | 2 | 1 |
| CO2 | 3 | - | 3 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 3 | - | 1 | 2 | - | - | 1 | 1 | 1 | 3 | 2 | 1 |
| CO4 | 3 | - | 3 | 2 | 1 | 1 | 1 | - | 2 | 1 | 1 | 3 | 2 | 1 |
| CO5 | 3 | - | 3 | - | - | 1 | - | 1 | 1 | 2 | 1 | 3 | 2 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP204T | Title of the Course | PATHOPHYSIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | 1 | - | 4 | |
| Course Objectives | 1. Describe the etiology and pathogenesis of the selected disease states;<br>2. Name the signs and symptoms of the diseases; and<br>3. Mention the complications of the diseases. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Apply the process of inflammation and repair along with pathophysiology of atherosclerosis based on the understanding of homeostasis, cellular injury, sclerosis and atheroma. |
| CO2 | Interpret the causes, development, and clinical features based on their understanding of pathophysiological mechanisms of following disease: hypertension, congestive heart failure, ischemic heart disease, asthma, chronic obstructive pulmonary disease and renal failure. |
| CO3 | Sketch the causes, development, and clinical features based on their understanding of pathophysiological mechanisms of related disease: hematological, endocrine, neurological, and gastrointestinal diseases. |
| CO4 | Express the causes, development, and clinical features based on their understanding of pathophysiological mechanisms of related disease: inflammatory diseases, liver conditions, bone and joint diseases, and cancer. |
| CO5 | Summarize the causes, development, and clinical features based on their understanding of pathophysiological mechanisms of following disease: meningitis, typhoid, leprosy, tuberculosis, urinary tract infections, and sexually transmitted diseases. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Basic principles of Cell injury and Adaptation** | Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance Basic mechanism involved in the process of inflammation and repair:<br>Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis | 10 | 1 | 3.4, 3.b, 3.d |
| 2 | **Cardiovascular System:** | Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)<br>Respiratory system: Asthma, Chronic obstructive airways diseases. Renal system: Acute and chronic renal failure. | 10 | 2 | 3.3, 3.4, 3.b, 3.d |
| 3 | **Hematological Diseases:** | Iron deficiency, megaloblastic anaemia (Vit B12 and folic acid), sickle cell anaemia, thalassemia, hereditary acquired anaemia, haemophilia<br>Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones<br>Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.<br>Gastrointestinal system: Peptic Ulcer | 10 | 3 | 3.3, 3.4, 3.b, 3.d |
| 4 | **Inflammatory Diseases** | Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease. Disease of bones and joints: Rheumatoid arthritis, osteoporosis and gout<br>Principles of cancer: classification, aetiology and pathogenesis of cancer | 8 | 4 | 3.3, 3.5, 3.b, 3.d, |
| 5 | **Infectious diseases** | Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections Sexually transmitted diseases: AIDS, Syphilis, Gonorrhoea | 7 | 5 | 3.3, 3.7, 3.b, 3.d |

**Reference Books:**

Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.

HarshMohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.

Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.

Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; United States;

Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.

Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.

Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Well, L. Michael Posey. Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.

V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.

Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

**e-Learning Source:**

https://www.researchgate.net/publication/332099805_PATHOPHYSIOLOGY

https://books.google.co.in/books?id=KwYIsLRyDp4C&printsec=frontcover&redir_esc=y#v=onepage&q&f=false

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | 1 | 2 | 1 | 2 | 1 | - | 2 | 3 | 2 | 2 |
| CO2 | 3 | - | - | - | - | 1 | 1 | - | 2 | - | 2 | 3 | 2 | 2 |
| CO3 | 3 | - | - | - | 1 | 1 | - | 1 | - | - | 2 | 3 | 2 | 2 |
| CO4 | 3 | - | - | - | 1 | 1 | 2 | 1 | 1 | - | 2 | 3 | 2 | 2 |
| CO5 | 3 | - | - | - | - | 2 | 2 | 1 | 1 | - | 2 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP205T | Title of the Course | COMPUTER APPLICATIONS IN PHARMACY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | - | - | 3 | |
| Course Objectives | 1. know the various types of application of computers in pharmacy<br>2. know the various types of databases<br>3. know the various applications of databases in pharmacy | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | State the binary number, decimal number system, one complement and two complement method, data flow diagrams on their understanding of the number system, concept of information systems. |
| CO2 | Differentiate the HTML, XML, CSS, MYSQL, MS ACCESS various types of databases on their understanding of the web technologies, Programming languages and concept of basic database |
| CO3 | Classify the hospital and clinical pharmacy, drug information and patient monitoring system on their understanding of the various types of application of computers in pharmacy. |
| CO4 | Describe the Bioinformatics and databases and impact of Bioinformatics in Vaccine Discovery on their understanding of the Bioinformatics |
| CO5 | Identify the Chromatographic data analysis, LIMS, TIMS on their understanding of the Computers as data analysis in Preclinical development |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Number system, Concept of Information Systems and Software** | Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division.<br>Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project. | 10 | 1 | 4.3, 4.4, 4.6,4.7,4.A |
| 2 | **Web technologies** | Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database. | 7 | 2 | 4.3, 4.4, 4.6,4.7,4.A |
| 3 | **Application of computers in Pharmacy** | Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring.<br>Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System | 10 | 2,3 | 4.3, 4.4, 4.6,4.7,4.A |
| 4 | **Bioinformatics** | Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery. | 10 | 3,4 | 4.3, 4.4, 4.6,4.7,4.A |
| 5 | **Computers as data analysis in Preclinical development** | Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS) | 8 | 5 | 4.3, 4.4, 4.6,4.7,4.A |

**Reference Books:**

Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.

Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)

**e-Learning Source:**

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 1 | 3 | 1 | 1 | - | 2 | 1 | - | 3 | 2 | 2 | 1 |
| CO2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | - | 1 | - | 3 | 1 | 1 | 1 |
| CO3 | 1 | 1 | 1 | 3 | - | 1 | 1 | 1 | 1 | - | 3 | 2 | 2 | 1 |
| CO4 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | - | 2 | - | 3 | 1 | 2 | 1 |
| CO5 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 1 | - | 3 | 1 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP206T | Title of the Course | ENVIRONMENTAL SCIENCES | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | 3 | - | - | 3 | |
| Course Objectives | 1. Create the awareness about environmental problems among learners.<br>2. Provided basic knowledge about the environment and its allied problems.<br>3. Motivate learner to participate in environment protection and environment improvement | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Define natural resource and environmental impacts of human activities on natural resource. |
| CO2 | Understand about structure of Ecosystem |
| CO3 | Analyse the functions of Ecosystem |
| CO4 | Explain the types of environmental pollution |
| CO5 | Analyse the impact of environmental pollution on human health and Environment |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Natural Resources** | The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources. | 10 | 1 | 6,7,13 |
| 2 | **Ecosystem structure and functions** | Ecosystems. Concept of an ecosystem. Structure and function of an ecosystem. Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) | 10 | 2 | 13,15 |
| 3 | **Environmental Pollution, control and management** | Environmental Pollution: Air pollution; Water pollution; Soil pollution | 10 | 3 | 13,6,14 |

**Reference Books:**

Agarwal, K.C. 2001 Environmental; Biology, Nidi Pub. Ltd. Bikaner
Bharucha Erach, The Biodiversity of India, Mapin Pub. Pvt. Ltd., Ahemdabad-380, India
Brunner R.C. 1989. Hazardous waste incineration, Mc Graw Hill
Cunningham W.P.2001.Cooper, T.H. Gorhani, E & Hepworth, Environmental encyclopedia, Jaicob Publication House, Mumbai.
Agarwal, K.C. 2001 Environmental; Biology, Nidi Pub. Ltd. Bikaner

**e-Learning Source:**

https://www.anits.edu.in/online_tutorials/es/Unit%202.pdf
https://www.shivajicollege.ac.in/Study/Environmental%20Pollution.pdf
https://www.svce.ac.in/wp-content/uploads/2021/01/EVS-UNIT-2.pdf
https://www.youtube.com/watch?v=or-z0Q03pcY&pp=ygUZbmF0dXJhbCBvZXNvdXJjZXMgbGVjdHVyZQ%3D%3D\

**Course Articulation Matrix:(Mapping of Cos with POs and PSOs)**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | - | - | - | 1 | 1 | - | - | 1 | 3 | 2 | 1 | 1 | 1 |
| CO2 | 1 | - | - | - | 1 | 1 | - | - | 1 | 3 | 2 | 1 | 2 | 1 |
| CO3 | 1 | - | - | - | 1 | 1 | - | - | 1 | 3 | 2 | 1 | 1 | 1 |
| CO4 | 1 | - | - | - | 1 | 1 | - | - | 1 | 3 | 2 | 2 | 1 | 1 |
| CO5 | 1 | - | - | - | - | 1 | - | - | 2 | 3 | 2 | 1 | 2 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP207P | Title of the Course | HUMAN ANATOMY & PHYSIOLOGY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | - | - | 4 | 2 | - |
| Course Objectives | 1. Explain the gross morphology, structure and functions of various organs of the human body.<br>2. Describe the various homeostatic mechanisms and their imbalances.<br>3. Identify the various tissues and organs of different systems of human body.<br>4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.<br>5. Appreciate coordinated working pattern of different organs of each system<br>6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Recognise the principle of homeostasis with special reference to feedback mechanism. |
| CO2 | Classify the nervous system with special reference to various anatomical and physiological neurological abnormalities. |
| CO3 | Demonstrate the anatomical and physiological framework of human body system (endocrine, digestive, respiratory, urinary, cardiovascular and reproductive, integumentary system) and special senses. |
| CO4 | Analyze the clinical significance of laboratory test for diagnosis of disorder |
| CO5 | Identify the permanent slide of vital organs and gonds. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Integumentary System** | To study the Integumentary System with the help of chart & model. | 4 | 1 | - |
| 2 | **Integumentary System** | To record body temperature. | 4 | 1 | - |
| 3 | **Nervous System** | To study the nervous system with the help of chart & model. | 4 | 1 | - |
| 4 | **Endocrine System** | To study the endocrine system with the help of chart & model. | 4 | 4 | - |
| 5 | **Neurological Experiment** | To demonstrate the general neurological examination. | 4 | 1 | - |
| 6 | **Neurological Experiment** | To demonstrate positive & negative feedback mechanism. | 4 | 1 | - |
| 7 | **Olfactory Nerve** | To demonstrate the function of olfactory nerve. | 4 | 1 | - |
| 8 | **Olfactory Nerve** | To demonstrate the visual & reflect activity. | 4 | 1 | - |
| 9 | **Tongue (Sense Organ)** | To examine the different type of taste with the help of chart & model. | 4 | 5 | - |
| 10 | **Tongue (Sense Organ)** | To study the special sense organ. | 4 | 5 | - |
| 11 | **Tidal Volume, Vital Capacity & Basal Mass Index** | Determination of Tidal volume & Vital capacity. Recording of Basal Mass Index | 4 | 2 | - |
| 12 | **Digestive System** | To study the digestive system with help of chart & model. | 4 | 5 | - |
| 13 | **Respiratory System** | To study the respiratory system with help of chart & model | 4 | 3 | - |
| 14 | **Cadiovascular System** | To study the cardiovascular system with help of chart & model | 4 | 3 | - |
| 15 | **Urinary Sstem** | To study the urinary system with help of chart & model | 4 | 3 | - |
| 16 | **Reproductive System & Family Planning Devices** | To study the reproductive system with help of chart & model | 4 | 5 | - |
| 17 | **Reproductive System & Family Planning Devices** | To study of family planning devices & pregnancy diagnostic test. | 4 | 5 | - |
| 18 | **Blood cell count & Permanent slides of vital organ** | Demonstration of total blood count by cell analyser. | 4 | 5 | - |
| 19 | **Blood cell count & Permanent slides of vital organ** | Permanent slides of vital organ & gonads | 4 | 5 | - |
| **e-Learning Source:** | | | | | |
| https://www.researchgate.net/publication/320452449_A_Practical_Book_of_Human_Anatomy_Physiology_-_II | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 2 | - | 3 | 3 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 1 |
| CO4 | 3 | 2 | 3 | 2 | - | 2 | 2 | - | 1 | - | 3 | 3 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | - | 1 | 1 | - | 1 | - | 3 | 3 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP208P | Title of the Course | PHARMACEUTICAL ORGANIC CHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | - | - | 4 | 2 | - |
| Course Objectives | 1. Predict atomic structure, chemical bonding, and molecular geometry based on the accepted model.<br>2. Able to identify and characterize the organic compound by various qualitative tests.<br>3. Follow the safety procedure to set up glassware and apparatus to conduct experiments in organic chemistry.<br>4. Adopt proper skills to present the results of a practical investigation concisely by referring to the available resources.<br>5. Able to communicate the hazardous effect of overuse of organic products in daily life. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Investigate qualitative, solubility analysis, detection of elements of unknown organic compounds by following the safety procedure to set up glassware and apparatus to conduct experiments in organic chemistry. |
| CO2 | Analyze functional group of organic compounds based on their qualitative testing. |
| CO3 | Analyze the organic compounds systematically based on their reactions with the given reagents. |
| CO4 | Synthesize suitable solid derivatives from organic compounds, ingrained with the possible hazardous effect of overuse of organic products in daily life |
| CO5 | Predict the melting and boiling point of some organic compounds by judging their intermolecular forces of attractions. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Systematic qualitative analysis of unknown organic compounds like** | Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. | 4 | 1,2 | - |
| 2 | **Detection of elements** | Nitrogen, Sulphur and Halogen by Lassaigne's test | 4 | 1,2 | - |
| 3 | **Solubility test** | Solubility test | 4 | 1,2 | - |
| 4 | **Functional group test** | Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. | 4 | 1,2 | - |
| 5 | **Melting point/Boiling point** | Organic compounds | 4 | 1,2 | - |
| 6 | **Melting point/Boiling point** | The literature using melting point/ boiling point. | 4 | 1,2 | - |
| 7 | **Preparation of derivatives** | Confirmation of the unknown compound by melting point/ boiling point. | 4 | 1,2,3 | - |
| 8 | **Analysis of organic compounds** | Minimum 5 systematically. | 4 | 1,3 | - |
| 9 | **Preparation of suitable solid derivatives from organic compounds** | Preparation of suitable solid derivatives from organic compounds | 4 | 4 | - |
| 10 | **Construction of molecular models** | Construction of molecular models | 4 | 5 | - |
| **e-Learning Source:** | | | | | |
| https://www.researchgate.net/publication/377262663_pharmaceutical_organic_and_medicinal_chemistry_practical_book | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | - | 3 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | - | 2 | - | - | 2 | - | 3 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | - | 3 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 3 | 2 | - | - | - | - | 2 | - | 3 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | - | 3 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|
| Dr. Kuldeep Singh | |

| Course Code | BP209P | Title of the Course | BIOCHEMISTRY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.<br>2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.<br>3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the importance of metabolism of substrates and their bio regulation |
| CO2 | Will acquire chemistry and biological importance of biological macromolecules |
| CO3 | Acquainted with qualitative and quantitative estimation of the biological macromolecules |
| CO4 | Know, understand and apply the interpretation of data emanating from a Diagnostic Test Lab |
| CO5 | To know how physiological conditions and their variation influence the structures and relativities of biomolecules |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Qualitative test of carbohydrates | Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch) | 4 | 2 | - |
| 2 | Qualitative test of Proteins | Identification tests for Proteins (albumin and Casein) | 4 | 4 | - |
| 3 | Qualitative test of Reducing Sugars. | Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) | 4 | 2 | - |
| 4 | Qualitative analysis of urine | Qualitative analysis of urine for abnormal constituents of urine. | 4 | 2 | - |
| 5 | Blood Creatinine estimation | Determination of blood creatinine | 4 | 5 | - |
| 6 | Blood sugar estimation | Determination of blood sugar | 4 | 5 | - |
| 7 | Total cholesterol estimation. | Determination of serum total cholesterol | 4 | 5 | - |
| 8 | Introduction of buffers | Preparation of buffer solution and measurement of pH | 4 | 1 | - |
| 9 | Hydrolysis of starch | Study of enzymatic hydrolysis of starch | 4 | 2 | - |
| 10 | Amylase activity | Determination of Salivary amylase activity | 4 | 4 | - |
| 11 | Effect of temperature on enzymes. | Study the effect of Temperature on Salivary amylase activity. | 4 | 3 | - |
| 12 | Effect of concentration on enzymes. | Study the effect of substrate concentration on salivary amylase activity. | 4 | 3 | - |
| e-Learning Source: | | | | | |
| https://www.amazon.in/Practical-Biochemistry-Damodaran-Geetha-K/dp/9351529940 | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | 3 | 2 | 3 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 3 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 1 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | - | 2 | 3 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh | |
|---|---|
| Name & Sign of Program Coordinator | Sign & Seal of HOD |

| Course Code | BP210P | Title of the Course | COMPUTER APPLICATIONS IN PHARMACY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | I | Semester | II | - | - | 2 | 1 | - |
| Course Objectives | 1. Understand the use of ms word, to design the label and format the input data.<br>2. Understand the html, to design personal web pages.<br>3. Understand database to design and implement in ms access<br>4. Generate and print reports on database<br>5. Understand to export data on web and xml page in ms access | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Define the use of ms word, create and generate label, enter information, design questionnaire based on their understanding of the label wizard and uses of word processing package |
| CO2 | Apply the HTML toward the designing basic web page using notepad on the basic concept of HTML |
| CO3 | Analysis of the drug and its effect using online tool. |
| CO4 | Design the form to modify and Create the data base, patient information, drug information and invoice based on their understanding of MS access |
| CO5 | Implement to exporting Tables, Queries, Forms and Reports on their understanding of the web and xml page in MS access |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Design questionnaire | Preparation of questions and collect related information of given disease using ms word. | 2 | 1 | - |
| 2 | Web page | Create a web page to show personal information using html. | 2 | 2 | - |
| 3 | Drug information | Retrieve all necessary information of a drug using online tool. | 2 | 3 | - |
| 4 | Generate label | Create label using wizard in ms word. | 2 | 1 | - |
| 5 | Create database | To store the patient information with required field in ms access database. | 2 | 4 | - |
| 6 | Form | Create form in ms access to view, add, delete & modify the record in database. | 2 | 4 | - |
| 7 | Report | Preparation and printing the report form database. | 2 | 4 | - |
| 8 | Invoice | Create invoice table using ms access | 2 | 4 | - |
| 9 | Drug information | Store and retrieve the drug information in ms access | 2 | 4 | - |
| 10 | Queries | To create and working with queries in ms access | 2 | 4 | - |
| 11 | Exporting | To export the Table, Queries, Form and Report to web page. | 2 | 5 | - |
| 12 | Exporting | To export the Table, Queries, Form and Report to xml page. | 2 | 5 | - |
| e-Learning Source: | | | | | |
| | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 1 | 3 | 1 | 2 | - | - | 2 | 1 | 3 | 2 | 2 | 2 |
| CO2 | 1 | 1 | 1 | 3 | 1 | 1 | - | - | 1 | 1 | 3 | 1 | 2 | 1 |
| CO3 | 1 | 1 | 1 | 3 | 1 | 2 | - | - | 1 | 1 | 3 | 1 | 1 | 2 |
| CO4 | 1 | 1 | 1 | 3 | 3 | 2 | - | - | 2 | 1 | 3 | 2 | 1 | 1 |
| CO5 | 1 | 1 | 1 | 3 | 1 | 2 | - | - | 1 | 1 | 3 | 1 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP301T | Title of the Course | PHARMACEUTICAL ORGANIC CHEMISTRY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | 3 | 1 | - | 4 | |
| Course Objectives | 1. Write the structure, name and the type of isomerism of the organic compound<br>2. Write the reaction, name the reaction and orientation of reactions<br>3. Account for reactivity/stability of compounds.<br>4. Prepare organic compounds | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Analyze the derivation of benzene's structure using analytical, synthetic, and other evidences, including the application of orbital theory and resonance affecting its aromatic character and adherence to Huckel's rule |
| CO2 | Evaluate the acidity of phenols and the basicity of aromatic amines on the basis of the effect of substituents on their aromatic ring, affecting acidity, basicity, reactivity, and aromaticity. |
| CO3 | Evaluate the quality of oils and fats by interpreting analytical constants derived from fatty acid reactions such as hydrolysis, hydrogenation, and saponification. |
| CO4 | Describe the synthesis, reactions, structures, and medicinal uses of Polynuclear hydrocarbons |
| CO5 | Analyze the stabilities of cycloalkanes using Baeyer's strain theory, Coulson-Moffitt's modification, and Sachse-Mohr's theory to predict the stability and reactivity of cyclopropane and cyclobutane. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Benzene and its derivatives** | Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule<br>Reactions of benzene - nitration, sulphonation, halogenationreactivity, Friedelcrafts alkylation- reactivity, limitations,Friedelcrafts acylation.<br>Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction<br>Structure and uses of DDT, Saccharin, BHC and Chloramine | 10 | 1, 2, 3, 4, 5 | 13.a, 13.b |
| 2 | **Phenols Aromatic Amines Aromatic Acids** | Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols Basicity of amines, effect of substituents on basicity,and synthetic uses of aryl diazonium saltsAcidity, effect of substituents on aci dit y and important reactions of benzoic acid. | 10 | 1, 2, 3, 4, 5 | 13.a, 13.b |
| 3 | **Fats and Oils** | Fatty acids – reactions.Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. Analytical constants – Acid value, Saponification value, Ester value,Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination. | 10 | 1, 2, 3, 4, 5 | 13.a, 13.b |
| 4 | **Polynuclear hydrocarbons:** | Synthesis, reactionsStructure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives | 8 | 1, 2, 3, 4, 5 | 13.a, 13.b |
| 5 | **Cyclo alkanes** | Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only | 7 | 1, 2, 3, 4, 5 | 13.a, 13.b |

**Reference Books:**

Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz. Organic Chemistry by Morrison andBoyd
Organic Chemistry by I.L. Finar , Volume-I
Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
Organic Chemistry by P.L.Soni
Practical Organic Chemistry by Mann and Saunders.
Vogel's text book of Practical Organic Chemistry
Advanced Practical organic chemistry by N.K.Vishnoi.

**e-Learning Source:**

https://www.researchgate.net/publication/348961390_PHARMACEUTICAL_ORGANIC_CHEMISTRY-II_Theory_Practical

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | - | - | 1 | - | - | 2 | 1 | 1 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | - | - | 1 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 3 | - | - | 2 | - | - | - | 1 | 1 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 3 | - | - | - | - | - | 2 | 1 | 1 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | - | - | 2 | - | - | 1 | 1 | 1 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP302T | Title of the Course | PHYSICAL PHARMACEUTICS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | 3 | 1 | - | 4 | |
| Course Objectives | 1. Upon the completion of the course students shall be able to understand various physicochemical properties of drug molecules in the designing of the dosage forms.<br>2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.<br>3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the mechanisms of solute solvent interactions, different factors affecting solubility of drugs, different law of binary solutions and miscibility of liquids based on the nature of the drug. |
| CO2 | Explain states and properties of matter, eutectic mixtures and various physicochemical properties of drug molecules based on the nature of the drug. |
| CO3 | Define and remember surface tension, how to measure surface and interfacial tension by different methods, surfactants and HLB scale based on nature of surfactants. |
| CO4 | Describe complexation and protein binding, and how protein binding effect on drug action based on nature of protein binding. |
| O5 | Discuss buffer isotonic solutions, purpose behind maintaining the isotonicity of drug solution based on type of the solutions. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Solubility of drugs** | Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical EDsolution temperature and applications. Distribution law, its limitations and applications. | 10 | 1 | 9.5<br>9.b |
| 2 | **States of Matter and properties of matter, Physicochemical properties of drug molecules** | State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism.<br>Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications. | 10 | 2 | 9.1<br>9.5<br>9.b |
| 3 | **Surface and interfacial phenomenon** | Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface. | 10 | 3 | 9.1<br>9.5<br>9.b |
| 4 | **Complexation and protein binding** | Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants. | 8 | 4 | 9.1<br>9.5<br>9.b |
| 5 | **pH, buffers and Isotonic solutions** | Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions. | 7 | 5 | 9.1<br>9.5<br>9.b |

**Reference Books:**


Physical Pharmacy by Alfred Martin

Experimental Pharmaceutics by Eugene, Parott

Tutorial Pharmacy by Cooper and Gunn.

Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.

Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.

Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

Physical Pharmaceutics by Ramasamy C and ManavalanR.

Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee

Physical Pharmaceutics by C.V.S. Subramanyam

| e-Learning Source: |
|---|
| http://nootanpharmacy.in/public/upload/KzFTMriwTT6t928jUA8reSCEVXpyDNoknUmMvdCv.pdf |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | - | 1 | 1 | 1 | - | - | - | 1 | 3 | 1 | 2 |
| CO2 | 3 | 1 | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 2 |
| CO3 | 3 | 1 | 2 | - | - | 3 | 1 | - | 2 | - | 1 | 3 | 1 | 2 |
| CO4 | 3 | 1 | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 2 | - | - | 1 | 1 | - | 2 | - | 1 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP303T | Title of the Course | PHARMACEUTICAL MICROBIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | 3 | 1 | - | 4 | |
| Course Objectives | 1. To know the methods of identification, cultivation and preservation of various microorganisms, importance and implementation of sterlization in pharmaceutical processing and industry.<br>2. To understand the sterility testing of pharmaceutical products, carried out microbiological standardization of Pharmaceuticals. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Recall and outline the basic characteristics, structures, and functions, Assess and analyze the methods of identification, cultivation and preservation of various microorganisms. |
| CO2 | Explain the underlying principles of different sterilization methods used to maintain aseptic conditions in pharmaceutical manufacturing environments. Evaluation and Use of Staining and sterilization methods. |
| CO3 | To understand about disinfectants, and their evaluation, sterility testing methods of pharmaceutical products. Assess and analyze the consequences of microbial contamination in pharmaceutical products and production processes, considering factors such as product safety, efficacy, and regulatory compliance. |
| CO4 | Describe about aseptic area, sources of contamination, clean area classification and microbiological standardization methods of Pharmaceuticals. Use microbiological testing techniques to conduct quality control assessments of pharmaceutical products, interpreting results to ensure adherence to industry standards and regulatory requirements. |
| CO5 | Explain the microbial spoilage of pharmaceutical products, Preservation of pharmaceutical products. Develop innovative approaches and preventive strategies to minimize the risk of microbial contamination in pharmaceutical manufacturing environments, integrating knowledge of microbiological principles and industry best practices. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction, history of microbiology** | Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy. | 10 | 1 | 3.3 |
| 2 | **Identification of bacteria using staining techniques** | Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous,radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods Equipments employed in large scale sterilization. Sterility indicators. | 10 | 2 | 3.3 & 3b |
| 3 | **Study of morphology classifi cation, Reproduction / replication and cultivation of Fungi and Viruses.** | Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. | 10 | 3 | 3.3 & 3b |
| 4 | **Designing of aseptic area, laminar flow equipments** | Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic. | 08 | 4 | 3.3 & 3b |
| 5 | **Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types** | 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. Application of cell cultures in pharmaceutical industry and research. | 07 | 5 | 3.3 & 3b |

| Reference Books: |
|---|
| W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. |
| Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi. |
| Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. |
| Rose: Industrial Microbiology. |
| **e-Learning Source:** |
| https://www.researchgate.net/publication/283463951_Pharmaceutical_Microbiology_Book |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 2 | 2 | 3 |
| CO2 | 3 | - | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 2 | 3 |
| CO3 | 3 | - | 2 | - | 1 | 2 | 1 | - | 1 | - | 1 | 3 | 1 | 3 |
| CO4 | 3 | - | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 2 | 3 |
| CO5 | 3 | - | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP304T | Title of the Course | PHARMACEUTICAL ENGINEERING | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | 3 | 1 | - | 4 | |
| Course Objectives | 1. To develop the understanding and applications of different unit operations employed during pharmaceutical manufacturing. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Explain the operations of pharmaceutical manufacturing based on the principles of size reduction, size separation and fluid flow. |
| CO2 | Apply the strategies for distillation and evaporation based on the knowledge of heat processes. |
| CO3 | Illustrate the procedures during development of pharmaceutical dosage forms based on the knowledge of drying and mixing. |
| CO4 | Solve the issues related to the fabrication of pharmaceutical dosage forms based on the principles of filtration and centrifugation. |
| CO5 | Sketch the quality designing of pharmaceutical plants based on the knowledge of corrosion and material handling aspects |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Flow of fluids, size reduction and size separation** | Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotameter.<br>Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.<br>Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank. | 10 | 1 | 9.5,9.b,9.2 |
| 2 | **Heat transfer, evaporation and distillation** | Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.<br>Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.<br>Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation. | 10 | 2 | 9.1,9.5,9.b, 9.2 |
| 3 | **Drying and mixing** | Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.<br>Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier. | 10 | 3 | 9.b,9.4,9.5 |
| 4 | **Filtration and centrifugation** | Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.<br>Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge. | 8 | 4 | 9.a,9.1,9.2, 9.4 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **Materials of pharmaceutical plant construction, Corrosion and its prevention** | Factors affecting during materials selected for pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems. | 7 | 5 | 9.1,9.3,9.5, 9.b |

**Reference Books:**

Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition

Solid phase extraction. Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.

Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al. C.V.S Subrahmanyam et al., Latest edition. Remington practice of pharmacy- Martin, Latest edition.

Introduction to chemical engineering – Walter L Badger & Julius Bancher

Unit operation of chemical engineering – Mcabe Smith, Latest edition.

**e-Learning Source:**

https://www.scribd.com/document/481648503/Pharmaceutical-engineering-pdf

**Course Articulation Matrix:(Mapping of Cos with POs and PSOs)**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | - | 1 | 2 | 1 | 2 | 2 | - | 3 | 3 | 1 | 1 |
| CO2 | 3 | 3 | 3 | - | 1 | 1 | 2 | 1 | 1 | - | 3 | 3 | 1 | 2 |
| CO3 | 3 | 3 | 3 | - | - | 1 | 2 | 2 | 1 | - | 3 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 3 | - | 1 | 1 | 1 | - | - | - | 3 | 3 | 1 | 1 |
| CO5 | 3 | 3 | 3 | - | 1 | 2 | - | 1 | 1 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP305P | Title of the Course | PHARMACEUTICAL ORGANIC CHEMISTRY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | - | - | 4 | 2 | - |
| Course Objectives | 1. To prepare different medicinal and pharmaceutical compounds.<br>2. To study the reaction, name the reaction and orientation of reactions involved in experiments.<br>3. To account for reactivity/stability of compounds, study different reagents, solvents, their uses and purpose of selectivity.<br>4. To prepare organic compounds and study their medicinal properties. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Apply concepts of molar calculations to calculate percentage yield as per standard stoichiometric calculations. |
| CO2 | Apply simple purification techniques such as recrystallization and steam distillation to purify organic compounds and intermediates according to standard synthetic procedures and protocols. |
| CO3 | Evaluate the quality of fats and oil by determining various parameters like acid value, saponification value and iodine value as per pharmacopeia |
| CO4 | Apply the concepts of different reaction mechanisms to synthesize medicinally important compounds based on standard protocol. |
| CO5 | Analyze the final product and the reaction mechanism involved in the synthesis of organic compounds like substitution, addition, oxidation, reduction coupling and condensation reactions based on the concepts of effect of substituent on stability and reactivity of aromatic ring. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Experiments involving laboratory techniques** | Recrystallization | 4 | 4, 5 | - |
| 2 | **Experiments involving laboratory techniques** | Steam distillation | 4 | 4, 5 | - |
| 3 | **Determination of following oil values (including standardization of reagents)** | Acid value | 4 | 1 | - |
| 4 | **Determination of following oil values (including standardization of reagents)** | Saponification value | 4 | 1 | - |
| 5 | **Determination of following oil values (including standardization of reagents)** | Iodine value | 4 | 1 | - |
| 6 | **Preparation of compounds** | Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol/Aniline by acylation reaction. | 4 | 2,3 | - |
| 7 | **Preparation of compounds** | 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline | 4 | 2,3 | - |
| 8 | **Preparation of compounds** | Acetanilide by halogenation (Bromination) reaction. | 4 | 2,3 | - |
| 9 | **Preparation of compounds** | 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid /Nitro benzene by nitration reaction. | 4 | 2,3 | - |
| 10 | **Preparation of compounds** | Benzoic acid from Benzyl chloride by oxidation reaction. | 4 | 2,3 | - |
| 11 | **Preparation of compounds** | Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. | 4 | 2,3 | |
| 12 | **Preparation of compounds** | 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions. | 4 | 2,3 | - |
| 13 | **Preparation of compounds** | Benzil from Benzoin by oxidation reaction. | 4 | 2,3 | - |
| 14 | **Preparation of compounds** | Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction | 4 | 2,3 | - |
| 15 | **Preparation of compounds** | Cinnammic acid from Benzaldehyde by Perkin reaction | 4 | 2,3 | - |
| 16 | **Preparation of compounds** | P-Iodo benzoic acid from P-amino benzoic acid | 4 | 2,3 | - |
| **e-Learning Source:** | | | | | |
| https://www.researchgate.net/publication/348961390_PHARMACEUTICAL_ORGANIC_CHEMISTRY-II_Theory_Practical | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 3 | 2 | - | 1 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | 2 | 3 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP306P | Title of the Course | PHYSICAL PHARMACEUTICS I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand various physicochemical properties of drug molecules in the designing the dosage forms<br>2. Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations<br>3. Demonstrate use of physicochemical properties in the formulation Development and evaluation of dosage forms. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Apply appropriate techniques to determine the solubility of a given drug sample |
| CO2 | Analyze the implications and significance of the partition coefficient in pharmaceuticals |
| CO3 | Examine the effects and significance of surface tension in pharmaceutical applications |
| CO4 | Explain the importance of surfactants and HLB and their role in the stabilization of dosage forms |
| CO5 | Describe the process of calculating the stability constant and donor-acceptor ratio of complexes |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Solubility | Determination of the solubility of drug at room temprtature. | 4 | 1 | - |
| 2 | Surface Tension | Determination of Surface tension of given sample by drops count method. | 4 | 3 | - |
| 3 | Surface Tension | Determination of Surface tension of given sample by drops weight method. | 4 | 3 | - |
| 4 | Partition co-efficient | Determination of Partition co-efficient of benzoic acid in benzene and water. | 4 | 2 | - |
| 5 | Partition co-efficient | Determination of Partition co-efficient of Iodine in CCl4 and water. | 4 | 2 | - |
| 6 | Surfactant | Determination of Critical micelle concentration (CMC) of surfactants. | 4 | 1, 3 | - |
| 7 | Phase conversion | Determination of % composition of Nacl in a solution using Phenol-Water system by CST method. | 4 | 1, 5 | - |
| 8 | Adsorption | Determination of Freundlich and Langmuir constants using activated charcoal. | 4 | 1, 5 | - |
| 9 | Surfactant | Determination of HLB number of a surfactant by saponification method. | 4 | 4 | - |
| 10 | Solubility | Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method | 4 | 1, 5 | - |
| 11 | Solubility | Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by solubility method. | 4 | 1, 5 | |
| e-Learning Source: | | | | | |
| https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20Physical%20Pharmaceutics%20I.pdf | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | - | 2 | - | 3 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP307P | Title of the Course | PHARMACEUTICAL MICROBIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand methods of identification, cultivation and preservation of various micro-organism<br>2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry<br>3. Learn sterility testing of pharmaceutical products<br>4. Carried out microbiological standardization of pharmaceuticals<br>5. Understand the cell culture technology and its application in pharmaceutical industries | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the use of different types of microscopes and laboratory apparatus in experimental microbiology. |
| CO2 | Understand and apply techniques such as the Hanging Drop method, simple staining, negative staining, and Gram staining for the identification of bacteria and the study of bacterial motility and staining characteristics in microbiological experiments. |
| CO3 | Understand and apply techniques for preparing nutrient broth and agar, performing autoclave sterilization, and conducting aseptic transfers in microbiological settings. |
| CO4 | Understand and apply techniques for performing inoculation of agar plates using the spread plate method and isolation of bacteria from given cultures using the streaking plate method in microbiological experiments. |
| CO5 | Understand and apply techniques for performing sterility testing of pharmaceutical products and antibiotic susceptibility tests using the antibiotic disc (Kirby-Bauer) method in microbiological experiments. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Microscopy Techniques | To study the apparatus used in experimental microbiology.<br>To study the different types of microscopes used in experimental microbiology | 8 | 1 | - |
| 2 | Study of Bacteria | To study the motility of bacteria with the help of Hanging drop method<br>To perform the simple staining of given microorganism<br>To perform the negative staining of the given culture of micro-organism<br>To perform the gram staining of given culture | 16 | 2 | - |
| 3 | Microbiological Techniques | To prepare nutrient broth.<br>To perform the moist heat sterilization of the given media and glass wares by Autoclave.<br>To perform aseptic transfer of nutrient broth. | 12 | 3 | - |
| 4 | Bacterial Culturing Techniques | To perform inoculation of agar plate by Spread plate method<br>To perform isolation of bacteria from given culture by streaking plate method | 8 | 4 | - |
| 5 | Microbiological Testing | To perform sterility testing of pharmaceutical products.<br>To perform Antibiotic susceptibility test by antibiotic disc method (Kirby-Bauer method). | 8 | 5 | - |
| e-Learning Source: | | | | | |
| https://www.researchgate.net/publication/339927351_A_Practical_Book_on_Pharmaceutical_Microbiology | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | - | 2 | - | 3 | 3 | 1 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | - | - | - | 3 | 3 | 1 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 2 | - | 3 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |

| Course Code | BP308P | Title of the Course | PHARMACEUTICAL ENGINEERING | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | III | - | - | 4 | 2 | - |
| Course Objectives | 1. To know various unit operations used in Pharmaceutical industries.<br>2. To understand the material handling techniques.<br>3. To perform various processes involved in the pharmaceutical manufacturing process.<br>4. To carry out various test to prevent environmental pollution.<br>5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.<br>6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Analyze the effects of different factors on rate of filtration and evaporation. |
| CO2 | Execute the process of size reduction and size distribution analysis. |
| CO3 | Determine the basic parameters of different heat processes. |
| CO4 | Demonstrate the working aspects of different pharmaceutical machineries. |
| CO5 | Evaluate the process of mixing and moisture content determination during pharmaceutical manufacturing. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Radiation constant | Determination of radiation constant of brass, iron, unpainted and painted glass. | 4 | 3 | - |
| 2 | Steam distillation | To calculate the efficiency of steam distillation. | 4 | 1,3 | - |
| 3 | Heat transfer | To determine the overall heat transfer coefficient by heat exchanger. | 4 | 3 | - |
| 4 | Drying | Construction of drying curves (for calcium carbonate and starch). | 4 | 5 | - |
| 5 | | Determination of moisture content and loss on drying. | 4 | 5 | - |
| 6 | Humidity determination | Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method. | 4 | 5 | - |
| 7 | Description of Pharmaceutical machineries | Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier. | 4 | 4 | - |
| 8 | Size analysis | Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots. | 4 | 2 | - |
| 9 | Size reduction | Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill. | 4 | 2 | - |
| 10 | Demonstration of equipments | Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment. | 4 | 4 | - |
| 11 | Filtration & Evaporation factors | Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity. | 4 | 1 | - |
| 12 | Crystallization | To study the effect of time on the Rate of Crystallization. | 4 | 1 | - |
| 13 | Mixing | To calculate the uniformity Index for given sample by using Double Cone Blender. | 4 | 5 | - |

**e-Learning Source:**

https://books.google.co.in/books?id=fOi6UCHF3-cC&printsec=frontcover#v=onepage&q&f=false

https://www.google.co.in/books/edition/Practical_Manual_Of_Pharmaceutical_Engin/fOi6UCHF3-cC?hl=en&gbpv=1&dq=Pharmaceutical+engineering+practical+manual&printsec=frontcover

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | - | 3 | 3 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | - | - | 3 | 3 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | - | 1 | 1 | - | - | 3 | 3 | 3 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP401T | Title of the Course | PHARMACEUTICAL ORGANIC CHEMISTRY III | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the methods of preparation and properties of organic compounds<br>2. Explain the stereo chemical aspects of organic compounds and stereo chemical reactions<br>3. Know the medicinal uses and other applications of organic compounds | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Apply concepts of optical isomerism in resolution of racemic mixtures, reactions of chiral molecules and asymmetric synthesis of organic compounds. |
| CO2 | Use the concept of geometrical isomerism to synthesize isomers by stereospecific and stereoselective reactions |
| CO3 | Analyze the relative aromaticity, stability and reactivity of five membered heterocyclic rings in the reactions and synthesis of heterocyclic compounds |
| CO4 | Relate the chemistry of six membered and fused ring heterocyclic compounds in the synthesis of medicinal compounds |
| CO5 | Implement reactions of synthetic significance to sketch synthetic route for organic compounds |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Stereo isomerism** | Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds, Elements of symmetry, chiral and achiral molecules, DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers, Reactions of chiral molecules, Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute | 10 | 1,2,3,4,5 | 13.3, 13.a |
| 2 | **Geometrical isomerism** | Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems), Methods of determination of configuration of geometrical isomers.Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions | 10 | 1,2,3,4,5 | 13.3, 13.a |
| 3 | **Heterocyclic compounds** | Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene, Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene | 10 | 1,2,3,4,5 | 13.a |
| 4 | **Synthetic reactions nd 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 | 10 | 1,2,3,4,5 | 13.a |
| 5 | **Reaction of synthetic compounds and its importance** | Metal hydride reduction (NaBH and LiALH4 reduction), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction, Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation | 10 | 1,2,3,4,5 | 13.3, 13.a |

**Reference Books:**

Organic chemistry by I.L. Finar, Volume-I & II.

A text book of organic chemistry – Arun Bahl, B.S. Bahl. Heterocyclic Chemistry by Raj K. Bansal

Organic Chemistry by Morrison and Boyd Heterocyclic Chemistry by T.L. Gilchrist

**e-Learning Source:**

https://www.researchgate.net/publication/343318646_PHARMACEUTICAL_ORGANIC_CHEMISTRY-II

| Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | - | - | 1 | - | - | 2 | 1 | 2 | 2 | 1 | 1 |
| CO2 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 2 | 2 | 1 | 1 |
| CO3 | 3 | 1 | 2 | - | - | 2 | - | - | 2 | 1 | 2 | 2 | 1 | 1 |
| CO4 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 2 | 2 | 1 | 1 |
| CO5 | 3 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 2 | 2 | 1 | 1 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP402T | Title of the Course | MEDICINAL CHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | 3 | 1 | - | 4 | |
| Course Objectives | 1. To know about the fundamental knowledge of the history of medicinal chemistry, therapeutic value and biotransformation of drugs.<br>2. Understand the chemistry of drugs with respect to their biological activity.<br>3. Know the metabolism, adverse effects and therapeutic value of drugs.<br>4. Understand the mechanism and importance of SAR. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Describe the history and development of medicinal chemistry, influence of physicochemical properties on drug action, kinetics, drug metabolism based on the understanding of physicochemical properties and metabolism. |
| CO2 | Demonstrate the biosynthesis, catabolism and receptor interactions of cholinergic neurotransmitters based on understanding with chemical structure, drug's therapeutic potential, structure activity relationship and synthesis of parasympathomimetic agents, cholinesterase inhibitors and cholinergic blocking agents. |
| CO3 | Demonstrate the biosynthesis catabolism and receptor interaction of adrenergic neurotransmitters based on understanding with chemical structure, drug's therapeutic potential, structure activity relationship and synthesis of sympathomimetic agents and adrenergic blockers. |
| CO4 | Illustrate the drug's therapeutic potential, structure activity relationship based on their understanding of the chemical structure of CNS acting drugs: sedatives and hypnotics, antipsychotics and anticonvulsants. |
| CO5 | Illustrate the drug's therapeutic potential, structure activity relationship based on their understanding of the chemical structure of the drugs: general anesthetics, narcotic and non-narcotic analgesic and anti-inflammatory agents. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Medicinal Chemistry** | History and development of medicinal chemistry. Physicochemical properties in relation to biological action. Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.<br>**Drug metabolism** Drug metabolism principles - Phase I and Phase II.<br>Factors affecting drug metabolism including stereo chemical aspects. | 10 | 1 | 13.3, 13.a |
| 2 | **Adrenergic Neurotransmitters: Sympathomimetic agents:** | Biosynthesis and catabolism of catecholamine.<br>Adrenergic receptors (Alpha & Beta) and their distribution. SAR of Sympathomimetic agents<br>**Direct acting**: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Ephedrine, Metaraminol.<br>**Alpha adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.<br>SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol. | 10 | 2 | 13.3, 13.a |
| 3 | **Cholinergic neurotransmitters: Parasympathomim etic agents: SAR of Parasympathomim etic agents** | Biosynthesis and catabolism of acetylcholine.<br>Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.<br>**Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophateiodide, Parathione, Malathion.<br>**Cholinesterase reactivator**: Pralidoxime chloride. Cholinergic Blocking agents: SAR of cholinolytic agents<br>**Solanaceous alkaloids and analogues:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.<br>**Synthetic cholinergic blocking agents**: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline | 10 | 3 | 13.a |

| | | | | | |
|---|---|---|---|---|---|
| | | bromide,Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride. | | | |
| 4 | **Drugs acting on Central Nervous System** | **Sedatives and Hypnotics**: Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, .Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem<br>**Barbiturtes:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital.<br>Miscelleneous:<br>**Amides & imides**: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol, Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. Antipsychotics<br>**Phenothiazeines:** SAR of Phenothiazeines- Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.<br>**Ring Analogues of Phenothiazeines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.Fluro buterophenones: Haloperidol, Droperidol, Risperidone. Beta amino ketones: Molindone hydrochloride. Benzamides: Sulpieride.<br>**Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant **Action Barbiturates**: Phenobarbitone, Methabarbital. Hydantoins: Phenytoin*, Mephenytoin, Ethotoin Oxazolidine diones: Trimethadione, Paramethadione<br>**Succinimides**: Phensuximide, Methsuximide, Ethosuximide* Urea and **Monoacylureas**: Phenacemide, Carbamazepine*<br>**Benzodiazepines**: Clonazepam<br>**Miscellaneous**: Primidone, Valproic acid , Gabapentin, Felbamate | 8 | 4 | 13.a |
| 5 | **Drugs acting on Central Nervous System** | **General anesthetics:** Dissociative anesthetics: Ketamine hydrochloride.* Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium.<br>**Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. Narcotic and non-narcotic analgesics<br>**Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.<br>**Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.<br>**Anti-inflammatory agents:** Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone. | 7 | 5 | 13.3, 13.a |

**Reference Books:**


Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.

Foye's Principles of Medicinal Chemistry.

Burger's Medicinal Chemistry, Vol I to IV.

Introduction to principles of drug design- Smith and Williams.

Remington's Pharmaceutical Sciences.

Martindale's extra pharmacopoeia.


**e-Learning Source:**

https://www.amazon.in/Gisvolds-Textbook-Medicinal-Pharmaceutical-Chemistry/dp/0781779294

https://www.elsevier.com/books/medicinal-chemistry/barret/978-1-78548-288-5

https://www.science.org/content/blog-post/medicinal-chemistry-books-2019

https://ilizone.in/mod/resource/view.php?id=172237

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 1 | - | 1 | 2 | - | - | 2 | - | 2 | 2 | 1 | 2 |
| CO2 | 3 | 1 | 1 | - | - | 1 | - | - | 1 | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | 1 | - | - | 2 | - | 2 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP403T | Title of the Course | PHYSICAL PHARMACEUTICS II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | 3 | 1 | - | 4 | |

**Course Objectives**

1. Understand various physicochemical properties of drug molecules in the designing the dosage form
2. Understand the concept of viscosity and flow behavior in the formulation development and evaluation of dosage forms.
3. Knowledge of physicochemical properties, formulation factors and instability markers in development of biphasic liquid dosages forms.
4. Demonstrate the application of particle size in designing the dosages forms.
5. Know the principles of chemical kinetics & to use them in assigning expiry date for Formulation

| Course Outcomes | |
|---|---|
| CO1 | Understand the physicochemical properties of drug molecules in designing the dosage forms. |
| CO2 | Explain the role of surfactants, interfacial phenomenon and thermodynamics |
| CO3 | Describe the flow behavior of fluids and concept of complexation. |
| CO4 | Apply the principles of chemical kinetics & to use them for stability testing & determination of expiry dates of formulations. |
| CO5 | Analyze the physicochemical properties in the formulation development & evaluation of dosage forms. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Colloidal dispersions** | Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action. | 7 | 1 | 9.3<br>9.4<br>9.5<br>9.a |
| 2 | **Rheology**<br>**Deformation of solids** | Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus | 10 | 2 | 9.1<br>9.2<br>9.3<br>9.a |
| 3 | **Coarse dispersion** | Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method. | 10 | 3 | 9.1<br>9.2<br>9.3<br>9.5 |
| 4 | **Micromeritics** | Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. | 10 | 4 | 9.1<br>9.2<br>9.3<br>9.b |
| 5 | **Drug stability** | **Reaction kinetics:** zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. **Physical and chemical factors influencing the chemical degradation of pharmaceutical product**: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention | 10 | 5 | 9.2<br>9.3<br>9.5 |

**Reference Books:**

Physical Pharmacy by Alfred Martin, Sixth edition
Physical Pharmaceutics by RamasamyC, and Manavalan R
Tutorial pharmacy by Cooper and Gunn.
Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.

**e-Learning Source:**

https://www.academia.edu/26735219/Martins_physical_pharmacy_and_pharmaceutical_sciences_6th_edition

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | - | - | 1 | 1 | - | 1 | - | 1 | 3 | 1 | 3 |
| CO2 | 3 | 2 | 2 | - | 1 | 2 | 1 | - | 2 | - | 1 | 3 | 1 | 3 |
| CO3 | 3 | 2 | 2 | - | 1 | 1 | 1 | - | 1 | - | 1 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | - | 1 | 2 | 1 | - | 2 | - | 1 | 3 | 2 | 3 |
| CO5 | 3 | 2 | 2 | - | 1 | - | 1 | - | - | - | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP404T | Title of the Course | PHARMACOLOGY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | 3 | 1 | - | 4 | |

**Course Objectives**

1. Have sound knowledge of fundamental principles and their applications in the area of Pharmaceutical Sciences and Technology.
2. Develop ability for in - depth analytical and critical thinking in order to identify, formulate and solve the issues related to Pharmaceutical Industry, Regulatory Agencies, and Hospital Pharmacy & Community Pharmacy and also in depth knowledge to design synthetic and analytical processes to perform experiments on synthesis, design, pharmaceutical analysis, pharmacological evaluation and formulation problems.
3. Develop an ability to use lab equipment and different kinds of simulation software with an ability to solve, analyze and interpret data generated from Formulation Development, Quality Control & Quality Assurance.
4. Develop written and oral communication skills in order to communicate effectively the outcomes of the Pharmaceutical problems. They also learn to acquire sound knowledge in order to execute the responsibilities successfully towards developing expertise as per the needs of industry and academia.
5. Develop team spirit, apart from responding to the social needs and professional ethics and also develop an aptitude along with problem-solving skills and aptitude to participate and succeed in competitive examinations for lifelong learning and continuous professional development.
6. Develop an understanding for the need of pharmaceutical sciences and technology towards giving quality life to people in society and also demonstrate knowledge of Research & Development in different disciplines of Pharmaceutical Sciences andTechnology

| Course Outcomes | |
|---|---|
| CO1 | Apply the general concepts of pharmacology to the process involved in drug pharmacokinetics. |
| CO2 | Understand the knowledge of receptor types, receptor theories, and signal transduction mechanisms to drug pharmacodynamics, drug discovery, clinical and preclinical evaluations of new drug, and Pharmacovigilance practices. |
| CO3 | Evaluate the pharmacological effects based on the understanding of drugs acting on Autonomic Nervous System, local anesthetics, myasthenia gravis, and glaucoma. |
| CO4 | Explain the pharmacological effects based on the understanding of drugs acting on CNS like- sedatives, hypnotics, anticonvulsants, general anesthetics, alcohol, and disulfiram. |
| CO5 | Discuss the pharmacological effects based on the understanding of drugs acting on CNS, such as antipsychotics, antidepressants, antianxiety agents, hallucinogens, CNS stimulants, and opioids, and assess the therapeutic approaches for Parkinson's and Alzheimer's diseases. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **General Pharmacology:** | **Introduction to Pharmacology-** Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.<br>**Pharmacokinetics-** Membrane transport, absorption, distribution, metabolism and excretion of drugs Enzyme induction, enzyme inhibition, kinetics of elimination | 2 | 1 | 3.5, 3.b, 3.d |
| 2 | **Adverse drug reactions.** | **Pharmacodynamics-** Principles and mechanisms of drug action.<br>Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.<br>Drug interactions (pharmacokinetic and pharmacodynamic)<br>Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance. | 2 | 2 | 3.b, 3.d |
| 3 | **Pharmacology of drugs acting on peripheral nervous system** | Organization and function of ANS. Neurohumoral transmission, co-transmission and classification of neurotransmitters. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents. Drugs used in myasthenia | 2 | 3 | 3.4, 3.5, 3.b, 3.d |

| | | | | | |
|---|---|---|---|---|---|
| | | gravis and glaucoma | | | |
| 4 | **Pharmacology of drugs acting on central nervoussystem** | Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotrans- mitters like with GABA, Glutamate, Glycine, serotonin, dopamine.<br>General anesthetics and pre-anesthetics.<br>Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics<br>Alcohols and disulfiram | 2 | 4 | 3.4, 3.5, 3.b,3.d |
| 5 | **Pharmacology of drugs acting on central nervous system** | Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.<br>Drugs used in Parkinsons disease and Alzheimer's disease. CNS stimulants and nootropics.<br>Opioid analgesics and antagonists, Drug addiction, drug abuse, tolerance and dependence. | 2 | 5 | 3.4,.3.5, 3.a, 3.b, 3.d, |

**Reference Books:**

Tripathi, K.D., 2013. Essentials of medical pharmacology. JP Medical Ltd.

Rang, H.P., Dale, M.M., Ritter, J.M., Flower, R.J. and Henderson, G., 2011. Rang & Dale's pharmacology. Elsevier Health Sciences.

Katzung, B.G., Masters, S.B. and Trevor, A.J. eds., 2004. Basic & clinical pharmacology.

Goodman, L.S., 1996. Goodman and Gilman's the pharmacological basis of therapeutics (Vol. 1549, pp. 1361-1373). New York: McGraw-Hill.

**e-Learning Source:**

https://www.academia.edu/26735219/Martins_physical_pharmacy_and_pharmaceutical_sciences_6th_edition

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | - | 1 | 1 | 1 | 3 | 1 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO2** | 3 | - | 1 | - | 2 | 3 | 1 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| **CO3** | 3 | - | 2 | 1 | 1 | 3 | 1 | 1 | - | - | 3 | 3 | 2 | 3 |
| **CO4** | 3 | - | 3 | 1 | 1 | 3 | 1 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| **CO5** | 3 | - | 3 | 2 | - | 3 | 1 | 1 | 2 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP405T | Title of the Course | PHARMACOGNOSY & PHYTOCHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | 3 | 1 | - | 4 | |
| Course Objectives | 1. To know the techniques in the cultivation and production of crude drugs<br>2. To know the crude drugs, their uses and chemical nature<br>3. Know the evaluation techniques for the herbal drugs<br>4. To carry out the microscopic and morphological evaluation of crude drugs | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Evaluate crude drugs on the basis of WHO guidelines with respect to its biological sources, macroscopy, microscopy, chemical constituents and uses. |
| CO2 | Describe the concepts of cultivation on basis of WHO guidelines, implicated for improvement of quality of medicinal plants and minimization of crop destruction |
| CO3 | Demonstrate the importance of Plant tissue culture techniques, based on understanding of basic requirements, growth and their maintenance, for augmented exploitation of natural resources. |
| CO4 | Explain the contribution of traditional systems of medicine, given the specific principles of each system, for improvement in health care. |
| CO5 | Identify the secondary metabolites on the basis of its structure, distribution, properties and tests for identification to understand its role in health care. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Pharmacognosy** | Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum –resins).<br>**Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs<br>**Quality control of Drugs of Natural Origin**: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida. | 10 | 1 | - |
| 2 | **Cultivation, Collection, Processing and storage of drugs of natural origin:** | Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants Conservation of medicinal plants | 10 | 2 | - |
| 3 | **Plant tissue culture:** | Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines | 7 | 3 | |
| 4 | **Pharmacognosy in various systems of medicine** | Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.<br>**Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins | 10 | 4 | - |
| 5 | **Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs Plant Products** | 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 Primary metabolites: 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: Novel medicinal agents from marine sources | 8 | 5 | - |

| Reference Books: |
|---|
| 1.W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders &Co., London, 2009. |
| 2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988. |
| 3. Text Book of Pharmacognosy by T.E.Wallis |
| **e-Learning Source:** |
| https://www.researchgate.net/publication/320452634_Text_Book_of_Pharmacognosy_and_Phytochemistry |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | 1 | 1 | 1 | 1 | 1 | - | - | - | 3 | 2 | 2 |
| CO2 | 3 | 1 | - | - | 1 | 1 | 1 | 2 | - | 1 | - | 3 | 2 | 3 |
| CO3 | 2 | - | 1 | - | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO4 | 3 | - | - | 1 | 1 | - | 1 | 2 | - | - | - | 3 | 3 | 3 |
| CO5 | 2 | 1 | - | - | 1 | 2 | 1 | 1 | 1 | - | - | 3 | 3 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP406P | Title of the Course | MEDICINAL CHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand the chemistry of drugs with respect to their pharmacological activity<br>2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs<br>3. Know the Structural Activity Relationship (SAR) of different class of drugs<br>4. Write the chemical synthesis of some drugs | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Synthesize heterocyclic compounds and drug intermediates such as 1,3-pyrazole, 1,3-oxazole, benzimidazole, and 2,3-diphenyl quinoxaline. |
| CO2 | Synthesize important drugs such as benzocaine, phenytoin, phenothiazine, and barbiturates. |
| CO3 | Assess the purity and potency of drugs like chlorpromazine, phenobarbitone, and atropine using various assay techniques. |
| CO4 | Assess the purity and potency of commonly used drugs such as ibuprofen, aspirin, and furosemide through appropriate analytical methods. |
| CO5 | Determine the physicochemical properties of drugs like paracetamol and diclofenac and correlate them with their pharmacological activity. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Preparation of Interme | 1,3-pyrazole, 1,3-oxazole, Benzimidazole, Benztriazole, 2,3- diphenyl quinoxaline | 10 | 1 | - |
| 2 | Preparation of drugs | Benzocaine Phenytoin Phenothiazine Barbiturate | 8 | 2 | - |
| 3 | Assay of CNS drugs | Chlorpromazine Phenobarbitone Atropine | 12 | 3 | - |
| 4 | Assay of Commonly Used Drugs | Ibuprofen Aspirin Furosemide | 4 | 4 | - |
| 5 | Determination of Physicochemical Properties | Partition coefficient of paracetamol Partition coefficient of diclofenac | 4 | 5 | - |

**e-Learning Source:**

https://drive.google.com/file/d/1_s04DZqFKuSSfz5RicxHz6cTDEPVGINx/view?usp=sharing

https://www.chemcome.com/wp-content/uploads/2020/11/Principles-of-Instrumental-Analysis-7th-edition-Skoog-by-Douglas-A.-Skoog-F.-James- Holler-Stanley-R.-Crouch-z-lib.org_.pdf

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | - | 3 | 3 | 1 | 2 |
| CO2 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | - | 3 | 3 | 1 | 2 |
| CO3 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | - | 3 | 3 | 1 | 2 |
| CO4 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | - | 3 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | - | 3 | 2 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh | |
|---|---|
| Name & Sign of Program Coordinator | Sign & Seal of HOD |

| Course Code | BP407P | Title of the Course | PHYSICAL PHARMACEUTICS II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand various physicochemical properties of drug molecules in the designing the dosage forms<br>2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations<br>3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the Methods for determining particle size distribution (sieving and microscopic), bulk density, true density, and porosity. |
| CO2 | Analyze the angle of repose of the given powder sample. |
| CO3 | Analyze the viscosity of liquids by Ostwald's viscometer and semi-solids by Brookfield viscometer. |
| CO4 | Understand the sedimentation volume with various suspending agents and varying concentrations of a single suspending agent. |
| CO5 | Analyze the reaction rate constants for first and second order reactions, and conducting accelerated stability studies and shelf life determination for aspirin. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Micromeritics | Determination of particle size distribution using sieving method.<br>Determination of particle size distribution in disperse medium using microscopic method.<br>Determination of bulk density, true density and porosity. | 12 | 1 | - |
| 2 | Density & Porosity | Determination of angle of repose of the given powder sample. | 4 | 2 | - |
| 3 | Rheology & Deformation of solids | Determination of viscosity of liquid using ostwald's viscometer.<br>Determination of viscosity of semi-solid by using Brookfield viscometer. | 8 | 3 | - |
| 4 | Coarse Dispersion | Determination of sedimentation volume with effect of different suspending agent.<br>Determination sedimentation volume with effect of different concentration of single suspending agent | 8 | 4 | - |
| 5 | Drug Stability | Determination of reaction rate constant for first order reaction.<br>Determination of reaction rate constant for second order reaction.<br>Determination of shelf life of aspirin and accelerated stability studies. | 16 | 5 | - |
| e-Learning Source: | | | | | |
| https://innocentbalti.files.wordpress.com/2015/01/martins-physical-pharmacy-6th-ed-2011-dr-murtadha-alshareifi.pdf | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | - | 2 | - | - | 1 | 1 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | 2 | 1 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | 1 | 1 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 1 | - | - | 1 | 1 | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh | |
|---|---|
| Name & Sign of Program Coordinator | Sign & Seal of HOD |

| Course Code | BP408P | Title of the Course | PHARMACOLOGY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | - | - | 4 | 2 | - |
| Course Objectives | 1. To understand the fundamental of experimental pharmacology.<br>2. To perform the different activities of drugs acting on CNS, GIT etc. on different animal models (simulation) | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Conceptual knowledge of experimental pharmacology basics |
| CO2 | Understand the CPCSEA guidelines for laboratory animal facility. |
| CO3 | Precise knowledge about commonly used instruments in pharmacological laboratory. |
| CO4 | Observe the effect of drugs on animals by simulated experiments by software's and videos. |
| CO5 | To understand the different methods of local anesthetics. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Basics of pharmacology | Introduction to experimental pharmacology | 4 | 1 | - |
| 2 | Instrument | Commonly used instruments in experimental pharmacology. | 4 | 3 | - |
| 3 | Lab.animals | Study of common laboratory animals. | 4 | 1 | - |
| 4 | CPCSEA rules | Maintenance of laboratory animals as per CPCSEA guidelines. | 4 | 2 | - |
| 5 | Lab.techniques | Common laboratory techniques Blood withdrawal. serum and plasma separation anesthetics and euthanasia used for animal studies. | 4 | 2 | - |
| 6 | Drug administration | Study of different routes of drugs administration in mice/rats. | 4 | 1 | - |
| 7 | Effect of enzyme inducer | Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleep time in mice. | 4 | 4 | - |
| 8 | Ciliary motility | Effect of drugs on ciliary motility of frog oesophagus. | 4 | 4 | - |
| 9 | Mydriasis | Effect of drugs on rabbit eye | 4 | 5 | - |
| 10 | Relaxant effect | Effects of skeletal muscle relaxants using rota-rod apparatus | 4 | 5 | - |
| 11 | Motor activity | Effect of drugs on locomotor activity using actophotometer. | 4 | 5 | - |
| 12 | Anticonvulsant | Anticonvulsant effect of drugs by MES and PTZ method: | 4 | 5 | - |
| 13 | Anticatatonic | Study of stereotype and anti-catatonic activity of drugs on rats/mice. | 4 | 5 | - |
| 14 | Anxiolytic | Study of anxiolytic activity of drugs using rats/mice: | 4 | 5 | - |
| 15 | Local anesthesia | Study of local anesthetics by different methods. | 4 | 3 | - |
| e-Learning Source: | | | | | |
| https://www.pragationline.com/wp-content/uploads/2020/03/N3992-Practical-Book-of-Pharmacology-2.pdf | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP409P | Title of the Course | PHARMACOGNOSY & PHYTOCHEMISTRY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | II | Semester | IV | - | - | 4 | 2 | - |
| Course Objectives | 1. To know the techniques in the cultivation and production of crude drugs<br>2. To know the crude drugs, their uses and chemical nature<br>3. Know the evaluation techniques for the herbal drugs<br>4. To carry out the microscopic and morphological evaluation of drugs | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the basic concept of microscope for microscopic evaluation of crude drugs. |
| CO2 | Identify crude drugs on the basis of their chemical testing. |
| CO3 | Identify crude drug adulterants on the basis of physicochemical testing. |
| CO4 | Identify characteristics of crude drugs through various physicochemical testing. |
| CO5 | Recognize crude drugs based on their macroscopic and microscopic characteristics. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Microscope study | To study about the compound microscope and its parts | 4 | 1 | - |
| 2 | Chemical test | To perform the chemical test of Agar | 4 | 2 | - |
| 3 | Chemical test | To perform the chemical test of Tragacanth | 4 | 2 | - |
| 4 | Chemical test | To perform the chemical test of Acacia | 4 | 2 | - |
| 5 | Chemical test | To perform the chemical test of Starch | 4 | 2 | - |
| 6 | Chemical test | To perform the chemical test of Castor oil. | 4 | 2 | - |
| 7 | Chemical test | To perform the chemical test of Honey | 4 | 2 | - |
| 8 | Swelling factor | To determine the swelling factor of isapgol seeds. | 4 | 3 | - |
| 9 | Ash value | To determine the ash value of given sample. | 4 | 3 | - |
| 10 | Extractive value | To determine the alcohol soluble extractive value of the given powdered drug. | 4 | 4 | - |
| 11 | Moisture content | To determine the moisture content of given crude drug | 4 | 4 | - |
| 12 | Stomatal number | To determine the stomatal number of given leaf | 4 | 5 | - |
| 13 | Stomatal index | To determine the stomatal index of given leaf | 4 | 5 | - |
| e-Learning Source: | | | | | |
| https://www.researchgate.net/publication/338832332_Practical_Handbook_of_Pharmacognosy_and_Phytochemistry-I | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | - | - | 1 | 3 | 2 | 2 |
| CO2 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | - | - | 1 | 3 | 2 | 3 |
| CO3 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | - | - | 1 | 3 | 1 | 3 |
| CO4 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | - | - | 1 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | - | - | 1 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh | |
|---|---|
| Name & Sign of Program Coordinator | Sign & Seal of HOD |

| Course Code | BP501T | Title of the Course | MEDICINAL CHEMISTRY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the chemistry of drugs with respect to their pharmacological activity<br>2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs<br>3. Know the Structural Activity Relationship of different class of drugs<br>4. Study the chemical synthesis of selected drugs | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Evaluate the pharmacodynamics, pharmacokinetics, stability, synthesis, and therapeutic potential by using knowledge of the chemical structure and Structure-Activity Relationships (SAR) of drugs that are categorized as antiallergic, antihistamine, antiulcer, and antineoplastic agents. |
| CO2 | Based on the comprehension of the drugs chemical structure and Structure-Activity Relationships (SAR), Judge the therapeutic potential, structure activity relationship, pharmacodynamics, pharmacokinetics, stability, and synthesis of the following categories: antianginal, diuretics, and antihypertensives. |
| CO3 | Based on understanding of the chemical structures and Structure-Activity Relationships (SAR) of the following pharmacological classes---congestive heart failure, antiarrhythmics, and antihyperlipidemics—Defend their therapeutic potential, pharmacodynamics, pharmacokinetics, stability, and synthesis. |
| CO4 | Appraise the therapeutic potential, structure-activity relationship, pharmacology, stability, and synthesis of drugs by utilising knowledge of the chemical structures of drugs that affect the thyroid and, sex hormones. |
| CO5 | Evaluate the drugs therapeutic potential, structure activity relationship, pharmacodynamics, pharmacokinetics, stability and synthesis in the following categories based on their understanding of the chemical structure of the drugs: antidiabetic and local anesthetics |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Antihistaminic agents, Anti-neoplastic agents,** | Histamine, receptors and their distribution in the human body. **H1–antagonist:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Triphelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartrate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrizine Cromolyn sodium. **H2-antagonists:** Cimetidine*, Famotidine, Ranitidine. Gastric proton-pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole. Anti-neoplastic agents: **Alkylating agents:** Mecloretharnine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa. **Antimetabolites**: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine. **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin. **Plant products:** Etoposide, Vinblastine sulphate, Vincristine sulphate. **Miscellaneous:** Cisplatin, Mitotane. | 10 | 1 | 3.4 |
| 2 | **Anti-anginal, Diuretics, Anti-hypertensive Agents** | **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* Clonidinehydrochloride, Guanethidine Monosulphate, Guanabenz Acetate, Sodium Nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride. | 10 | 2 | 3.4 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | **Anti-arrhythmic Drugs, Anti-hyperlipidemic agents, Coagulant & Anticoagulants, Drugs used in Congestive Heart Failure** | **Anti-arrhythmic Drugs**: Quinidine Sulphate, Procainamide Hydrochloride, Disopyramide Phosphate*, Phenytoin Sodium, Lidocaine Hydrochloride, Tocainide Hydrochloride, Mexiletine Hydrochloride, Lorcainide Hydrochloride, Amiodarone, Sotalol.<br>**Anti-hyperlipidemic agents**: Clofibrate, Lovastatin, Cholestyramine and Colestipol.<br>**Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, Clopidogrel.<br>**Drugs used in Congestive Heart Failure**: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan. | 10 | 3 | 3.4 |
| 4 | **Drugs acting on Endocrine system:** | **Drugs acting on Endocrine system**: Nomenclature, Stereochemistry and metabolism of steroids.<br>**Sex hormones:** Testosterone, Andralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl Stilbestrol.<br>**Drugs for erectile dysfunction**: Sildenafil, Tadalafil.<br>**Oral contraceptives:** Mifepristone, Norgestrel, **Levonorgestrel**<br>**Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone.<br>**Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole. | 8 | 4 | 3.4 |
| 5 | **Antidiabetic agents, Local Anesthetics:** | **Antidiabetic agents:** Insulin and its preparations.<br>**Sulfonylureas:** Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.<br>**Biguanides:** Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone, Meglitinides, Repaglinide, Nateglinide.<br>**Glucosidase inhibitors:** Acarbose, Voglibose.<br>**Local Anesthetics:** SAR of Local anesthetics. Benzoic acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.<br>**Amino Benzoic acid derivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.<br>**Miscellaneous:** Phenacaine, Diperodon, Dibucaine. | 7 | 5 | 3.4 |

**Reference Books:**

Wilson and Gisvold's Organic Medicinal and Pharmaceutical Chemistry
Foye's Principles of Medicinal Chemistry
Burger's Medicinal Chemistry
Introduction to Principles of Drug Design
Organic Chemistry by I.L. Finar,
The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1 to 5.
The Pharmacopoeia of India.
Elementary Practical Organic Chemistry by Vogel A

**e-Learning Source:**

https://www.carewellpharma.in/B_Pharmacy/Notes/

**Course Articulation Matrix:(Mapping of Cos with POs and PSOs)**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | 2 | 3 | 1 | 2 |
| CO2 | 3 | 1 | 1 | - | 1 | 1 | - | - | 2 | - | 2 | 3 | 1 | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | 2 | 3 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | - | 2 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | 2 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP502T | Title of the Course | INDUSTRIAL PHARMACY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know the various pharmaceutical dosage forms and their manufacturing techniques.<br>2. Know various considerations in development of pharmaceutical dosage forms<br>3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Execute the knowledge of physicochemical properties of drugs (Pre-formulations) as a tool in the optimization of solid and liquid dosage forms. |
| CO2 | Describe the formulation of tablets, capsules and liquid orals using established procedures and technology. |
| CO3 | Understand the various considerations in development of capsules and pellets on the basis of their manufacturing techniques. |
| CO4 | Analyze parenteral and ophthalmic dosage forms based on their types. |
| CO5 | Explain formulation methods of cosmetics products and aerosols with appropriate packaging materials based on their applications. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Preformulation Studies, Physical properties, Chemical Properties, Application of preformulation** | Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. a. **Physical properties:** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism<br>b. **Chemical Properties**: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms | 10 | 1 | **9.1<br>9.3<br>9.4<br>9.5** |
| 2 | **Tablets, Introduction, Excipients, Tablet coating, Liquid orals** | **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**: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.<br>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 | 10 | 2 | **9.1<br>9.2<br>9.4<br>9.a** |
| 3 | **Introduction Capsules, Packing, Pellets** | Hard gelatin capsules: Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.<br>Soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.<br>Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets | 8 | 3 | **9.1<br>9.2<br>9.4<br>9.b** |
| 4 | **Parenteral Products, advantages and limitations, Production procedure, Ophthalmic preparations** | **Parenteral Products**: a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity b. Production procedure, production facilities and controls, aseptic processing c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations | 10 | 4 | **9.1<br>9.3<br>9.4<br>9.a** |
| 5 | **Introduction Cosmetics** | **Cosmetics:** Formulation and preparation of the following cosmetic **Preparations:** lipsticks, shampoos, cold cream and vanishing cream, tooth | 10 | 5 | **9.2<br>9.3** |

| | | | | | |
|---|---|---|---|---|---|
| | **Formulation,**<br>**Pharmaceutical Aerosols, Packaging**<br>**Materials** | pastes, hair dyes and sunscreens. Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.<br>**Packaging Materials Science**: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests. | | | **9.4**<br>**9.a** |

**Reference Books:**

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition

**e-Learning Source:**

https://www.researchgate.net/publication/319980566_PREFORMULATION_STUDIES

**Course Articulation Matrix:(Mapping of Cos with POs and PSOs)**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | - | 1 | - | 2 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 1 | - | 1 | - | 1 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP503T | Title of the Course | PHARMACOLOGY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the mechanism of drug action and its relevance in the treatment of different diseases<br>2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments<br>3. Demonstrate the various receptor actions using isolated tissue preparation<br>4. Appreciate correlation of pharmacology with related medical sciences | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Judge the therapeutic potential, pharmacodynamic and pharmacokinetic of drugs used in the management of congestive heart failure, hypertension, angina, arrhythmia and hyperlipidemia based on their knowledge of haemodynamic and electrophysiology of heart. |
| CO2 | Appraise the application of blood forming agents and their role in treatment of cardiovascular disorders, further able to analyse the importance of diuretics in cardiovascular diseases based on their knowledge of blood disorders its pathophysiology and pharmacology of drugs used in the management of these disorders. |
| CO3 | Distinguish the pharmacology of anti-histaminic, anti-serotonrotoniergic, NSAIDs, angiotensin, bradykinin, substance P, anti-gout anti-rheumatic drugs after having the knowledge of physiology of histamine, serotonin, prostaglandin and other autocoids. |
| CO4 | Analyse the treatment and management of endocrine disorders such as gigantism, dwarfism, hypo and hyperthyroidism, diabetes and disorders of adrenal glands based on their knowledge of pathophysiology of these disorders and pharmacology of drugs used in management of these disorders. |
| CO5 | Compare the androgens, anabolic steroids, estrogens, progesterone, oral contraceptives and drugs acting on the uterus based on the knowledge of role of male and female sex hormones and pharmacology of drugs of these categories. Perform the bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine after having the basic knowledge of these hormones and drugs. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Pharmacology of drugs acting on cardio vascular system** | Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure, Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidemic drugs | 10 | 3 | **3.4,3.b, 3.d** |
| 2 | **Pharmacology of drugs acting on cardio vascular system** | Drug used in the therapy of shock.<br>Hematinics, coagulants and anticoagulants. Fibrinolytics and anti-platelet drugs, Plasma volume expanders Pharmacology of drugs acting on urinary system Diuretics Anti-diuretics | 10 | 3 | **3.3,3.4,3.b, 3.d** |
| 3 | **Autocoids and related drugs** | Introduction to autacoids and classification Histamine, 5-HT and their antagonists.<br>Prostaglandins, Thromboxanes and Leukotrienes. Angiotensin, Bradykinin and Substance P., Non-steroidal anti-inflammatory agents Anti-gout drugs Antirheumatic drugs | 10 | 3 | **3.4,3.6,3.b, 3.d** |
| 4 | **Pharmacology of drugs acting on endocrine system** | Basic concepts in endocrine pharmacology.<br>Anterior Pituitary hormones- analogues and their inhibitors. Thyroid hormones- analogues and their inhibitors.<br>Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. Insulin, Oral Hypoglycemic agents and glucagon.<br>ACTH and corticosteroids. | 8 | 2 | **3.4,3.b,3.d** |
| 5 | **Pharmacology of drugs acting on endocrine system** | Androgens and Anabolic steroids.<br>Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus.<br>Bioassay Principles and applications of bioassay. Types of bioassay<br>Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine, digitalis, histamine and 5-HT | 7 | 3 | **3.4,3.7,3.b, 3.d** |

**Reference Books:**

Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier

Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.

Goodman and Gilman's, The Pharmacological Basis of Therapeutics

Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins

**e-Learning Source:**

https://www.researchgate.net/publication/319980566_PREFORMULATION_STUDIES

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | 2 | 1 | 1 | 1 | 2 | 1 | 2 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | - | 2 | 1 | 1 | 1 | 1 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | - | 2 | - | 1 | 1 | 1 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | - | 2 | 2 | - | 2 | 1 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | - | 2 | 1 | 1 | 1 | 1 | 1 | 2 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP504T | Title of the Course | PHARMACOGNOSY & PHYTOCHEMISTRY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | 3 | 1 | - | 4 | |
| Course Objectives | To know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Judge the production and significance of plant secondary metabolites through various biosynthetic pathways based on radioactive isotope studies. |
| CO2 | Investigate the different plants' secondary metabolites chemistry, bio-sources, therapeutic uses, and commercial applications of the following categories based on their chemical classes of secondary metabolites: Alkaloids, Phenylpropanoids and Flavonoids, Lignans, Steroids, Cardiac Glycosides & Triterpenoids, Volatile oils, Tannins, Resins, Glycosides and Iridoids. |
| CO3 | Develop the skill in extraction, isolation, analysis, confirmation, and estimation of phytoconstituents of the following categories based on chromatography and spectroscopic methods: Terpenoids, Glycosides, Alkaloids and Resins. |
| CO4 | Apply the industrial production and estimation methods of therapeutically important drugs based on herbal phytoconstituents. |
| CO5 | Develop competency in the modern methods for extraction and use of the latest techniques for analysis formulations based on herbal phytoconstituents. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Metabolic pathways in higher plants and their determination** | a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.<br>b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies. | 7 | 1 | - |
| 2 | **General introduction, Alkaloids, Phenylpropanoids and Flavonoids** | General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of followingsecondary metabolites:<br>**Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, Phenylpropanoids and **Flavonoids:** Lignans, Tea, Ruta<br>Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,<br>**Tannins**: Catechu, Pterocarpus<br>**Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony Glycosides: Senna, Aloes, Bitter Almond<br>**Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids | 14 | 2 | - |
| 3 | **Isolation, Identification and Analysis of Phytoconstituents** | Isolation, Identification and Analysis of Phytoconstituents<br>a) Terpenoids: Menthol, Citral, Artemisin<br>b) Glycosides: Glycyrhetinic acid & Rutin<br>c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine<br>d) Resins: Podophyllotoxin, Curcumin | 06 | 3 | - |
| 4 | **Industrial production, estimation and utilization phytoconstituents** | Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine,Taxol, Vincristine and Vinblastine | 10 | 4 | **15.9, 15.b** |
| 5 | **Basics of Phytochemistry** | Modern methods of extraction, application of latest techniques like Spectroscopy,<br>chromatography and electrophoresis in the isolation, purification and identification of crude drugs. | 08 | 5 | - |

**Reference Books:**

W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
Remington's Pharmaceutical sciences.

| e-Learning Source: |
|---|
| https://www.iptsalipur.org/wp-content/uploads/2020/08/BP504T_PGPC_UNIT_II.pdf |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | 1 | 2 | 2 | 1 | - | - | - | 2 | 2 | 2 |
| CO2 | 3 | - | - | - | 1 | 1 | 2 | 2 | - | - | - | 3 | 2 | 3 |
| CO3 | 3 | - | - | - | - | 2 | 2 | 1 | - | - | - | 3 | 2 | 2 |
| CO4 | 3 | - | - | - | - | 1 | 2 | 1 | - | - | - | 3 | 3 | 3 |
| CO5 | 3 | - | - | - | 1 | 1 | 2 | 1 | - | - | - | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP505T | Title of the Course | PHARMACEUTICAL JURISPRUDENCE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | 3 | 1 | - | 4 | |
| Course Objectives | 1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.<br>2. Various Indian pharmaceutical Acts and Laws<br>3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals<br>4. The code of ethics during the pharmaceutical practice | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the regulation licensing penalties based on testing and examination of new drug. |
| CO2 | Remember the various schedules for drug sale regulation on the basis of licensing authorities along with offence and penalities. |
| CO3 | Discuss the various pharmacy Acts based on their goals, descriptions, licencing, export, manufacture, regulatory bodies, controls, consultation committees, and fines. |
| CO4 | Analyze the cruelty to animal act and recognize the drug and magic remedies act on the basis of ethical guidelines and price control. |
| CO5 | Review the drug committees, Code of Pharmaceutical Ethics, Medical Termination of Pregnancy Act, Right to Information Act, and an introduction to Intellectual Property Rights (IPR) on the basis of pharmaceutical legislations. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Drugs and Cosmetics Act, 1940 and its rules 1945** | Objectives, Definitions, Legal definitions of schedules to the Act and Rules<br>Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties.<br>Manufacture of drugs – Prohibition of manufacture and sale of certain 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. | 10 | 1,3,6 | 16.1<br>16.5<br>16.10<br>16.b |
| 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 – Wholesale, Retail sale and Restricted license. Offences and penalties<br>Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.<br>Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors | 10 | 1,3,6 | 16.1<br>16.5<br>16.10<br>16.b |
| 3 | **Pharmacy Act, Medicinal and Toilet Preparation Act, Narcotic Drugs and Psychotropic substances Act** | Pharmacy Act –1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacycouncils; constitution and functions, Registration of Pharmacists, Offences and Penalties<br>1. Medicinal and Toilet Preparation Act –1955: Objectives, Definitions, Licensing,Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.<br>**Narcotic Drugs and Psychotropic substances Act-1985 and Rules**: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties | 10 | 1,2,3,4,5,6 | 16.1<br>16.3<br>16.10<br>16.b |
| 4 | **Drugs and Magic Remedies Act, Prevention of Cruelty to animals Act, DPCO** | Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties<br>**Prevention of Cruelty to animals Act-1960**: Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and | 8 | 1,2,3,4,6 | 16.1<br>16.3<br>16.7<br>16.10<br>16.b |

| | | | | | |
|---|---|---|---|---|---|
| | | acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties<br>**National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM) | | | |
| 5 | **Pharmaceutical Legislations, IPR** | Pharmaceutical Legislations – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee<br>2. Code of Pharmaceutical ethics D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath<br>3. Medical Termination of Pregnancy Act<br>4. Right to Information Act<br>5. Introduction to Intellectual Property Rights (IPR) | 07 | 1,4,5 | 16.1<br>16.3<br>16.10<br>16.b |

**Reference Books:**

Forensic Pharmacy by B. Suresh

Text book of Forensic Pharmacy by B.M. Mithal

Hand book of drug law-by M.L. Mehra

A text book of Forensic Pharmacy by N.K. Jain

**e-Learning Source:**

DTAB:https://cdsco.gov.in/opencms/opencms/en/dec-dtab-committee

Drugs and Cosmetics Act:https://cdsco.gov.in/opencms/opencms/en/Acts-and-rules/Drugs-and-Cosmetics-Act/

Cosmetics Rules:https://cdsco.gov.in/opencms/opencms/en/Acts-and-rules/Cosmetics-Rules/

WIPO:https://www.wipo.int/academy/en/

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | - | 1 | 1 | 3 | 3 | 1 | - | 1 | 3 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | - | - | 2 | 3 | 3 | 1 | - | 1 | 3 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 1 | - | 1 | 3 | 2 | 1 | - | 1 | 3 | 2 | 3 |
| **CO4** | 2 | 3 | 2 | - | - | 2 | 3 | 1 | 1 | - | 2 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | - | - | 1 | 3 | 3 | 1 | - | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP506P | Title of the Course | INDUSTRIAL PHARMACY I | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | - | - | 4 | 2 | - |
| Course Objectives | 1. Know the various pharmaceutical dosage forms and their manufacturing techniques.<br>2. Know various considerations in development of pharmaceutical dosage forms<br>3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the preparation and evaluation of tablet on the basis of preformulation studies of various tablets. |
| CO2 | Understand the preparation and evaluation of tetracycline capsules. |
| CO3 | Understand the prepration of injection on the basis of evaluation of various glass containers. |
| CO4 | Understand the prepration of various topical preprations. |
| CO5 | Understand the prepration of various opthalmic preprations. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Tablet | To perform the preformulation studies of paracetamol/aspirin drug.<br>To prepare and evaluate paracetamol granules by wet granulation method.<br>To prepare and evaluate aspirin tablets.<br>To perform the film coating of tablets/granules. | 16 | 1 | - |
| 2 | Capsule | To prepare and evaluate tetracycline capsules. | 4 | 2 | - |
| 3 | Parenterals | To prepare and submit 10 ml of Ascorbic acid injection.<br>To understand the prepare and submit 10ml of calcium gluconate injection.<br>To evaluate glass containers used as packaging material and distinct the type-1, type-2 and type-3 glass. | 12 | 3 | - |
| 4 | Cosmetic | To prepare and submit 10 gm Cold Cream<br>To prepare and submit 10 gm Vanishing Cream | 8 | 4 | - |
| 5 | Ophthalmic Preparation | To prepare zinc sulphate eye drop.<br>To prepare chloramphenicol eye ointment. | 8 | 5 | - |
| e-Learning Source: | | | | | |
| https://www.google.co.in/books/edition/The_Theory_and_Practice_of_Industrial_Ph/p_VsAAAAMAAJ?hl=en&gbpv=0&bsq=Theory%20And%20Practice%20of%20Industrial%20Pharmacy%20By%20Liberman%20%26%20Lachman | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | - | 3 | 3 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 1 | - | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP507P | Title of the Course | PHARMACOLOGY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand the mechanism of drug action and its relevance in the treatment of different diseases<br>2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments<br>3. Demonstrate the various receptor actions using isolated tissue preparation<br>4. Appreciate correlation of pharmacology with related medical sciences | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | To understand the basic principle of bioassay and types of bioassay. |
| CO2 | To demonstrate isolation of different organs/tissues from the laboratory animals by In Silico. |
| CO3 | To understand the effect of different drugs on the concentration response curves. |
| CO4 | To demonstrate the various receptor actions using isolated tissue preparation |
| CO5 | To understand the application of pharmacological knowledge in the prevention and treatment of various disease. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Pharmacology introduction | Introduction to in-vitro pharmacology and physiological salt solutions. | 4 | 1 | - |
| 2 | Drugs effect | Effect of drugs on isolated frog heart. | 4 | 1 | - |
| 3 | drugs effect | Effect of drugs on blood pressure and heart rate of dog. | 4 | 1 | - |
| 4 | Diuretic activity | Study of diuretic activity of drugs using rats/mice. | 4 | 2 | - |
| 5 | Acetylcholine DRC | DRC of acetylcholine using frog rectus abdominis muscle. | 4 | 2 | - |
| 6 | Drugs effect | Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively. | 4 | 2 | - |
| 7 | Matching bioassay | Bioassay of histamine using guinea pig ileum by matching method. | 4 | 3 | - |
| 8 | Interpolation bioassay | Bioassay of oxytocin using rat uterine horn by interpolation method. | 4 | 3 | - |
| 9 | Three point bioassay | Bioassay of serotonin using rat fundus strip by three-point bioassay. | 4 | 3 | - |
| 10 | Four point bioassay | Bioassay of acetylcholine using rat ileum/colon by four-point bioassay. | 4 | 4 | - |
| 11 | PA2 | Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schild plot method). | 4 | 4 | - |
| 12 | PD2 | Determination of PD2 value using guinea pig ileum. | 4 | 4 | - |
| 13 | Drug effect | Effect of spasmogens and spasmolytic using rabbit jejunum. | 4 | 5 | - |
| 14 | Drug activity | Anti-inflammatory activity of drugs using carrageenan induced paw-edema model. | 4 | 5 | - |
| 15 | Drug activity | Analgesic activity of drug using central and peripheral methods | 4 | 5 | - |
| e-Learning Source: | | | | | |
| Animal simulation Ex- Pharm | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP508P | Title of the Course | PHARMACOGNOSY & PHYTOCHEMISTRY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | V | - | - | 4 | 2 | - |
| Course Objectives | 1. To know the modern extraction techniques characterization and identification of the herbal drugs and phytoconstituents.<br>2. To understand the preparation and development of herbal formulation.<br>3. To understand the herbal drug interactions.<br>4. To carry out isolation and identification of phytoconstituents. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Develop the competency in extraction and isolation techniques of the phytoconstituents. |
| CO2 | Develop competency in the assessment of different phytoconstituents. |
| CO3 | Develop the skill in the estimation of different phytoconstituents by chromatography methods. |
| CO4 | Develop the skill in the isolation techniques of volatile oils. |
| CO5 | Estimate the different sugars of herbal drugs by paper chromatography. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Morphology,histol ogy and powdercharacteristics of crude drugs | Morphology,histology and powder characteristics and extraction and detection of cinchona,cinnamon,senna,clove,ephedra,fennel and coriander. | 15 | 1 | - |
| 2 | Isolation and detection of active principles | To isolate caffeine from tea dust.<br>To isolate diosgenin from dioscorea.<br>To isolate atropine from belladonna.<br>To isolate sennosides from senna. | 12 | 1 | - |
| 3 | Paper chromatography | Separation of sugars by paper chromatography. | 3 | 5 | - |
| 4 | TLC | To determinr the Rf value of given sample. | 3 | 3 | - |
| 5 | Distillation | Distillation of volatile oils and detection of phytoconstituents by TLC. | 3 | 4 | - |
| 6 | Chemical test | To perform the chemical test of Asafoetida,Benzoin,Colophony,Aloes,Myrrh | 6 | 2 | - |
| e-Learning Source: | | | | | |
| https://www.miperknlapindia.ac.in/BP508P-pharmacognosy-phytochemistry2.pdf | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | 1 | 3 | 2 | 2 |
| CO2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 3 | 2 | 2 |
| CO3 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | 1 | 3 | 2 | 2 |
| CO4 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | - | - | 1 | 3 | 2 | 2 |
| CO5 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | 1 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP601T | Title of the Course | MEDICINAL CHEMISTRY III | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the importance of drug design and different techniques of drug design.<br>2. Understand the chemistry of drugs with respect to their biological activity.<br>3. Know the metabolism, adverse effects and therapeutic value of drugs.<br>4. Know the importance of SAR of drugs. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Evaluate the pharmacodynamics, pharmacokinetics, stability, therapeutic potential, and synthesis of the Beta-lactams, monobactams, lactamase inhibitors, and aminoglycoside antibiotic classes using knowledge of chemical structure and Structure-Activity Relations |
| CO2 | Evaluate the pharmacodynamics, pharmacokinetics, stability, therapeutic potential, and synthesis of the tetracyclines, macrolide, polyenes and miscellaneous antibiotic classes using knowledge of chemical structure and Structure-Activity Relationships (SAR) and appraise the basic concept and application of prodrug design. |
| CO3 | Judge the drug's therapeutic potential, structure activity relationship, pharmacodynamics, pharmacokinetics, stability and synthesis in the following categories based on their understanding of the chemical structure of the drugs: antitubercular, urinary tract anti-infectives and antivirals. |
| CO4 | Based on understanding of the chemical structures and Structure-Activity Relationships (SAR) of the following pharmacological classes—antifungal, antiprotozoal and anthelmintic—Defend their therapeutic potential, pharmacodynamics, pharmacokinetics, stability, |
| CO5 | Apply different drug design approaches and technique towards the drug development based on the basic concept of drug design. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Antibiotics** | Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.<br>**β-Lactam antibiotics**: Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams Aminoglycosides: Streptomycin, Neomycin, Kanamycin **Tetracyclines:** Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline | 10 | I | 3.3 |
| 2 | **Antibiotics** | Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.<br>**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 | 10 | 2 | 3.3 |
| 3 | **Anti-tubercular Agents** | **Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid. * Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate. Urinary tract anti-infective agents Quinolones: SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine<br>Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir | 10 | 3 | 3.3 |
| 4 | **Antifungal agents** | **Antifungal agents:** Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin. Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.<br>**Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, | 08 | 4 | 3.3 |

| | | | | | |
|---|---|---|---|---|---|
| | | Eflornithine. Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. Sulphonamides and Sulfones Historical development, chemistry,<br>**Classification and SAR of Sulfonamides**: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole. Sulfones: Dapsone | | | |
| 5 | **Introduction to Drug Design** | Introduction to Drug Design Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.<br>**Combinatorial Chemistry:** Concept and applications chemistry, solid phase and solution phase synthesis. of combinatoria | 07 | 5 | 3.3, 3.4 |

**Reference Books:**


Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.

Foye's Principles of Medicinal Chemistry.

Burger's Medicinal Chemistry, Vol I to IV.

Introduction to principles of drug design- Smith and Williams.

Remington's Pharmaceutical Sciences

Martindale's extra pharmacopoeia

Organic Chemistry by I.L. Finar, Vol. II


**e-Learning Source:**

https://books.google.co.in/books/about/Wilson_and_Giswold_s_Textbook_of_Organic.html?id=CIpWhgWV5q0C

https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 1 | - | 1 | 1 | - | - | 2 | - | 1 | 3 | 1 | 3 |
| CO2 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | - | 1 | 3 | 1 | 3 |
| CO3 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | - | 1 | 3 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | 2 | - | - | 1 | - | 1 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | 2 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP602T | Title of the Course | PHARMACOLOGY III | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases<br>2. Comprehend the principles of toxicology and treatment of various poisoningsand<br>3. Appreciate correlation of pharmacology with related medical sciences | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Analyse the pharmacodynamic and pharmacokinetic properties of drugs based on the understanding of pathophysiology and drugs used in the diseases of the following system: Respiratory and gastrointestinal system. |
| CO2 | Discuss the therapeutic potential, drug interaction and toxicity management of drugs based on understanding of pharmacokinetic and pharmacodynamic of drugs in the following categories: Sulfonamides, cotrimoxazole, Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycoside. |
| CO3 | Describe the management of tuberculosis, leprosy, fungal and viral diseases, helminthiasis, malaria and amoebiasis after having the knowledge of aetiology and pharmacology of drugs used in these diseases. |
| CO4 | Evaluate the pharmacology and therapeutic strategies for UTIs, STDs, malignancies and immunocompromised patients after having the knowledge of aetiology, pathophysiology and pharmacology of drugs used in these ailments such as immunosuppressant, immunostimulants, protein drugs, monoclonal antibodies and biosimilars. |
| CO5 | Explain types of toxicity and their management including genotoxicity, carcinogenicity, teratogenicity, mutagenicity, teratogenicity, mutagenicity and the principles of treating poisoning based on their knowledge of gene structure and function and type and mechanism of poison. Illustrate the rhythm, cyles and biological clocks and their significance in chronotherapy based on their knowledge of time of disease exacerbation and its relation with particular time (morning, afternoon, evening, night). |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Pharmacology of drugs acting on Respiratory system** | Anti -asthmatic drugs,<br>Drugs used in the management of COPD<br>Expectorants and antitussives d. Nasal decongestants Respiratory stimulants<br>Pharmacology of drugs acting on the Gastrointestinal TractAntiulcer agents.<br>Drugs for constipation and diarrhoea.<br>Appetite stimulants and suppressants.<br>Digestants and carminatives.<br>Emetics and anti-emetics. | 10 | 3 | 3.3 |
| 2 | **Chemotherapy** | General principles of chemotherapy. Sulfonamides and cotrimoxazole. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides | 10 | 3 | 3.3 |
| 3 | **Chemotherapy** | Antitubercular agents Antileprotic agent. Anti-gout drugs. Antirheumatic drugs Antifungal agents Antiviral drugs Anthelmintics Antimalarial drugs Antiamoebic agents | 10 | 3 | 3.3 |
| 4 | **Chemotherapy Immuno pharmacol ogy** | Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy.<br>Immunopharmacology Immunostimulants Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars | 8 | 2 | 3.3 |
| 5 | **Principles of toxicology Chronopharmac ology** | Definition and basic knowledge of acute, subacute and chronic toxicity. b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity<br>c. General principles of treatment of poisoning<br>d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.<br>Chronopharmacology a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy. | 7 | 3 | 3.3, 3.4 |

**Reference Books:**

Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier

Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.

Goodman and Gilman's, The Pharmacological Basis of Therapeutics

| |
|---|
| Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins |
| **e-Learning Source:** |
| https://drive.google.com/drive/folders/169qOfL9G-zcJ6SQ9c6f-YDvSX6GN_EjU?usp=share_link |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | 3 | 1 | 1 | 1 | 2 | 1 | 1 | - | 2 | 3 | 2 | 2 |
| CO2 | 3 | - | 3 | 1 | - | 2 | 1 | 2 | 2 | - | 2 | 3 | 2 | 2 |
| CO3 | 3 | - | 3 | 1 | - | 2 | 1 | 1 | 1 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | - | 3 | 1 | 1 | 1 | 1 | 1 | 1 | - | 2 | 3 | 3 | 2 |
| CO5 | 3 | - | 3 | 1 | 1 | 2 | 1 | 2 | 1 | - | 2 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP603T | Title of the Course | HERBAL DRUG TECHNOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |
| Course Objectives | 1. To know the WHO and ICH guidelines for the evaluation of herbal drugs, herbal cosmetics, nutraceuticals and appreciate patenting of herbal drugs, GMP. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Evaluate the herbal raw material as a source of crude drugs for the preparation of herbal medicine based on Good agricultural practices in the cultivation of medicinal plants including Organic farming. |
| CO2 | Judge the Nutraceuticals, Herbal-Drug, and Herb-Food Interactions, in the treatment of various diseases and Herbal-Drug and Herb-Food Interactions, based on the health benefits of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome, and various Gastrointestinal diseases. |
| CO3 | Investigate the herbal raw material for the preparation of herbal cosmetics and herbal nano-formulations based on protective and antioxidant effects for skin and, hair care. |
| CO4 | Eestimate the herbal drug preparations as per the WHO and ICH guidelines and knowledge about the IPR, patenting aspects, and regulatory issues for the assessment of traditional drugs and natural products. |
| CO5 | Develop competency in the testing and manufacturing practices of herbal drugs in Indian systems of medicine. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Herbs as raw materials | **Herbs as raw materials:** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs, Selection, identification and authentication of herbal materials Processing of herbal raw material<br>**Biodynamic Agriculture:** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.<br>**Indian Systems of Medicine:**<br>a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy<br>b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma. | 11 | 1 | - |
| 2 | Nutraceuticals | **Nutraceuticals**<br>General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.<br>Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina<br>**Herbal-Drug and Herb-Food Interactions:** General introduction to interaction andclassification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra. | 07 | 2 | 3.1, 3.4, 3.8, 3.9 |
| 3 | Herbal Cosmetics | **Herbal Cosmetics:** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.<br>**Herbal excipients:** Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.<br>**Herbal formulations :** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes | 10 | 3 | - |
| 4 | Evaluation of Drugs, Regulatory Issues | **Evaluation of Drugs:** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.<br>**Patenting and Regulatory requirements of natural products:**<br>a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy<br>b) Patenting aspects of Traditional Knowledge and Natural Products. | 10 | 4 | 3.b |

| | | | | | |
|---|---|---|---|---|---|
| | | Case study of Curcuma & Neem.<br>**Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs. | | | |
| 5 | **General Introduction to Herbal Industry** | **General Introduction to Herbal Industry:**<br>Herbal drugs industry: Present scope and future prospects.<br>A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.<br>**Schedule T – GoodManufacturing Practice of Indian systems of medicine:**<br>Components of GMP (Schedule – T) and its objectives<br>Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records. | 07 | 5 | - |

**Reference Books:**

W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.

Textbook of Pharmacognosy by Tyler, Brady & Robber.

Essentials of Pharmacognosy, Dr. SH. Ansari, IInd edition, Birla publications, New Delhi, 2007

Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

**e-Learning Source:**

https://www.intechopen.com/chapters/53301

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | 1 | 1 | 1 | - | - | 1 | - | 1 | 2 | 2 | 3 |
| CO2 | 3 | 1 | 2 | 1 | 1 | 1 | - | - | 2 | - | 1 | 2 | 3 | 3 |
| CO3 | 3 | 1 | 2 | 1 | - | 1 | - | - | 2 | - | 1 | 3 | 2 | 3 |
| CO4 | 3 | 1 | 2 | 1 | - | 2 | - | - | 1 | - | 1 | 3 | 3 | 3 |
| CO5 | 3 | 1 | 2 | 1 | 1 | 2 | - | - | 1 | - | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP604T | Title of the Course | BIOPHARMACEUTICS & PHARMACOKINETICS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |

**Course Objectives**

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance &applications.

| Course Outcomes | |
|---|---|
| CO1 | Understand the mechanisms of drug absorption through the GIT and non-per oral extravascular routes based on the nature of the drug. |
| CO2 | Explain metabolic pathways, factors affecting renal excretion of drugs and different terms of bioavailability based on physicochemical properties of the drug. |
| CO3 | Apply pharmacokinetic principles, including compartment and non-compartment models, physiological models, and one-compartment open models for various administration routes, as well as calculate and interpret key pharmacokinetic parameters based on route of administrations. |
| CO4 | Apply the principles of the two-compartment open model, calculate loading and maintenance doses based on drug properties. |
| CO5 | Analyze the concept of non-linear pharmacokinetics and explain the factors causing non-linearity and use Michaelis-menton equation to estimate parameters based on pharmacokinetics parameters of the drug. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Biopharmaceutics, Absorption & Distribution** | Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs. | 10 | 1, 2 | 9.5 9.b |
| 2 | **Elimination, Bioavailability and Bioequivalence** | Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs. | 10 | 3, 4 | 9.5 9.b |
| 3 | **Pharmacokinetics** | Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE ,t1/2,Vd,AUC,Ka, Clt and CLR- definitions methods of eliminations, understanding of their significance and application | 10 | 5 | 9.1 9.5 9.b |
| 4 | **Multicompartment models** | Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settings | 8 | 6 | 9.1 9.5 9.b |
| 5 | **Nonlinear Pharmacokinetics** | Introduction, Factors causing Non-linearity, Michaelis-menton method of estimating parameters, Explanation with example of drugs. | 7 | 7 | 9.5 9.b |

**Reference Books:**


Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.

Biopharmaceutics and Pharmacokinetics; By Robert F Notari

Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA.

Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi.

Pharmacokinetics: By Milo Gibaldi Donald, R. Mercel Dekker Inc.

Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press..

Biopharmaceutics; By Swarbrick

Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New

| |
|---|
| York and Basel, 1987. |
| Remington's Pharmaceutical Sciences, ByMack Publishing Company, Pennsylvnia |
| **e-Learning Source:** |
| https://drive.google.com/file/d/1PuOdN2CUMvjnUNse5PTYAXkfSImTGqjW/view?usp=sharing |
| https://ptabdata.blob.core.windows.net/files/2017/IPR2017-00854/v34_Exhibit%201034%20-%20Gibaldi.PDF |
| https://accesspharmacy.mhmedical.com/content.aspx?bookid=513&sectionid=41488019#56601005 |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 2 | - | 1 | 1 | - | 2 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | - | 1 | 1 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | - | 2 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP605T | Title of the Course | PHARMACEUTICAL BIOTECHNOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |
| Course Objectives | Understanding the importance of Immobilized enzymes in Pharmaceutical Industries, Genetic engineering applications in relation to production of pharmaceuticals, immune system and vaccine, Importance of Monoclonal antibodies in Industries, fermentation technology | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Recall the basic principles and applications of biotechnology in the pharmaceutical field. Describe the role of enzymes in biotechnological processes and their pharmaceutical relevance. |
| CO2 | Explain the processes involved in genetic engineering and its pharmaceutical applications. Analyze the traditional pharmaceutical manufacturing processes and biotechnological methods. |
| CO3 | Understanding the immune system, Hypersensitivity reactions, Monoclonal antibodies. Apply the principles of biotechnology to develop new pharmaceutical products such as vaccines and Monoclonal antibodies. |
| CO4 | Explain the importance of various immunological techniques i.e. Microbial genetics, Microbial biotransformation and Mutation. Analyze social implications of biotechnological advances in pharmaceuticals. |
| CO5 | Describe the role fermentation technology. Use biotechnological techniques in the production of pharmaceutical products i.e. organic acids, antibiotics etc. Evaluate the efficacy and safety of Blood products. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Brief introduction to Biotechnology** | Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.<br>Enzyme Biotechnology- Methods of enzyme immobilization and applications.<br>Biosensors- Working and applications of biosensors in Pharmaceutical Industries.<br>Brief introduction to Protein Engineering.<br>Use of microbes in industry. Production of Enzymes- General consideration- Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. Basic principles of genetic engineering. | 10 | 1 | 9.1 |
| 2 | **Recombinant DNA technology** | Study of cloning vectors, restriction endonucleases and DNA ligase.<br>Recombinant DNA technology. Application of genetic engineering in medicine.<br>Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones- Insulin. Brief introduction to PCR | 10 | 2 | 9.1&9.9 |
| 3 | **Immune System** | Structure of Immunoglobulins Structure and Function of MHC<br>Hypersensitivity reactions, Immune stimulation and Immune suppressions.<br>General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.<br>Storage conditions and stability of official vaccines Hybridoma technology- Production, Purification and Applications Blood products and Plasma Substituties. | 10 | 3 | - |
| 4 | **Blotting Techniques** | Immuno blotting techniques- ELISA, Western blotting, Southern blotting.<br>Genetic organization of Eukaryotes and Prokaryotes Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.<br>Introduction to Microbial biotransformation and applications.<br>Mutation: Types of mutation/mutants. | 08 | 4 | 9.1&9.9 |
| 5 | **Fermentation methods** | Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.<br>Large scale production fermenter design and its various controls.<br>Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,<br>Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties. | 07 | 5 | 9.1&9.9 |

| Reference Books: |
|---|
| B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C. |
| RA Goldshy et. al., : Kuby Immunology. |
| J.W. Goding: Monoclonal Antibodies. |
| J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry. |
| Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio. |
| S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication. |
| Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi |
| **e-Learning Source:** |
| https://www.google.co.in/books/edition/Molecular_Biotechnology/icV6EAAAQBAJ?hl=en&gbpv=1&dq=Biotechnology:+Principles+and+Applications&printsec=frontcover |
| https://www.google.co.in/books/edition/Biopharmaceutical_Drug_Design_and_Develo/D5iIHKLX-GQYC?hl=en&gbpv=1&dq=B.R.+Glick+and+J.J.+Pasternak:+Molecular+Biotechnology:+Principles+and+Applications+of+RecombinantDNA:+ASM+Press+Washington+D.C.&printsec=frontcover |
| https://www.google.co.in/books/edition/A_Textbook_of_Biotechnology/-7qcEAAAQBAJ?hl=en&gbpv=1 |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 1 | 2 | - | 2 | - | 1 | 1 | - | 1 | 2 | 2 | 2 |
| **CO2** | 3 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | - | 1 | 2 | 2 | 3 |
| **CO3** | 3 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 3 |
| **CO4** | 3 | 1 | 1 | 2 | 1 | 2 | - | 1 | 1 | - | 1 | 1 | 2 | 3 |
| **CO5** | 3 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP606T | Title of the Course | QUALITY ASSURANCE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the cgmp aspects in a pharmaceutical industry<br>2. Appreciate the importance of documentation<br>3. Understand the scope of quality certifications applicable to pharmaceutical industries<br>4. Understand the responsibilities of QA & QC departments | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the scope of quality management, QbD, ICH guidelines, ISO and NABL accreditation based on their principles and processes. |
| CO2 | Describe the concepts of maintenance of organization and personnel responsibilities on the basis of pharmaceutical industrial flow parameters. |
| CO3 | Analyze the cGMP aspects in the pharmaceutical industry on the basis of understanding operational parameters. |
| CO4 | Explain the basic concept of complaints, goods handling and recalling, waste disposal and documentation employing QA & QC reports. |
| CO5 | Analyze the significance of calibration, validation and qualification based on the concept of quality assurance. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Concepts of Pharmaceutical Assurance and Quality Management** | Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP<br>Total Quality Management (TQM): Definition, elements, philosophies<br>ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines<br>Quality by design (QbD): Definition, overview, elements of QbD program, tools ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation : Principles and procedures | 10 | 1 | - |
| 2 | **Organization and personnel Premises Equipments and raw materials** | Personnel responsibilities, training, hygiene and personal records.<br>Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.<br>Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. | 10 | 2 | - |
| 3 | **Quality control test for packaging materials Understanding of Good Laboratory Practices** | Quality control test for containers, rubber closures and secondary packingmaterials.<br>General Provisions, Organization and Personnel, Facilities,Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities | 10 | 3 | - |
| 4 | **Pharmaceutical Complaints Document maintenance in pharmaceutical industry** | Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.<br>Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records. | 08 | 4 | - |
| 5 | **Concepts Calibration & Validation Warehousing** | Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.<br>Good warehousing practice, materials management | 07 | 5 | - |

**Reference Books:**

Quality Assurance Guide by organization of Pharmaceutical Products of India.
Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh

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|---|
| How to Practice GMP's – P P Sharma.. |
| ISO 9000 and Total Quality Management – Sadhank G Ghosh |
| Good laboratory Practices – Marcel Deckker Series |
| ICH guidelines, ISO 9000 and 14000 guidelines |
| **e-Learning Source:** |
| https://pharmonly.net/wp-content/uploads/2022/08/Industrial-Pharmacy-Lachman-Libbermann-4th-edition.pdf |
| https://www.iso.org/home.html |
| https://nablwp.qci.org.in/Home/index |
| https://www.piramalpharmasolutions.com/themes/zen/assets/misc/whitepapers/Quality |
| https://www.researchgate.net/publication/308595149_A_Model_of_Pharmaceutical_Customer_Complaints_and_Redressal_System |
| https://www.researchgate.net/publication/354722731_DOCUMENTATION_IN_PHARMACEUTICAL_INDUSTRY |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | - | - | 1 | 3 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 3 | - | 3 | 1 | 2 | - | - | 1 | 3 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | - | - | 1 | 3 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | - | - | 1 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | - | - | 1 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP607P | Title of the Course | MEDICINAL CHEMISTRY III | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | - | - | 4 | 2 | - |
| Course Objectives | 1. learn the basic laboratory skills, laboratory equipments and laboratory reagents involved in synthesis and assay procedure of some drugs and their intermediates necessary in medicinal chemistry<br>2. Set up a safe experimental procedure to avoid a risk of an accident and keep concerned about human health and the environment.<br>3. Understand the proper procedures for the safe use of chemicals and can follow the proper procedures for chemical waste disposal and synthesize chemical compounds and intermediates.<br>4. Draw chemical structures and reactions by using chem. Draw software. Also students able to calculate various physicochemical properties by using Chem Draw software.<br>5. Adopt proper communication skills by expressing theoretical and practical knowledge through viva-voce. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the fundamental methodologies, instruments, and safety protocols essential for the synthesis and assay procedures of pharmacologically significant compounds. |
| CO2 | Apply the concepts of different reaction mechanism to synthesize and purify medicinally important compounds based on standard protocol. |
| CO3 | Evaluate the purity of drug based on different analytical techniques and assay procedures as per IP/BP and USP. |
| CO4 | Apply green chemistry principles to the synthesis of APIs and drug intermediates, employing techniques such as microwave-assisted, solvent-free synthesis in accordance with established green chemistry principles. |
| CO5 | Apply computational chemistry techniques to sketch chemical structures, reactions and to calculate the physicochemical properties of drug-like molecules. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Preparation of drugs and intermediates** | Sulphanilamide | 4 | 1,2 | - |
| 2 | **Preperation of drug** | 7-Hydroxy, 4-methyl coumarin | 4 | 1,2 | - |
| 3 | **Preperation of drug** | Chlorobutanol | 4 | 1,2 | - |
| 4 | **Preperation of drug** | Triphenyl imidazole | 4 | 1,2 | - |
| 5 | **Preperation of drug** | Tolbutamide | 4 | 1,2 | - |
| 6 | **Preperation of drug** | Hexamine | 4 | 1,2 | - |
| 7 | **Assay of drugs** | Isonicotinic acid hydrazide | 4 | 1,3 | - |
| 8 | **Assay** | Chloroquine | 4 | 1,3 | - |
| 9 | **Assay** | Metronidazole | 4 | 1,3 | - |
| 10 | **Assay** | Dapsone | 4 | 1,3 | - |
| 11 | **Assay** | Chlorpheniramine maleate | 4 | 1,3 | - |
| 12 | **Assay** | Benzyl penicillin | 4 | 1,3 | - |
| 13 | **Preparation of medicinally important compounds or intermediates by Microwave irradiation technique** | Preparation of medicinally important compounds or intermediates by Microwave irradiation technique | 4 | 1,2,4 | - |
| 14 | **Drawing structures and reactions using chem draw®** | Drawing structures and reactions using chem draw® | 4 | 5 | - |
| 15 | **Determination** | Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5) | 4 | 5 | - |
| **e-Learning Source:** | | | | | |
| https://www.ncbi.nlm.nih.gov/books/NBK55884/ | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 3 | 2 | 1 | 2 | - | - | 1 | 2 | 3 | 3 | 1 | 3 |
| CO2 | 3 | 1 | 3 | 2 | 2 | 2 | - | - | 1 | 2 | 3 | 3 | 1 | 3 |
| CO3 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | 2 | 3 | 3 | 1 | 3 |
| CO4 | 3 | 1 | 3 | 2 | 1 | 1 | - | - | 1 | 2 | 3 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 3 | 2 | 1 | 2 | - | - | 1 | 2 | 3 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP608P | Title of the Course | PHARMACOLOGY III | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | - | - | 4 | 2 | - |
| Course Objectives | 1. Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases<br>2. Comprehend the principles of toxicology and treatment of various poisonings<br>3. Appreciate correlation of pharmacology with related medical sciences. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Determine the dosage for pharmacological experiments and convert it to a human dose using established calculation methods. |
| CO2 | Evaluating drugs for their gastrointestinal efficacy, hypoglycemic effects, and anti-allergic properties, and correlating clinical and biochemical parameters with the disease. |
| CO3 | Capable of understanding OECD guidelines, interpreting acute toxicity and related studies for safety evaluation, and analyzing the pharmacokinetic profile of the given drug. |
| CO4 | Conduct pyrogen tests, interpret the results, and apply regulatory standards to ensure safety and compliance in pharmaceutical testing. |
| CO5 | Proficient of applying appropriate biostatistical methods for data interpretation and calculations. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Dose calculation** | Dose calculation in pharmacological experiments. | 4 | 1 | - |
| 2 | **Antiallergic activity** | Anti-allergic activity by mast cell stabilization assay. | 4 | 1 | - |
| 3 | **Pylorus ligation** | Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model. | 4 | 1 | - |
| 4 | **Drug effect** | Study of effect of drugs on gastrointestinal motility. | 4 | 2 | - |
| 5 | **Drug effect** | Effect of agonist and antagonists on guinea pig ileum. | 4 | 2 | - |
| 6 | **Serum biochemical estimation** | Estimation of serum biochemical parameters by using semi-autoanalyzer. | 4 | 2 | - |
| 7 | **Purgative effect** | Effect of saline purgative on frog intestine. | 4 | 3 | - |
| 8 | **Hypoglycemic effect** | Insulin hypoglycemic effect in rabbit. | 4 | 3 | - |
| 9 | **Pyrogen test** | Test for pyrogens (rabbit method). | 4 | 3 | - |
| 10 | **Toxicity study** | Determination of acute oral toxicity (LD50) of a drug from a given data. | 4 | 4 | - |
| 11 | **Skin irritation** | Determination of acute skin irritation / corrosion of a test substance. | 4 | 4 | - |
| 12 | **Eye irritation** | Determination of acute eye irritation / corrosion of a test substance. | 4 | 4 | - |
| 13 | **Pharmacokinetic study** | Calculation of pharmacokinetic parameters from a given data. | 4 | 5 | - |
| 14 | **ANOVA test** | Biostatistics methods in experimental pharmacology (student's t test, ANOVA). | 4 | 5 | - |
| 15 | **Biostats** | Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test). | 4 | 5 | - |
| **e-Learning Source:** | | | | | |
| **Animal simulation Ex- Pharm** | | | | | |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | 3 | 3 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | - | 3 | 3 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 1 | - | 3 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | - | 3 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| Dr. Kuldeep Singh<br>Name & Sign of Program Coordinator | Sign & Seal of HOD |
|---|---|

| Course Code | BP609P | Title of the Course | HERBAL DRUG TECHNOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | III | Semester | VI | - | - | 4 | 2 | - |
| Course Objectives | 1. To understand raw material as a source of herbal drugs from cultivation to herbal drug product.<br>2. To know the WHO and ICH guidelines for evaluation of herbal drugs.<br>3. To know the herbal cosmetics, natural sweeteners. nutraceuticals.<br>4. To appreciate patenting of herbal drugs, GMP | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Develop the skill to check out the phytoconstituents by preliminary phytochemical screening of crude drugs. |
| CO2 | Develop the competency in determination of alcohol content of Asava and Arista. |
| CO3 | Develop the competency in determination of Aldehyde, Phenol and alkaloids content in herbal drug formulations. |
| CO4 | Develop the skill to prepare and standardization of extract in herbal formulations as per Pharmacopoeial requirements |
| CO5 | Develop the skill to prepare and standardized herbal extract in cosmetic formulations like creams, lotions and shampoos. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Morphology, histol ogy and powder, characteristics of crude drugs** | Morphology, histology and powder characteristics and extraction and detection of cinchona, cinnamon,senna, clove, ephedra, fennel and coriander. | 15 | 1 | - |
| 2 | **Isolation and detection of active principles** | To isolate caffeine from tea dust.<br>To isolate diosgenin from dioscorea.<br>To isolate atropine from belladonna.<br>To isolate sennosides from senna. | 12 | 1 | - |
| 3 | **Paper chromatography** | Separation of sugars by paper chromatography. | 3 | 5 | - |
| 4 | **TLC** | To determinr the Rf value of given sample. | 3 | 3 | - |
| 5 | **Distillation** | Distillation of volatile oils and detection of phytoconstituents by TLC. | 3 | 4 | - |
| 6 | **Chemical test** | To perform the chemical test of Asafoetida, Benzoin, Colophony, Aloes, Myrrh | 6 | 2 | - |
| **e-Learning Source:** | | | | | |
| https://www.hindawi.com/journals/tswj/2017/5873648/ | | | | | |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | 1 | 1 | 3 | 3 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | 1 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | 1 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | - | - | 1 | 1 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | - | - | 1 | 1 | 3 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP701T | Title of the Course | INSTRUMENTAL METHODS OF ANALYSIS (THEORY) | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | 3 | 1 | 0 | 4 | |
| Course Objectives | Upon completion of the course the student shall be able to<br>1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis.<br>2. Understand the chromatographic separation and analysis of drugs.<br>3. Perform quantitative & qualitative analysis of drugs using various analytical instruments. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | *Examine* the pharmaceutical substance by UV Visible spectroscopy and fluorimetry on the basis of its chemical structure and interactions with electromagnetic radiations. |
| CO2 | *Judge* the pharmaceutical substance by IR spectroscopy, flame photometry, atomic absorption spectroscopy and nepheloturbidometry using the knowledge of its chemical structure and interactions with electromagnetic radiations.. |
| CO3 | Based upon the chemical structure and physicochemical properties of the pharmaceutical substance: *Critique* the pharmaceutical substance by chromatography and electrophoresis. |
| CO4 | *Investigate* the pharmaceutical substance by gas chromatography and high performance liquid chromatography on the basis of its chemical structure and physicochemical properties. |
| CO5 | *Appraise* the pharmaceutical substance using ion exchange chromatography, gel chromatography and affinity chromatography on the basis of its chemical structure and physicochemical properties. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **UV Visible spectroscopy and Fluorimetry** | **UV Visible spectroscopy**: Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications -Spectrophotometric titrations, Single component and multicomponent analysis.<br>**Fluorimetry:** Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications. | 10 | 1 | 3.2 & 3.4 |
| 2 | **IR spectroscopy, Flame Photometry, Atomic absorption spectroscopy and Nephelo turbidometry** | **IR spectroscopy:** Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations. Instrumentation-Sources of radiation, wavelength selectors, detectors -Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications.<br>**Flame Photometry**: Principle, interferences, instrumentation and applications.<br>**Atomic absorption spectroscopy**: Principle, interferences, instrumentation and applications.<br>**Nepheloturbidometry:** Principle, instrumentation and applications. | 10 | 2 | 3.2 & 3.4 |
| 3 | **Adsorption and Partition column chromatography, Thin layer chromatography, Paper chromatography and Electrophoresis** | **Introduction to chromatography**<br>**Adsorption and partition column chromatography:** Methodology, advantages, disadvantages and applications.<br>**Thin layer chromatography**: Introduction, Principle, Methodology, $R_f$ values, advantages, disadvantages and applications.<br>**Paper chromatography:** Introduction, methodology, development techniques, advantages, disadvantages and applications.<br>**Electrophoresis:** Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications. | 10 | 3 | 3.2 & 3.4 |
| 4 | **Gas chromatography and High performance liquid chromatography** | **Gas chromatography:** Introduction, theory, instrumentation, Derivatization, temperature programming, advantages, Disadvantages and applications.<br>**High performance liquid chromatography** (HPLC): Introduction, theory, Instrumentation, Advantages and applications. | 8 | 4 | 3.2 & 3.4 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **Ion exchange chromatography, Gel chromatography and Affinity chromatography** | **Ion exchange chromatography-** Introduction, classification, Ion exchange resins, properties, Mechanism of ion exchange process, Factors affecting ion exchange, Methodology and applications.<br>**Gel chromatography-** Introduction, theory, Instrumentation and applications.<br>**Affinity chromatography-** Introduction, theory, Instrumentation and applications. | 7 | 5 | 3.2 & 3.4 |

| **Reference Books:** |
|---|
| Instrumental Methods of Chemical Analysis by B.K Sharma |
| Organic spectroscopy by Y.R Sharma |
| Text book of Pharmaceutical Analysis by Kenneth A. Connors |
| Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel |
| Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake |
| Organic Chemistry by I.L. Finar |
| Organic spectroscopy by William Kemp |
| Quantitative Analysis of Drugs by D. C. Garrett |
| Quantitative Analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi |
| Spectrophotometric identification of Organic Compounds by Silverstein |
| **e-Learning Source:** |
| https://www.classcentral.com/course/swayam-spectroscopic-techniques-for-pharmaceutical-and-biopharmaceutical-industries-14301 |
| https://www.sciencedirect.com/science/article/pii/S1878535213001056 |
| https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6258797/ |
| https://www.google.co.in/books/edition/Pharmaceutical_Analysis/Ub8wod1CJ50C?hl=en&gbpv=1&dq=pharmaceutical+analysis+spectral+chromatography&printsec=frontcover |
| https://www.google.co.in/books/edition/Pharmaceutical_Analysis_E_Book/YExgDAAAQBAJ?hl=en&gbpv=1&dq=pharmaceutical+analysis+spectral +chromatography&printsec=frontcover |

| | **Course Articulation Matrix: (Mapping of Cos with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 1 | 3 | - | - | - | - | 1 | - | 2 | 3 | 1 | 2 |
| **CO2** | 3 | 1 | 1 | 3 | - | - | - | - | 1 | - | 2 | 3 | 1 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | - | - | - | - | 1 | - | 2 | 3 | 1 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | - | - | - | - | 1 | - | 2 | 3 | 1 | 2 |
| **CO5** | 3 | 2 | 2 | 3 | - | - | - | - | 1 | - | 2 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP702T | Title of the Course | INDUSTRIAL PHARMACY II | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know the process of pilot plant and scale up of pharmaceutical dosage forms<br>2. Understand the process of technology transfer from lab scale to commercial batch<br>3. Know different Laws and Acts that regulate pharmaceutical industry<br>4. Understand the approval process and regulatory requirements for drug products | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Reframe pilot plant scale-up processes for pharmaceutical products, ensuring compliance with regulatory guidelines and effective documentation practices. |
| CO2 | Recommend the technology transfer processes in the pharmaceutical industry; including quality risk management, documentation, regulatory compliance, and commercialization, with a specific focus on WHO guidelines. |
| CO3 | Based on understanding of regulatory requirements for drug approval: Grade their preparation and submission of key documents such as IND and NDA applications, and manage clinical studies in compliance with FDA guidelines. |
| CO4 | Appraise the Total Quality Management, Quality by Design, Six Sigma, and compliance with ISO 9000 and ISO 14000 standards on the basis of knowledge of quality management systems in the pharmaceutical industry. |
| CO5 | Based on understanding of regulatory requirements, Conclude the approval procedures for new drugs in India and the roles and responsibilities of CDSCO and state licensing authorities. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Pilot plant scale up techniques** | Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology | 10 | 1 | 9.1<br>9.2<br>9.5<br>9.b |
| 2 | **Terminology, Technology transfer protocol, Quality risk management** | **Technology development and transfer**: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues | 10 | 2 | 9.b<br>9.5<br>9.1 |
| 3 | **Regulatory affairs** | Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals Regulatory **Requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies. | 10 | 3 | 9.5<br>9.b<br>9.2 |
| 4 | **Quality management systems** | **Quality management systems**: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP | 8 | 4 | 9.1<br>9.5<br>9.b |
| 5 | **Indian Regulatory Requirements** | **Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs | 7 | 5 | 9.1<br>9.2<br>9.5<br>9.b |

| Reference Books: |
|---|
| Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs |
| Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition. |
| Regulatory Affairs brought by learning plus, inc. a |
| **e-Learning Source:** |
| http://www.iraup.com/about.php |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | - | 2 | 3 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | - | 1 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | - | 2 | - | 3 | 3 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | - | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | - | 1 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP703T | Title of the Course | PHARMACY PRACTICE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | 3 | 1 | - | 4 | |
| Course Objectives | 1. To know various drug distribution methods in a hospital, pharmacy stores and inventory control management<br>2. To monitor drug therapy of patient through medication chart review and clinical review, obtain medication history interview and counsel the patients, identify drug related problems and adverse drug reactions<br>3. To know pharmaceutical care services, patient counseling in community pharmacy<br>4. Appreciate the concept of rational drug therapy.To interpret selected laboratory results of specific disease state | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Design the organizational structures and functions of hospitals, hospital pharmacies, and community pharmacies, as well as classify and manage adverse drug reactions effectively. |
| CO2 | Develop hospital and community pharmacy operations, including drug distribution systems, formularies, therapeutic drug monitoring, medication adherence strategies, patient medication history interviews, and management practices, ensuring optimal patient care and compliance with healthcare standards. |
| CO3 | Investigate pharmacy and therapeutic committee activities, drug information services, patient counseling techniques, education and training programs, and prescribed medication order communication skills to enhance patient care and healthcare delivery in a hospital setting. |
| CO4 | Implement budget plans, provide clinical pharmacy services, and manage over-the-counter (OTC) sales to optimize financial management, patient care, and pharmaceutical services. |
| CO5 | Develop effective strategies for drug store management and inventory control, conduct research on investigational drug use, and analyze interpretations of clinical laboratory tests to optimize pharmaceutical operations and improve patient care. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Hospital and it's organization, Hospital pharmacy and its organization, Hospital pharmacy and its organization, Adverse drug reaction, Community Pharmacy** | Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.<br>Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.<br>Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting, drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management<br>Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store. | 10 | 1 | - |
| 2 | **Drug distribution system in a hospital, Hospital formulary Therapeutic drug monitoring, Medication adherence, Patient medication history interview, Community pharmacy management** | Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs<br>Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.<br>Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. Need for the patient medication history interview, medication interview forms. Financial, materials, staff, and infrastructure requirements | 10 | 2 | - |
| 3 | **Pharmacy and therapeutic committee, Drug information services,** | Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. | 10 | 3 | - |

| | | | | | |
|---|---|---|---|---|---|
| | **Patient counseling, Education and training program in the hospital Prescribed medication order and communication skills** | Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist. Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients | | | |
| 4 | **Budget preparation and implementation, Clinical Pharmacy, Over the counter (OTC) sales** | Budget preparation and implementation, Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. Introduction and sale of over the counter, and Rational use of common over the counter medications. | 10 | 4 | - |
| 5 | **Drug store management and inventory control, Investigational use of drugs, Interpretation of Clinical Laboratory Tests** | Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure. Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. Blood chemistry, hematology, and urinalysis | 10 | 5 | - |

**Reference Books:**

Principles of Clinical Research edited by Giovanna di Ignazio Di Giovanna and Haynes.

Clinical Data Management edited by R K Rondels S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications

Goodman & Gilman: JG Hardman, LE Limbard, 10th Edn. McGraw Hill Publications, 2001.

**e-Learning Source:**

https://ilizone.iul.ac.in/course/modedit.php?update=193274&return=0&sr=0

**Course Articulation Matrix:(Mapping of Cos with POs and PSOs)**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 3 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP704T | Title of the Course | NOVEL DRUG DELIVERY SYSTEM | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Upon completion of the course student shall be able to understand various approaches for development of novel drug delivery systems.<br>2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Explain the criteria for selecting drugs and polymers for novel drug delivery systems, and describe various approaches for their development, Formulation, and evaluation. |
| CO2 | Identify approaches, technologies, and drug carriers used to improve the selectivity, effectiveness, and/or safety of drug administration. |
| CO3 | Examine the benefits and limitations of Transdermal, Gastro-retentive, and Naso-pulmonary drug delivery systems. |
| CO4 | Evaluate the effectiveness of different Targeted Drug Delivery systems including liposomes, niosomes, nanoparticles, and monoclonal antibodies. |
| CO5 | Describe the different types of Ocular Drug Delivery Systems and Intrauterine Drug Delivery Systems including intra uterine devices (IUDs). |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Controlled drug delivery systems, Polymer** | Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations<br>Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems. | 10 | 1 | 9.5<br>9.b |
| 2 | **Microencapsulatio n, Mucosal Drug Delivery system, Implantable Drug Delivery Systems** | Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications<br>Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems<br>Introduction, advantages and disadvantages, concept of implants and osmotic pump | 10 | 2 | 9.1<br>9.5 |
| 3 | **Transdermal Drug Delivery Systems, Gastroretentive drug delivery systems, Nasopulmonary drug delivery system** | Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications.<br>Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers | 10 | 3 | 9.5<br>9.b |
| 4 | **Targeted drug Delivery** | Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications | 8 | 4 | 9.1<br>9.5 |
| 5 | **Ocular Drug Delivery Systems, Intrauterine Drug Delivery Systems** | Introduction, intra ocular barriers and methods to overcome– Preliminary study, ocular formulations and ocuserts<br>Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications | 7 | 5 | 9.1<br>9.5<br>9.b |

**Reference Books:**

Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/ Weinheim

| |
|---|
| N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001). |
| S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002 |
| **Journals:** |
| Indian Journal of Pharmaceutical Sciences (IPA) |
| Indian Drugs (IDMA) |
| Journal of Controlled Release (Elsevier Sciences) |
| Drug Development and Industrial Pharmacy (Marcel & Decker) |
| International Journal of Pharmaceutics (Elsevier Sciences) |
| **e-Learning Source:** |
| https://www.google.co.in/books/edition/Novel_Drug_Delivery_Technologies/TgDQDwAAQBAJ?hl=en&gbpv=1&dq=NOVEL+DRUG+DELIVERY+SYSTEM&printsec=frontcover |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | - | 3 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | - | 3 | 3 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP705P | Title of the Course | INSTRUMENTAL METHODS OF ANALYSIS (PRACTICAL) | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | 0 | 0 | 4 | 2 | |
| Course Objectives | Upon completion of the course the student shall be able to<br>1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis.<br>2. Understand the chromatographic separation and analysis of drugs.<br>3. Perform quantitative & qualitative analysis of drugs using various analytical instruments. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | *Execute* the analysis of the pharmaceutical substance through UV Visible spectroscopy by using the knowledge of its chemical structure and interactions with UV Visible radiations. |
| CO2 | *Operate* the fluorimetry for the analysis of the pharmaceutical substance by using the knowledge of its chemical structure and interactions with electromagnetic radiations. |
| CO3 | *Test* the pharmaceutical substance through flame photometry and nepheloturbidometry by using the knowledge of its chemical structure and interactions with electromagnetic radiations. |
| CO4 | *Implement* the chromatographic separation of the pharmaceutical substance on the basis of its chemical structure and physicochemical properties. |
| CO5 | *Demonstrate* the advanced chromatographic technique for the pharmaceutical substance on the basis of its chemical structure and physicochemical properties. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **UV Visible spectroscopy** | Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds | 4 | 1 | 3.2, 3.4 |
| 2 | **UV Visible spectroscopy** | Estimation of dextrose by Colorimetry | 4 | 1 | 3.2, 3.4 |
| 3 | **UV Visible spectroscopy** | Estimation of sulfanilamide by Colorimetry | 4 | 1 | 3.2, 3.4 |
| 4 | **UV Visible spectroscopy** | Simultaneous estimation of Ibuprofen and Paracetamol by UV spectroscopy | 4 | 1 | 3.2, 3.4 |
| 5 | **UV Visible spectroscopy** | Assay of Paracetamol by UV Spectrophotometry | 4 | 1 | 3.2, 3.4 |
| 6 | **Fluorimetry** | Estimation of Quinine sulfate by fluorimetry | 4 | 2 | 3.2, 3.4 |
| 7 | **Fluorimetry** | Study of quenching of fluorescence | 4 | 2 | 3.2, 3.4 |
| 8 | **IR spectroscopy** | Determination of sodium by flame photometry | 4 | 3 | 3.2, 3.4 |
| 9 | **Flame Photometry** | Determination of potassium by flame photometry | 4 | 3 | 3.2, 3.4 |
| 10 | **Nepheloturbidometry** | Determination of chlorides and sulphates by nephelo turbidometry | 4 | 3 | 3.2, 3.4 |
| 11 | **Chromatography** | Separation of amino acids by paper chromatography | 4 | 4 | 3.2, 3.4 |
| 12 | **Chromatography** | Separation of sugars by thin layer chromatography | 4 | 4 | 3.2, 3.4 |
| 13 | **Chromatography** | Separation of plant pigments by column chromatography | 4 | 4 | 3.2, 3.4 |
| 14 | **High performance liquid chromatography** | Demonstration experiment on HPLC | 4 | 5 | 3.2, 3.4 |
| 15 | **Gas chromatography** | Demonstration experiment on Gas Chromatography | 4 | 5 | 3.2, 3.4 |

**Reference Books:**

Instrumental Methods of Chemical Analysis by B.K Sharma
Organic spectroscopy by Y.R Sharma
Text book of Pharmaceutical Analysis by Kenneth A. Connors
Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
Organic Chemistry by I.L. Finar
Organic spectroscopy by William Kemp
Quantitative Analysis of Drugs by D. C. Garrett
Quantitative Analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi
Spectrophotometric identification of Organic Compounds by Silverstein

**e-Learning Source:**

Instrumental method of analysis: https://www.youtube.com/watch?v=BSlG2oASWNQ

| |
|---|
| Fluorimetry: https://www.youtube.com/watch?v=9MQPp0ewI8g |
| Assay of paracetamol by UV Spectrophotometry: https://www.youtube.com/watch?v=IybO3cbsFC0 |
| High performance liquid chromatography (HPLC): https://www.youtube.com/watch?v=Y7-CuEGfnyI |
| Gas chromatography: https://www.youtube.com/watch?v=ZpPzImDSfqc |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 1 | - | 2 | 3 | 1 | 2 |
| CO2 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 1 | - | 2 | 3 | 1 | 2 |
| CO3 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 1 | - | 2 | 3 | 1 | 2 |
| CO4 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 1 | - | 2 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 1 | 3 | - | 1 | 1 | - | 1 | - | 2 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP706PS | Title of the Course | PRACTICE SCHOOL | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VII | - | - | 12 | 6 | - |
| Course Objectives | 1. Introduction of pharmacy practice.<br>2. Pharmacy practice will help in understanding practical aspects of the different field.<br>3. It will also help to accomplish future endeavours as well as employability. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the advanced instruments used and their applications in drug analysis. |
| CO2 | Understand the concepts and applications of alternative medicine. |
| CO3 | Learn to execute and utilize softwares of pharmaceutical importance. |
| CO4 | Understand the calibration of various analytical instruments. |
| CO5 | Know analysis of drugs using various analytical instruments. |

| Experiment No. | Title of the Experiment | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | Formulation development | Current status of Pharmacovigilance in India. | 5 | 3 | - |
| 2 | Quality control | Role of Pharmacist in community pharmacy and health services. | 5 | 4 | - |
| 3 | Quality control | Quality control of Solid dosage form. | 5 | 5 | - |
| 4 | Quality control | Quality control of Liquid dosage form. | 5 | 5 | - |
| 5 | Quality control | Quality control of Parenteral preparations. | 5 | 5 | - |
| 6 | Nutraceuticals | Herbs as Neutraceuticals and their clinical use. | 5 | 1 | - |
| 7 | Formulation development | Medication error and its management. | 5 | 1 | - |
| 8 | Drug design and process chemistry | Drug interaction clinical significance. | 5 | 3 | - |
| 9 | Drug design and process chemistry | Supply chain management in Drug distribution | 5 | 2 | - |
| 10 | Alternative medicine | Alternative medicine in homeopathy. | 5 | 2 | - |
| 11 | Alternative medicine | Alternative medicine in Unani. | 5 | 2 | - |
| 12 | Quality control | Quality control test for containers, rubbers, closures and packaging materials. | 5 | 5 | - |
| 13 | Phytomedicine | Herbal product development and current trends in formulation of herbal pharmaceuticals and newer herbal drug delivery system. | 5 | 1 | - |
| 14 | Formulation development | Current status of Pharmacovigilance in India. | 5 | 3 | - |
| 15 | Quality control | Role of Pharmacist in community pharmacy and health services. | 5 | 4 | - |

| e-Learning Source: |
|---|
| https://www.bing.com/search?q=Pharmacognosy+by+Trease+and+Evans. |
| https://www.bing.com/search?q=Current+Concepts+in+Drug+Design+by+T.+Durai+and+Ananda+Kumar. |
| https://www.bing.com/search?q=Mukherjee%2C+P.W.+Quality+Control+of+Herbal+Drugs |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 1 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 2 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 3 | 1 | 3 | 2 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP801T | Title of the Course | BIOSTATISTICS & RESEARCH METHODOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | To know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment), various statistical techniques to solve statistical problems. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Describe the applications of biostatics and measure of central tendency, dispersion and correlation. |
| CO2 | Understand the regression analysis, probability theory and parametric tests. |
| CO3 | Apprehend the designing of methodology for research, observational and experimental studies. |
| CO4 | Know the concept of blocking, confounding and regression analysis and use of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of experiment). |
| CO5 | Choose the appropriate design and analysis of experiments such as factorial design and response surface methodology. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction, Measures of central tendency, Correlation** | **Introduction:** Statistics, Biostatistics, Frequency distribution<br>**Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems<br>**Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples | 10 | 1 | - |
| 2 | **Regression, robability, Parametric test** | **Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples Probability:Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems<br>Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples<br>Parametric test: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference | 10 | 2 | - |
| 3 | **Non Parametric tests, Introduction to Research** | **Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test<br>Introduction to Research: Need for research, Need for designof Experiments, Experiential Design Technique, plagiarism<br>Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter **Plot graph Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases. | 10 | 3 | - |
| 4 | **Introduction to Practical Components of Industrial and Clinical Trials Problems** | Blocking and confounding system for Two-level factorials<br>**Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels<br>Introduction to Practical components of Industrial and Clinical Trials<br>**Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach | 8 | 4 | - |
| 5 | **Design and Analysis of experiments:** | Design and Analysis of experiments:<br>**Factorial Design:** Definition, 22, 23design. Advantage of factorial design<br>**Response Surface methodology**: Central composite design, Historical design, Optimization Techniques | 7 | 5 | - |

**Reference Books:**

Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

| |
|---|
| Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork. |
| Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha |
| Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam, |
| **e-Learning Source:** |
| https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5122272/ |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | - | 1 | 2 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 3 | - | - | 2 | 1 | 1 | - | 1 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | - | - | 1 | 2 | 1 | - | 1 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | - | 1 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | - | 1 | 2 | 1 | 2 |



**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP802T | Title of the Course | SOCIAL & PREVENTIVE PHARMACY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.<br>2. Have a critical way of thinking based on current healthcare development.<br>3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Test the concept of health and disease on the basis of health education employing personal hygiene and health care. |
| CO2 | Evaluate the prevention and control of disease based on knowledge of preventive medicine. |
| CO3 | Grade the objectives of national health programs for control of diseases on the basis of various promotional health programme sc |
| CO4 | Appraise the national health intervention programme and role of WHO based on knowledge for control and prevention of diseases |
| CO5 | Analyse the concept of community health services on the basis of rural and urban community health mission |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Concept of health and disease** | Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health Hygiene and health: personal hygiene and health care; avoidable habits | 10 | 1 | - |
| 2 | **Preventive medicine** | General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse | 10 | 2 | - |
| 3 | **National health programs** | 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. | 10 | 3 | - |
| 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 | 8 | 4 | - |
| 5 | **Community services** | 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. | 7 | 5 | - |

**Reference Books:**

Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications

Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications

Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications

Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS

**e-Learning Source:**

https://drive.google.com/drive/folders/1zqR5sZiU4qngXrPCwXriQEDQHAv7Vy7u?usp=sharing

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | - | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | - | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 1 | 3 | 2 | - | 1 | 2 | 1 | - | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 1 | 3 | 2 | - | 2 | 2 | - | 1 | 3 | 3 | 3 | 3 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP803ET | Title of the Course | PHARMA MARKETING MANAGEMENT | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Design the organizational structures and functions of hospitals, hospital pharmacies, and community pharmacies, as well as classify and manage adverse drug reactions effectively. |
| CO2 | Analyze the pharmaceutical marketing and market research on the basis of product and consumer profile. |
| CO3 | Apply product management in pharmaceutical marketing based on product positioning of new and existing pharmaceutical products. |
| CO4 | Execute different promotional technique for OTC products employing various platforms for product promotion |
| CO5 | Examine pharmaceutical marketing channels for sales management based upon physical distribution and professional sales representative. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Marketing, Consumer profile, Role of market research** | Marketing: Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. Pharmaceutical market: Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research. | 10 | 2 | - |
| 2 | **Classification, product line and product mix decisions** | Classification, product line and product mix decisions, product life cycle,product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry. | 10 | 2 | - |
| 3 | **Promotion, OTC Products** | Promotion: Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products. | 10 | 3 | - |
| 4 | **Pharmaceutical marketing channels** | Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physicaldistribution management Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR. | 8 | 4 | - |
| 5 | **Pricing: Meaning, importance, objectives** | Pricing: Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order)and NPPA (National Pharmaceutical Pricing Authority). Emerging concepts in marketing: Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing | 7 | 5 | - |

**Reference Books:**

Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi

Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.

Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill

Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India

**e-Learning Source:**

https://drive.google.com/drive/folders/2grK0el2fn1vo9g-jgXZKbfDlduySXPT3?usp=sharing

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 1 | - | 1 | 3 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | - | 1 | 3 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 1 | - | 1 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | - | 1 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | - | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

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|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP804ET | Title of the Course | PHARMACEUTI CAL REGULATORY SCIENCE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know about the process of drug discovery and development<br>2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals<br>3. Know the regulatory approval process and their registration in Indian and international markets | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the concepts of innovator and generic drugs, drug development process. |
| CO2 | Know the regulatory guidance's and guidelines for filing and approval process, preparation of dossiers and their submission to regulatory agencies in different countries. |
| CO3 | Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals and the submission of global documents in CTD/ eCTD, ASEAN formats. |
| CO4 | Understand the clinical trials requirements for approvals for conducting clinical trials, pharmacovigilance and process of monitoring in clinical trials. |
| CO5 | Knowledge of basic terminology, regulatory guidance's, guidelines, laws and acts. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **New Drug Discovery and development** | Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development. | 10 | 1 | 16.5<br>16.10<br>16.b |
| 2 | **Regulatory Approval Process Regulatory authorities and agencies** | Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA. Overview of regulatory authorities of India, United States, European Union, Australia,Japan, Canada (Organization structure and types of applications) | 10 | 2 | 16.1<br>16.5<br>16.b |
| 3 | **Registration of Indian drug product in overseas market** | Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research | 10 | 3 | 16.3<br>16.b<br>16.10 |
| 4 | **Clinical trials** | Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials. | 8 | 4 | 16.1<br>16.3<br>16.7<br>16.b |
| 5 | **Regulatory Concepts** | Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book | 7 | 5 | 16.10<br>16.b |

**Reference Books:**

Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.

The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Healthcare Publishers

New Drug Approval Process: Accelerating Global Registrations By Richard AGuarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190

Guidebook for drug regulatory submissions / SandyWeinberg. By John Wiley & Sons. Inc.

FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.

Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143

Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams

Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene

Drugs: From Discovery to Approval, Second Edition By Rick Ng

**e-Learning Source:**

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP805ET | Title of the Course | PHARMACOVIGILANCE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. The student would appreciate the knowledge on pharmacovigilance.They would have studied the principles of Pharmacovigilance.<br>2. They would get a better understanding of the regulatory requirements for conducting clinical trials..<br>3. They would have understood the types of ADR and clinical trial analysis.<br>4. They would have studied the responsibilities of key points involved in clinical trials.<br>5. They would have an understanding on the safety monitoring and reporting. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the concept of pharmacovigilance with the reference to WHO international drug monitoring programme, Pharmacovigilance Program of India (PvPI), Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment, Management of adverse drug reactions. |
| CO2 | Discuss the classification of drug and disease with respect to WHO adverse reaction. |
| CO3 | Appraise the Vaccine safety and its surveillance by basic understanding of adverse effects related to immunization. |
| CO4 | Describe the Pre-clinical phase, Clinical phase,Post approval phase on the basis of ICH Guidelines for effective generation in safety data. |
| CO5 | Judge the genetics related ADR on the basis of Indian and global pharmacovigilance requirements with focus on pharmacokinetic parameters. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Pharmacovigilance, Introduction to adverse drug reactions, Basic terminologies used in pharmacovigilance** | History and development of Pharmacovigilance, Importance of safety monitoring of Medicine, WHO international drug monitoring programme, Pharmacovigilance Program of India(PvPI), Definitions and classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment, Management of adverse drug reactions, Terminologies of adverse medication related events, Regulatory terminologies | 10 | 1 | 3.8, 3.b |
| 2 | **Drug and disease classification, Drug dictionaries and Coding in pharmacovigilance, Information Resources in Pharmacovigilance, Establishing pharmacovigilance programme** | Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, Daily defined dose, International Non proprietary Names for drugs, WHO adverse reaction terminologies, MedDRA and Standardised MedDRA queries, WHO drug dictionary, Eudravigilance medicinal product dictionary, Basic drug information resources, Specialised resources for ADRs, Establishing in a hospital Establishment & operation of drug safety department in industry, Contract Research Organisations (CROs), Establishing a national programme | 10 | 2 | 3.8, 3.b |
| 3 | **Vaccine safety surveillance, Pharmacovigilance methods, Communication in pharmacovigilance** | Vaccine Pharmacovigilance, Vaccination failure, Adverse events following immunization, Passive surveillance – Spontaneous reports and case series, Stimulated reporting, Active surveillance – Sentinel sites, drug event monitoring and registries, Comparative observational studies – Cross sectional study, case control study and cohort study, Targeted clinical investigations, Effective communication in Pharmacovigilance, Communication in Drug Safety Crisis management, Communicating with Regulatory Agencies, Business Partners, Healthcare facilities &Media | 10 | 3 | 3.8, 3.b |
| 4 | **Safety data generation, ICH Guidelines for Pharmacovigilance** | Pre clinical phase, Clinical phase,Post approval phase (PMS), Organization and objectives of ICH, Expedited reporting, Individual case safety reports, Periodic safety update reports,Post approval expedited reporting, Pharmacovigilance planning, Good clinical practice in pharmacovigilance studies | 8 | 4 | 3.8, 3.b |
| 5 | **Pharmacogenomics of adverse drug reactions, Drug safety evaluation in special population, CIOMS, CDSCO (India) and Pharmacovigilance** | Genetics related ADR with example focusing PK parameters. Paediatrics, Pregnancy and lactation, Geriatrics, CIOMS Working Groups, CIOMS Form, D&C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements | 7 | 5 | 3.8, 3.b |

**Reference Books:**

Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.

Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.

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| Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers. |
| Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle,Wiley Publishers. |
| An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers. |
| Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers. |
| Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers |
| A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G Parthasarathi, Karin NyfortHansen,Milap C. Nahata |
| National Formulary of India |
| Text Book of Medicine by Yashpal Munjal |
| Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna |
| **e-Learning Source:** |
| http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=729 |
| http://www.ich.org/ |
| http://www.cioms.ch/ |
| http://cdsco.nic.in/ |
| http://www.who.int/vaccine_safety/en/ |
| http://www.ipc.gov.in/PvPI/pv_home.html |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | - | 1 | 1 | 1 | 3 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | - | 1 | 1 | 1 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | - | 1 | 1 | 1 | 3 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | - | 1 | 1 | 1 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | - | 1 | 1 | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP806ET | Title of the Course | QUALITY CONTROL AND STANDARDIZATION OF HERBALS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Know WHO guidelines for quality control of herbal drugs<br>2. Know Quality assurance in herbal drug industry<br>3. Know the regulatory approval process and their registration in Indian and international markets<br>4. Appreciate EU and ICH guidelines for quality control of herbal drugs | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Gain knowledge on biological source, active constituents and uses of crude drugs, Understand the techniques of evaluation of crude drugs as per the WHO guidelines |
| CO2 | Understand the basic principles of cultivation, collection and storage of crude drugs, Application of the crop improvement concepts involved in techniques for improvement of quality of medicinal plants |
| CO3 | Exploring the tissue culture technique in medicinal plants |
| CO4 | Appreciate the applications of Primary &Secondary metabolites of the plant and explore its medicinal importance based on its chemical class Understand the principles and application of different system of alternative medicine |
| CO5 | Explore novel medicinal agents from different sources of natural origin |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Basic tests for drugs** | Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms<br>WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use | 10 | 1 | - |
| 2 | **Basic tests for drugs** | Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.<br>WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants | 10 | 2 | - |
| 3 | **ICH guidelines** | EU and ICH guidelines for quality control of herbal drugs.<br>Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines | 10 | 3 | - |
| 4 | **Stability testing of herbal medicines** | Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.<br>Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions | 8 | 4 | - |
| 5 | **Pharmacovigilance systems** | Regulatory requirements for herbal medicines.<br>WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias.<br>Role of chemical and biological markers in standardization of herbal products | 7 | 5 | - |

**Reference Books:**


Pharmacognosy by Trease and Evans

Pharmacognosy by Kokate, Purohit and Gokhale

Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006

Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002

EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products

Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002

Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.

WHO. Quality Control Methods for Medicinal Plant Materials,World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.

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| WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981. |
| WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999. |
| WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005 |
| WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004. |
| **e-Learning Source:** |
| https://chem.libretexts.org/Bookshelves/Organic_Chemistry |
| https://www.masterorganicchemistry.com/ |
| https://www.google.co.in/books/edition/Advanced_Practical_Organic_Chemistry_Thi/pv9D2hinogC?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |
| https://www.google.co.in/books/edition/Intermediate_Organic_Chemistry/2YdxBgAAQBAJ?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |


| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 2 | 1 | 1 | 1 | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO2 | 3 | 1 | 2 | 2 | - | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 1 | 2 | 2 | - | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO4 | 2 | 1 | 3 | 2 | 1 | - | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 1 | 2 | 1 | - | 1 | - | 1 | 1 | 2 | 2 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP807ET | Title of the Course | COMPUTER AIDED DRUG DESIGN | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Design and discovery of lead molecules<br>2.The role of drug design in drug discovery process<br>3.The concept of QSAR and docking<br>4.Various strategies to develop new drug like molecules.<br>5.The design of new drug molecules using molecular modeling software | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Analyze the concept of health and disease on the basis of health education employing personal hygiene and health care. |
| CO2 | Analyse prevention and control of disease based on knowledge of preventive medicine. |
| CO3 | Discuss objectives of national health programs for control of diseases on the basis of various promotional health programme schemes. |
| CO4 | Discuss national health intervention programme and role of WHO based on knowledge for control and prevention of diseases. |
| CO5 | Analyse the concept of community health services on the basis of rural and urban community health mission. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to Drug Discovery and Development<br>Lead discovery and Analog Based Drug Design<br>Analog Based Drug Design** | Stages of drug discovery and development.<br>Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.<br>Bioisosterism, Classification, Bioisosteric replacement. Any three case studies | 10 | 1 | 4.3,4.4,4.5, 4.6,4.7,4.c, 9.2,9.4,9.5, 9.b |
| 2 | **Quantitative Structure Activity Relationship (QSAR)** | SAR versus QSAR, History and development of QSAR, Types of hysic chemical parameters, experimental and theoretical approaches for the determination of hysic chemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA. | 10 | 2 | 4.3,4.4,4.5, 4.6,4.7, 4.c, 9.2,9.4, 9.5, 9.b |
| 3 | **Molecular Modeling and virtual screening techniques** | **Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,<br>**Molecular docking**: Rigid docking, flexible docking, manual docking,Docking based screening. De novo drug design | 10 | 3 | 4.3,4.4,4.5, 4.6,4.7, 4.c, 9.2,9.4, 9.5, 9.b |
| 4 | **Informatics & Methods in drug design** | Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases. | 8 | 4 | 4.3,4.4,4.5, 4.6,4.7, 4.c, 9.2,9.4, 9.5, 9.b |
| 5 | **Molecular Modeling:** | Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination. | 7 | 5 | 4.3,4.4,4.5, 4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b |

**Reference Books:**

Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore
Martin YC. "Quantitative Drug Design" Dekker, New York.
Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
Koro Ikovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" JohnWiley& Sons, New York.
Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston
Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

**e-Learning Source:**

https://chem.libretexts.org/Bookshelves/Organic_Chemistry
https://www.masterorganicchemistry.com/
https://www.google.co.in/books/edition/Advanced_Practical_Organic_Chemistry_Thi/lpv9D2hin6gC?hl=en&gbpv=1&dq=organic+chemistry&

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| printsec=frontcover |
| https://www.google.co.in/books/edition/Intermediate_Organic_Chemistry/2YdxBgAAQBAJ?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP808ET | Title of the Course | CELL & MOLECULAR BIOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Summarize cell and molecular biology history.<br>2. Summarize cellular functioning and composition.<br>3. Describe the chemical foundations of cell biology.<br>4. Summarize the DNA properties of cell biology.<br>5. Describe protein structure and function<br>6. Describe cellular membrane structure and function<br>7. Describe basic molecular genetic mechanisms.<br>8. Summarize the Cell Cycle | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understanding the history of cell and molecular biology, cellular functioning and composition and chemical foundations of cell biology. |
| CO2 | Understanding about DNA and RNA and their functioning. |
| CO3 | Students able to Describe protein structure and function, Protein Synthesis |
| CO4 | Know the basic molecular genetic mechanisms. |
| CO5 | Summarize the Cell Cycle including Cell Signals, Receptors for Cell Signals, Signaling Pathways |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Cell and Molecular Biology** | a) Cell and Molecular Biology: Definitions theory and basics and Applications.<br>b) Cell and Molecular Biology: History and Summation.<br>c) Properties of cells and cell membrane.<br>d) Prokaryotic versus Eukaryotic<br>e) Cellular Reproduction<br>f) Chemical Foundations – an Introduction and Reactions (Types) | 10 | 1 | - |
| 2 | **DNA and RNA** | a) DNA and the Flow of Molecular Information<br>b) DNA Functioning<br>c) DNA and RNA<br>d) Types of RNA<br>e) Transcription and Translation | 10 | 2 | - |
| 3 | **Proteins** | a) Proteins: Defined and Amino Acids<br>b) Protein Structure<br>c) Regularities in Protein Pathways<br>d) Cellular Processes<br>e) Positive Control and significance of Protein Synthesis | 10 | 3 | - |
| 4 | **Genetics** | a) Science of Genetics<br>b) Transgenics and Genomic Analysis<br>c) Cell Cycle analysis<br>d) Mitosis and Meiosis<br>e) Cellular Activities and Checkpoints | 8 | 4 | - |
| 5 | **Cell Signals** | a) Cell Signals: Introduction<br>b) Receptors for Cell Signals<br>c) Signaling Pathways: Overview<br>d) Misregulation of Signaling Pathways<br>e) Protein-Kinases: Functioning | 7 | 5 | - |

**Reference Books:**

W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.

Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers &Distributors, Delhi.

Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.

Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology

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|---|
| Rose: Industrial Microbiology |
| Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan |
| Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution |
| Peppler: Microbial Technology. |
| Edward: Fundamentals of Microbiology. |
| N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi |
| Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company |
| B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C. |
| RA Goldshy et. al., : Kuby Immunology. |
| **e-Learning Source:** |
| https://chem.libretexts.org/Bookshelves/Organic_Chemistry |
| https://www.masterorganicchemistry.com |
| https://www.google.co.in/books/edition/Advanced_Practical_Organic_Chemistry_Thi/lpv9D2hm6gC?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |
| https://www.google.co.in/books/edition/Intermediate_Organic_Chemistry/2YdxBgAAQBAJ?hl=en&gbpv=1&dq=organic+chemistry&printsec=frontcover |


| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 3 |
| CO4 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 3 |
| CO5 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP809ET | Title of the Course | COSMETIC SCIENCE | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1.Key ingredients used in cosmetics and cosmeceuticals<br>2.Key building blocks of cosmetics for various formulations<br>3.Scientific principles to develop cosmetics and cosmeceuticals with desired safety | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Gain information on key ingredients used in cosmetics and cosmeceuticals |
| CO2 | Understand key building blocks of cosmetics for various formulations |
| CO3 | Know the current technologies in the market |
| CO4 | Understand the scientific principles to develop cosmetics and cosmeceuticals with desired safety |
| CO5 | Know the various problems induced due to cosmetics |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Classification, definition, cosmetic, excipients.** | Classification of cosmetic and cosmeceutical products.<br>Definition of cosmetics as per Indian and EU regulations, evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs.<br>**Cosmetic excipient:** Surfactant, rheology modifiers, humectant, emollients, preservatives, classification and application.<br>Skin: Basic structure and function of skin.<br>Hair: Basic structure of hair. Hair growth cycle.<br>**Oral Cavity:** Common problem associated with teeth and gums. | 10 | 1 | 9.1<br>9.5 |
| 2 | **Principles of formulation and building blocks of skin care products.** | **Principles of formulation and building blocks of skin care products:**<br>Face wash, moisturizing cream, cold cream, vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.<br>Antiperspirants & deodorants: Actives & mechanism of action.<br>**Principle of formulation and building block of hair care products:**<br>Conditioning shampoo, hair conditioner, antidandruff shampoo, hair oils.<br>Chemistry and formulation of paraphenylenediamine based hair dye.<br>Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth, teeth whitening, mouthwash. | 10 | 2 | 9.1<br>9.5<br>9.b |
| 3 | **Classification of sunscreens and SPF. Role of herbs in cosmetics.<br>Analytical cosmetics.** | Sun protection, classification of sunscreens and SPF. **Role of herbs in cosmetics:**<br>**Skin Care:** Aloe and turmeric Hair care: Henna and amla<br>**Oral care**: Neem and clove<br>Analytical cosmetics: BIS specification and analytical methods for shampoo, skin cream and toothpaste. | 10 | 3 | 9.1<br>9.5 |
| 4 | **Principle of cosmetic evaluation** | **Principle of cosmetic evaluation**: Principle of sebumeter, corneometer.<br>Measurement of TEWL, skin color, hair tensile strength, hair combing properties, soaps, and syndet bars. Evaluation and skin benefits. | 8 | 4 | 9.1<br>9.5 |
| 5 | **Cosmetic problems associated with hair, scalp and skin.<br>Antiperspirants and deodorants.** | Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms comedogenic, dermatitis.<br>Cosmetic problems associated with hair and scalp: Dandruff, hair fall causes.<br>Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.<br>Antiperspirants and deodorants: Actives and mechanism of action. | 7 | 5 | 9.5<br>9.b |

**Reference Books:**

Harry's Cosmeticology, Wilkinson, Moore. Seventh Edition, George Godwin.

Cosmetics - Formulations, Manufacturing and Quality Control. P.P. Sharma, 4th Edition. Vandana Publications Pvt. Ltd., Delhi.

Text book of cosmelicology by Sanju Nanda & Roop K. Khar. Tata Publishers.

**e-Learning Source:**

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6188460/

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP810ET | Title of the Course | EXPERIMENTAL PHARMACOLOGY | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Appreciate the applications of various commonly used laboratory animals<br>2. Appreciate and demonstrate the various screening methods used in pre clinical research<br>3. Appreciate and demonstrate the importance of biostatistics and research methodology<br>4. Design and execute a research hypothesis independently. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Appreciate the knowledge gained on pre clinical evaluation of drugs and recent experimental techniques in the drug discovery and development. |
| CO2 | Understood the various laboratory animals and their maintenance as per the guidelines and also describe good laboratory practices in maintenance and handling of experimental animals. |
| CO3 | Appraised the regulations and ethical requirement for the usage of experimental animals. |
| CO4 | Learnt and describe the various pre clinical screening methods (in-vitro and in-vivo) involved in the drug discovery process. |
| CO5 | Correlate the pre clinical data to human's clinical data. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Laboratory animals** | Laboratory animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals. Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals. Techniques of blood collection and euthanasia. | 8 | 1 | - |
| 2 | **Introduction: Pre clinical screening models** | **Pre clinical screening models:**<br>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.<br>b. **Study of screening animal models for**: Diuretics, nootropics, anti-parkinson's, antiasthmatics.<br>**Preclinical screening models for**: CNS activity, analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant,antiepileptic, antiparkinsonism, and alzheimer's disease. | 10 | 2 | - |
| 3 | **Pre clinical screening models for ANS activity** | Preclinical screening models for ANS activity: sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics. | 8 | 3 | - |
| 4 | **Pre clinical screening models for CVS activity** | 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. | 8 | 4 | - |
| 5 | **Research methodology and bio-statistics** | 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 | 5 | 5 | - |

**Reference Books:**

Fundamentals of experimental pharmacology by M N Ghosh.
Hand book of experimental pharmacology by S K Kulakarni.
CPCSEA guidelines for laboratory animal facility.
Drug discovery and evaluation by Vogel H G.

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| Drug screening methods by Suresh Kumar Gupta and S K Gupta. |
| Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard. |
| **e-Learning Source:** |
| https://epcsea.nic.in/WriteReadData/userfiles/file/SOP_CPCSEA_inner_page.pdf |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | - | 3 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | - | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | - | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | - | 3 | 2 | 3 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP811ET | Title of the Course | ADVANCED INSTRUMENTATION TECHNIQUES | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | 0 | 4 | |
| Course Objectives | 1. To understand the advanced instruments used and its applications in drug analysis.<br>2. To understand the chromatographic separation and analysis of drugs.<br>3. To understand the calibration of various analytical instruments.<br>4. To know analysis of drugs using various analytical instruments. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | *Examine* the pharmaceutical substance by NMR spectroscopy and mass spectrometry on the basis of its chemical structure and interactions with electromagnetic radiations. |
| CO2 | *Judge* the pharmaceutical substance by thermal methods of analysis and X ray diffraction methods using the knowledge of its chemical structure and relevant interactions. |
| CO3 | *Apprehend* the calibration and validation of analytical instruments using the prerequisites of performance. |
| CO4 | *Investigate* the pharmaceutical substance by radioimmunoassay and extraction techniques on the basis of its chemical structure and physicochemical properties. |
| CO5 | *Appraise* the pharmaceutical substance using hyphenated techniques on the basis of its chemical structure and physicochemical properties. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Nuclear magnetic resonance spectroscopy, Mass spectrometry** | **Nuclear magnetic resonance spectroscopy:** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, spin - spin coupling, relaxation, instrumentation and applications.<br>**Mass spectrometry:** Principles, fragmentation, ionization techniques - Electron impact, chemical ionization, MALDI, FAB. Analyzers - Time of flight and quadrupole, instrumentation, applications. | 10 | 1 | 3.2 & 3.4 |
| 2 | **Thermal methods of analysis, X-ray diffraction methods** | **Thermal methods of analysis:** Principles, instrumentation and applications of thermogravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC).<br>**X-ray diffraction methods**: Origin of X-rays, basic aspects of crystals, X-ray crystallography, rotating crystal technique, single crystal diffraction, powderdiffraction, structural elucidation and applications. | 10 | 2 | 3.2 & 3.4 |
| 3 | **Calibration and validation as per ICH and USFDA Guidelines** | Calibration and validation as per ICH and USFDA guidelines.<br>**Calibration of following Instruments:** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame photometer, HPLC and GC. | 10 | 3 | 3.2 & 3.4 |
| 4 | **Radioimmunoassa y, Extraction techniques** | **Radioimmunoassay**: Importance, various components, principle, different methods, limitation and applications of radio immuno assay.<br>Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid - liquid extraction. | 8 | 4 | 3.2 & 3.4 |
| 5 | **Hyphenated techniques** | Hyphenated techniques - LC-MS/MS, GC-MS/MS, HPTLC-MS. | 7 | 5 | 3.2 & 3.4 |

**Reference Books:**

Instrumental methods of chemical analysis by B K Sharma.

Organic spectroscopy by Y R Sharma.

Text book of pharmaceutical analysis by Kenneth A Connors.

Vogel's text book of quantitative chemical analysis by A I Vogel.

Practical pharmaceutical chemistry by A H Beckett and J B Stenlake.

Organic chemistry by I L Finar.

Organic spectroscopy by William Kemp.

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|---|
| Quantitative analysis of drugs by D C Garrett |
| Quantitative analysis of drugs in pharmaceutical formulations by P D Sethi. |
| Spectrophotometric identification of organic compounds by Silverstein. |
| **e-Learning Source:** |
| https://www.google.com/search?q=Nuclear+magnetic+resonance+spectroscopy+research+article&sxsrf=ALiCzsaSX1-lUmnGqpxRQbGaI6loXv5xaQ%3A1671859588931&ei=hI2mY7e7OInh4-EPwIC38A0&ved=0ahUKEwi3jaanwpH8AhWJ8DgGHUDADd4Q4dUDCA8&uact=5&oq=Nuclear+magnetic+resonance+spectroscopy+research+article&gs_lcp=Cgxnd3Mtd2I6LXNlcnAQAzIFCAAQogQyBQgAEKIEMgUIABCiBDIFCAAQogQyBQgAEKIEOgoIABBHENYEELADOgcIIxCwAhAnOgoIABCABBCxAxANOgcIABCABBANOgYIABAHEB46BAgjECc6BwgAELEDEEM6CggAEMMEEAoQoAFKBAhBGABKBAhGGABQ7gRY3BFgtRRoAXABeACAAeACiAG4CJIBBTItMy4xmAEAoAEBoAECyAEIwAEB&sclient=gws-wiz-serp |

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 1 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO2 | 3 | 1 | 1 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO3 | 3 | 1 | 1 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO4 | 3 | 1 | 1 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 | 3 |
| CO5 | 3 | 1 | 1 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP812ET | Title of the Course | DIETARY SUPPLEMENTS & NUTRACEUTICALS | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the need of supplements by the different group of people to maintain healthy life.<br>2. Understand the outcome of deficiencies in dietary supplements.<br>3. Appreciate the components in dietary supplements and their application.<br>4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | *Assess* the definitions and classifications of functional foods, nutraceuticals, and dietary supplements, their effectiveness in preventing or curing health issues and their sources, marker compounds, chemical nature, medicinal uses, and health benefits within the context of public health, maternal and child nutrition, ageing, and community nutrition education. |
| CO2 | *Evaluate* the occurrence, chemical nature, and medicinal benefits of various phytochemicals and functional foods, including carotenoids, sulfides, polyphenolics, flavonoids, prebiotics/probiotics, phytoestrogens, tocopherols, proteins, vitamins, minerals, and commonly consumed foods and beverages. |
| CO3 | *Appraise* the production and damaging effects of free radicals on cellular components and assess the role of dietary fibers and complex carbohydrates as functional food ingredients. |
| CO4 | *Judge* the role of free radicals in various diseases, including diabetes mellitus, inflammation, cancer, and atherosclerosis, and assess the effectiveness of endogenous and synthetic antioxidants and functional foods in chronic disease prevention. |
| CO5 | *Create* strategies to enhance the potential of nutraceuticals considering processing, storage, and environmental factors, and design regulatory compliance plans for food safety and quality standards, including FSSAI, FDA, FPO, MPO, AGMARK, HACCP, GMPs, and pharmacopoeial specifications. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Definition of functional foods, Public health nutrition** | Definition of functional foods, nutraceuticals and dietary supplements. Classification of nutraceuticals, health problems and diseases that can be prevented or cured by nutraceuticals<br>i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.<br>b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.<br>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. | 7 | 1 | - |
| 2 | **Phytochemicals as nutraceuticals** | **Phytochemicals as nutraceuticals**: Occurrence and characteristic features(chemical nature medicinal benefits) of following:<br>Carotenoids - α and β Carotene, Lycopene, Xanthophylls, leutin SULFIDES: Diallyl sulfides, Allyl trisulfide.<br>**Polyphenolics:** Reservetrol Flavonoids - Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones Prebiotics/Probiotics: Fructo oligosaccharides, Lacto bacillum<br>Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans Tocopherols<br>Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like. | 15 | 2 | - |
| 3 | **Introduction to free radicals, Dietary fibre and complex carbohydrates** | **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.<br>Dietary fibres and complex carbohydrates as functional food ingredients. | 7 | 3 | - |
| 4 | **Free radicals, Antioxidants, Synthetic antioxidants, Functional foods** | Free radicals in diabetes mellitus, inflammation, ischemic reperfusion injury, cancer, atherosclerosis, free radicals in brain metabolism and pathology, kidney damage,<br>muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing. Antioxidants: Endogenous antioxidants - enzymatic and nonenzymatic antioxidant defence, superoxide dismutase, catalase, | 10 | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| | | glutathione peroxidase, glutathione, Vitamin C, Vitamin E, α- Lipoic acid, melatonin.-<br>Synthetic antioxidants: Butylated hydroxy toluene, Butylated hydroxy anisole. Functional foods for chronic disease prevention | | | |
| 5 | **Nutraceutical, Regulatory aspects, Pharmacopoeial specifications** | Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.<br>**Regulatory aspects**: FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on food safety. Adulteration of foods.<br>Pharmacopoeial specifications for dietary supplements and nutraceuticals. | 6 | 5 | - |

**Reference Books:**


Dietetics by Sri Lakshmi

Role of dietary fibres and neutraceuticals in preventing diseases by K T Agusti and P Faizal: B S Punblication.

Advanced nutritional therapies by Cooper K. A. (1996).

The food pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).

Prescription for nutritional healing by James F Balch and Phyllis A Balch 2nd Edn., Avery Publishing Group, NY (1997).

G Gibson and C williams Editors. 2000 Functional foods. Woodhead Publ.Co.London.

Goldberg I. Functional Foods. 1994. Chapman and Hall, New York.

Labuza, T P. 2000 Functional Foods and Dietary Supplements: Safety, good manufacturing practice (GMPs) and shelf life testing in Essentials of Functional Foods M K Sachmidl and T P Labuza eds. Aspen Press.

Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)

Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease.* Eighth edition. Lea and Febiger.


**e-Learning Source:**

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6188460/

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | - | 3 | 3 | 1 | 3 |
| **CO2** | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| **CO3** | 3 | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | - | 3 | 3 | 2 | 2 |
| **CO4** | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP813ET | Title of the Course | PHARMACEUTICAL PRODUCT DEVELOPMENT | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | 1 | - | 4 | |
| Course Objectives | 1. Understand the need of supplements by the different group of people to maintain healthy life.<br>2. Understand the outcome of deficiencies in dietary supplements.<br>3. Appreciate the components in dietary supplements and their application.<br>4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims. | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Explain pharmaceutical product development and regulations related to preformulation |
| CO2 | Classify the pharmaceutical excipients – semi solid dosage form |
| CO3 | Discuss about pharmaceutical excipients – solid dosage forms, liquid dosage forms and NDDS |
| CO4 | Explain the pharmaceutical product development by Optimization and quality by design (QbD) techniques |
| CO5 | Discuss about Pharmaceutical packaging and their regulatory considerations. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to pharmaceutical product development and regulations** | Introduction to pharmaceutical product development, objectives, and regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms. | 10 | 1 | 9.5<br>9.b |
| 2 | **Introduction to pharmaceutical product development for semi solid preparations** | An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories: Solvents and solubilizers. Cyclodextrins and their applications. Non - ionic surfactants and their applications. Polyethylene glycols and sorbitols. Suspending and emulsifying agents. Semi solid excipients. | 10 | 2 | 9.1<br>9.5 |
| 3 | **Introduction to pharmaceutical product development for solid preparations** | An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories: Tablet and capsule excipients. Directly compressible vehicles. Coat materials. Excipients in parenteral and aerosols products. Excipients for formulation of NDDS. Selection and application of excipients for pharmaceutical formulations, with specific industrial applications. | 10 | 3 | 9.5<br>9.b |
| 4 | **Optimization techniques in pharmaceutical product development & study of QbD** | Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development. | 8 | 4 | 9.1<br>9.5<br>9.b |
| 5 | **Packaging materials & regulatory considerations** | Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations. | 7 | 5 | 9.5<br>9.b |

**Reference Books:**

Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, Charles Bon; Marcel Dekker Inc., USA.

Encyclopaedia of Pharmaceutical Technology, edited by James Swarbrick, Third Edition, Informa Healthcare publishers.

Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, by A. Lieberman, Leon Lachman and Joseph B. Schwartz, Marcel Dekker Inc., USA

Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, by H.A. Liberman, Martin, M.R and Gilbert S. Banker, Marcel Dekker Inc., USA.

Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, by Kenneth E. Avis and H.A. Liebermann, Marcel Dekker Inc., USA.

The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop K Khar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt. Ltd. 2013.

Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, Lippincott Williams & Wilkins, USA.

Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K. Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.

Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems by Loyd V. Allen, Jr., N.G. Popovich and H. C. Ansel, Lippincott Williams & Wilkins, USA.

Aulton's Pharmaceutics – The Design and Manufacture of Medicines by Michael E. Aulton, 3rd Ed., Churchill Livingstone, UK.

**e-Learning Source:**

https://www.google.co.in/books/edition/Pharmaceutical_Drug_Product_Development/cinhDwAAQBAJ?hl=en&gbpv=1&dq=PHARMACEUTICAL+PRODUCT+DEVELOPMENT&printsec=frontcover

| PO-PSO / CO | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | - | 3 | 3 | 2 | 3 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP813PW | Title of the Course | PROJECT WORK | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | - | - | 12 | 6 | |

| Course Outcomes | |
|---|---|
| CO1 | Develop the hypothesis based upon research gap identified from literature review. |
| CO2 | Design the plan of work and experimental lay out according to protocol. |
| CO3 | Evaluate the hypothesis to answer the designed research problem. |
| CO4 | Organize the outcomes of the project work in accordance with the results obtained. |
| CO5 | Conclude the outcomes of the project work as per the proposed hypothesis. |

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 3 |
| CO4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

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|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |

| Course Code | BP814AI | Title of the Course | ARTIFICIAL INTELLIGENCE IN HEALTH & ALLIED SCIENCES | L | T | P | C | SDG Goals |
|---|---|---|---|---|---|---|---|---|
| Year | IV | Semester | VIII | 3 | - | - | 2 | |
| Course Objectives | 1. Understand the basics of Artificial Intelligence (AI) and Machine Learning (ML)<br>2. -Learn how AI is applied in Pharmaceutical Sciences<br>3. -Develop skills in using AI tools and techniques in pharmaceutical research and development<br>4. -Critically evaluate the potential and limitations of AI in Pharmaceutical Sciences | | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | Understand the basics of AI and Machine Learning (ML): Define AI and ML, and explain their differences and applications. |
| CO2 | Apply AI concepts to pharmaceutical sciences: Identify areas in pharmaceutical sciences where AI can be applied, and explain how AI can improve drug discovery, development, and delivery. |
| CO3 | Use AI tools and techniques: Apply AI algorithms and models to pharmaceutical data, and interpret the results |
| CO4 | Evaluate the potential and limitations of AI in pharmaceutical sciences: Critically evaluate the benefits and challenges of using AI in pharmaceutical sciences, and discuss future directions. |
| CO5 | Communicate AI concepts and results effectively: Present AI concepts and results clearly and concisely, using appropriate visual aids and technical language. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO | SDG Targets |
|---|---|---|---|---|---|
| 1 | **Introduction to AI and Machine Learning** | - Definition and types of AI<br>- Machine Learning (ML) basics<br>- Supervised, Unsupervised, and Reinforcement Learning | 06 | 1 | 3.8 |
| 2 | **AI Applications in Pharmaceutical Sciences** | - Drug discovery and development<br>- Predictive modeling and simulation<br>- Pharmacokinetics and pharmacodynamics<br>- Personalized medicine | 06 | 2 | 3.3, 3.4 |
| 3 | **AI Tools and Techniques** | -Deep Learning (DL) and Convolutional Neural Networks (CNNs)<br>- Natural Language Processing (NLP)<br>- Transfer Learning and Domain Adaptation<br>- AI frameworks and libraries (e.g., TensorFlow, PyTorch) | 06 | 3 | 3.4 |
| 4 | **Case Studies and Applications** | - AI in drug repurposing and repositioning<br>- AI-assisted clinical trials<br>- AI-powered pharmacovigilance<br>- Real-world examples and case studies | 06 | 4 | 3.8 |
| 5 | **Ethics, Regulatory, and Future Directions** | - Ethical considerations in AI-powered pharmaceutical research<br>- Regulatory frameworks and guidelines<br>- Future directions and emerging trends in AI-powered pharmaceutical sciences | 06 | 5 | 3.c |

**Reference Books:**

Machine learning and AI for healthcare by Arjun Panesar A press publication.

Artificial intelligence in healthcare, Dr. Parag Mahajan, Axtria Insights Publications.

Artificial intelligence in pharmaceutical science by Mullaicharam bhupathyraaj, K.Reeta Vijaya Rani, Musthafa Mohamed Essa, CRC Press.

Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems by Loyd V. Allen, Jr., N.G. Popovich and H. C. Ansel, Lippincott Williams & Wilkins, USA.

Aulton's Pharmaceutics – The Design and Manufacture of Medicines by Michael E. Aulton, 3rd Ed., Churchill Livingstone, UK.

**e-Learning Source:**

| | Course Articulation Matrix:(Mapping of Cos with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 |

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

| | |
|---|---|
| Dr. Kuldeep Singh<br>**Name & Sign of Program Coordinator** | **Sign & Seal of HOD** |