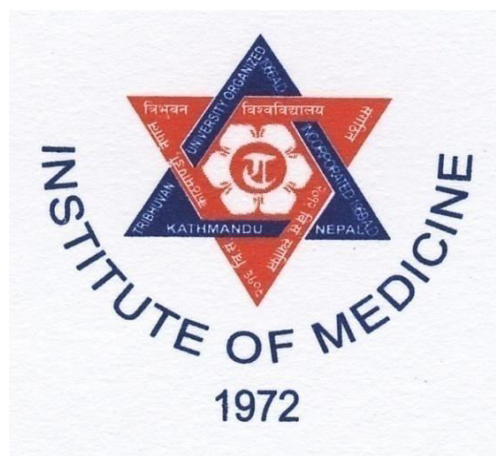


Curriculum
on
Bachelor in Pharmacy
(B. Pharm)



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1. Introduction

T.U. Institute of Medicine (IOM) has been a pioneer institute in health professions education in Nepal. Over the last three decades, IOM has demonstrated its commitment to produce different categories and levels of Human Resource for Health (HRH) as per the changing needs of the nation. In response to the growing demand for the quality pharmacy manpower required for the country (National Drug Policy, 1995) and along with the national and regional-level policy to develop pharmaceutical education in academic institutions, the Institute of Medicine has been entrusted to offer that opportunity to the country. Looking retrospectively, IOM has established its credibility over the decades through creatively blending the progressive world trends in health profession education with country-specific national and local needs. Prospectively, as a public institution in the forefront, it has the responsibility and challenges to produce qualified health personnel with minimum resource input that the larger public could afford in the long run.

In this context, keeping in view of the formal request made by Ministry of Health to the IOM, the curriculum for B. Pharm. was designed and Bachelor of Pharmacy Program was started in 2000 AD (2057 BS).

In a way, the need to launch a B.Pharm course at the TU-IOM was a direct response to a huge demand in the Pharmacy human resources needed for the country. Partly, it was also a response to the call at regional level to formulate proposals to develop undergraduate, post graduate and continuing education of pharmacists in the country as recommended by the WHO consultative meeting at New Delhi in Dec. 1988.

The course of B.Pharm. has been introduced at the Institute of Medicine in the year 2000 AD. Since the inception of this curriculum the course has been introduced in Maharajgunj Medical Campus (MMC) and various campuses affiliated to IOM. The need for revision or modification of the curriculum has been felt for a long time. The shifting of pharmacy profession from product-oriented to patient-oriented had made the compulsion for modification of the curriculum accordingly and hence the Department of Pharmacy, IOM has initiated the process for the updating of the curriculum. Strategies of this curriculum focused on Problem Based, Learning, Self Directed Learning, Competency Based Learning, Evidence Based learning, Community Oriented Learning, Integrated Teaching Learning and Need Based.

The Department of Pharmacy, after numerous consultations with experts from different departments of MMC, as well as affiliated campuses of IOM, has prepared a draft of the updated curriculum considering the various aspects of the current contents and to give the students more relevant information pertaining to the course, which will eventually help them in their endeavour of becoming responsible health professionals.

2. Goals

The goal of the curriculum is to produce qualified pharmacists who could provide pharmaceutical services, research and education in the capacity of:

1. Community and hospital pharmacist
2. Herbal drug development experts
3. Drug/medicines regulators
4. Specialists in technology and research
5. Managers of pharmaceutical services
6. Specialists in various scientific aspects of pharmacy

The basic professional education will enable the graduates to demonstrate a broad understanding of the scientific principles and techniques of the pharmaceutical sciences. At the same time, it will also enable them to continue their studies to undertake postgraduate training and research. The curriculum has been inspired by the values that pharmacists should be the vital members of the health care team and on graduation they will hold job either in government or private sector in important areas such as community pharmacy, clinical pharmacy, hospital pharmacy, regulatory control and drug management, pharmaceutical industry, quality assurance, academic activities, training activities and research.

3. Objectives

In order to provide quality services in the above-mentioned areas, the graduates will be able to

- Maintain professional dignity and respect
- Demonstrate broad understanding of the scientific basis of the specialty of pharmacy
- Integrate and apply the skill and knowledge in practice creatively as per requirement in various pharmacy related areas confidently
- Appraise critically the national legislation on drug and related fields, National Health Policy and National Drug Policy and other regulations related to pharmacy in the context of total health care system of Nepal
- Show the leadership for collaborative research projects
- Recognize and promote alternative perspectives in the effective utilization of natural resources available within the country
- Demonstrate competence in searching, handling and integrating information and applying knowledge, skills and attitudes in professional problem solving.

4. Competencies to be achieved by B. Pharm graduates

B. Pharm graduates should acquire knowledge, skill and attitudes, which will enable them to

- Demonstrate handling, dispensing, procurement, drug storage, formulation and small/large scale production.
- Maintain professional ethics and code of conduct

- Communicate effectively with different healthcare professionals and stakeholders
- Demonstrate professional competence to work as member of the multiprofessional health care team
- Counsel the patients
- Maintain Interpersonal Relationship Skill with Patients, Doctors, Nurses and other healthcare professionals.
- Perform as a team member of health workers in clinical setting.
- Evaluate drug-interaction and avoid drug incompatibility.
- Provide drug and poison information to the doctors, health personnel and users.
- Manage the hospital pharmacy.
- Provide over-the-counter (OTC) drugs rationally to the community and generate awareness.
- Monitor the implementation of National Drug Policy and drug regulations.
- Plan, manage and evaluate retail and wholesale pharmacies and drug industries.
- Demonstrate the ability to conduct further studies & research work on different pharmaceutical fields.
- Perform as a teacher in educational institutions.
- Perform drug quality assessment using different methods.
- Monitor and evaluate quality assurance system serving as GMP superintendent in drug industry.
- Inspect the drug manufacturing plant, storage conditions, drug handling, drug distribution, use and record keeping.
- Perform in an industry as a production manager, marketing manager or quality control manager.
- Perform on the capacity of Good Manufacturing Practitioner and as advocator of WHO/GMP.
- Demonstrate the promotion of 'Certificate of Pharmaceutical Products 'moving in the international commerce.

5. Duration of the course: The course is for four academic years, concentrating mainly on professional pharmacy courses and the supplementary subjects which are essential for the professional pharmacy courses.

6. Entry criteria into the programme and entrance exam: Minimum 2.4 GPA will be required in 10+2 Science (Biology Stream) or Equivalent. Minimum C Grade will be required on all subject separately including English, Physics, Chemistry and Biology in Theory and Practical.

7. The number of student intake: The number of intake per year will be as per the rules of

IOM

8. Medium of instruction and examinations: Medium of instruction and examination shall be in English.

9. Course outline

The first year consists of six-theory papers and three practical carrying a total load of 990 Teaching Hours (46) including both theory and practical. In the second year, there are six theory papers and six-practical carrying a total load of 1080 Teaching Hours (48). In the third year, there are seven theory papers and three practical carrying a total load of 900 Teaching Hours (48) and in the fourth year there will be four theory and one practical paper carrying a total load of 450 Teaching Hours (36). The course consists of total of 3420 Teaching Hours (178). Apart from these papers, a 3 months' period is allotted to Dissertation and a 2 months time is allotted to the in-plant training in the fourth year.

10. Curriculum structure of Bachelor of Pharmacy

Code No.	Name of the subject	Hrs/ wk	Hrs/ yr	Credit	Marks
FIRST YEAR					
BP 401 A	Anatomy, Physiology & Pathology-Theory	3	90	6	100
BP 402 A	Biochemistry- Theory	3	90	6	100
BP 402 B	Biochemistry-Practical	3	90	2	50
BP 403 A	Pharmaceutical Chemistry-Theory	3	90	6	100
BP 403 B	Pharmaceutical Chemistry-Practical	3	90	2	50
BP 404 A	Medicinal Chemistry I-Theory	3	90	6	100
BP 405 A	Pharmacology I-Theory	3	90	6	100
BP 406 A	Pharmaceutical Microbiology-Theory	3	90	6	100
BP 406 B	Pharmaceutical Microbiology-Practical	3	90	2	50
	Total of First Year	33	990	46	750
SECOND YEAR					
BP 501 A	Pharmaceutics I (Physical Pharmacy)-Theory	3	90	6	100
BP 501 B	Pharmaceutics I (Physical Pharmacy)-Practical	3	90	2	50
BP 502 A	Medicinal Chemistry II-Theory	3	90	6	100
BP 502 B	Medicinal Chemistry II-Practical	3	90	2	50
BP 503 A	Biopharmaceutics and Pharmacokinetics-	3	90	6	100
BP 503 B	Theory	3	90	2	50

	Biopharmaceutics and Pharmacokinetics- Practical				
BP 504 A	Pharmacognosy -Theory	3	90	6	100
BP 504 B	Pharmacognosy –Practical	3	90	2	50
BP 505 A	Pharmacology II-Theory	3	90	6	100
BP 505 B	Pharmacology II-Practical	3	90	2	50

BP 506 A	Pharmaceutical analysis and quality assurance I-Theory	3	90	6	100
BP 506 B	Pharmaceutical analysis and quality assurance I- Practical	3	90	2	50
	Total of Second Year	36	1080	48	900
THIRD YEAR					
BP 601 A	Pharmaceutical Engineering-Theory	3	90	6	100
BP 602 A	Pharmaceutics II (Dosage Forms and Formulation) -Theory	3	90	6	100
BP 602 B	Pharmaceutics II (Dosage Forms and Formulation)–Practical	3	90	2	50
BP 603 A	Pharmaceutical analysis and quality assurance II- Theory	3	90	6	100
BP 603 B	Pharmaceutical analysis and quality assurance II- Practical	3	90	2	50
BP 604 A	Ayurvedic and Herbal Technology-Theory	3	90	6	100
BP 604 B	Ayurvedic and Herbal Technology-Practical	3	90	2	50
BP 605 A	Biostatistics & Research Methodology-Theory	3	90	6	100
BP 606 A	Pharmaceutical Jurisprudence-Theory	3	90	6	100
BP 607 A	Community Pharmacy and First Aid-Theory	3	90	6	100
	Total of Third Year	30	900	48	850
FOURTH YEAR					
BP 701 A	Clinical and Hospital Pharmacy-Theory	3	90	6	100
BP 701 B	Clinical and Hospital Pharmacy-Practical	3	90	2	50
BP 702 A	Pharmaceutical Management-Theory	3	90	6	100
BP 703 A	Pharmaceutics III (Industrial Pharmacy) –	3	90	6	100

	Theory				
BP 704 A	Pharmacotherapeutics-Theory	3	90	6	100
BP 705 DT	Dissertation			6	100
BP 706 IP	In-plant Training in Hospital +Industry (4 weeks each)			4	100
	Total of Fourth Year	15	450	36	650
	Grand Total	114	3420	178	3150

For the dissertation work, each student should develop a thesis topic, which will be carried out under the guidance of teachers. The students should submit a thesis and defend it.

Recognizing the need to develop the ability to translate theory into practice, students are placed for in-plant training in pharmaceutical manufacturing units, hospitals, drug stores as a part of curriculum at the beginning of 4th year.

There will be One-week field trip for Pharmacognosy and One-week field trip for Community Pharmacy Management during the second year. There will be a One-week field trip for visiting various Domestic/Multinational pharmaceutical industries in third year.

11. Brief outline of the subjects:

Anatomy, physiology and pathology: This course makes student to learn the structure and function of human body and relate them with common disorders of various systems so that the students will be able to explain the scientific basis of use of drugs in our society. The knowledge of this course is essential for the professional pharmacy courses as Hospital and Clinical pharmacy, Pharmacology and Pharmacotherapeutics.

Biochemistry: This course deals with general principles of biochemistry applicable to pharmaceutical sciences. It provides the students the knowledge on biochemicals, their formation, transportation, storage, metabolism and roles in physiological processes, their physical and chemical properties and estimation.

Pharmaceutical Microbiology: The students will gain the knowledge and skills related to the isolation and identification of microbes, sterilisation and sterility testing of different pharmaceutical preparations, evaluation of preservatives in pharmaceutical preparations and applications of fermentation technology in manufacturing drugs and vaccines, principles and methods of different microbiological assays and standardisation.

Pharmaceutical Chemistry: This course will provide the basic knowledge and skills in the preparation, properties, purity and limit tests of inorganic as well as organic compounds used in pharmaceutical preparations of medicinal importance. It will be directly helpful in achieving the

competencies in the professional pharmacy fields like natural product chemistry and medicinal chemistry.

Pharmacognosy and Ayurvedic and Herbal Technology: The aim of this course is to provide the knowledge and skill of basic principle and techniques in Pharmacognosy and to make the students familiar with the herbal drugs in different systems of medicines, phytochemistry, evaluation and standardisation of crude drugs.

Biopharmaceutics & Pharmacokinetics: This course intends to give the students an insight into the biopharmaceutics, significance of plasma concentration time profiles and its measurement, pharmacokinetic processes, bioavailability and bioequivalence. This course will help the students to develop the competency in their role in formulation development and clinical setting.

Pharmaceutics I (Physical Pharmacy): This course will provide students the knowledge of physicochemical phenomena including chemical reaction, interfacial phenomena, phase equilibria and different types of homogeneous and heterogeneous systems. This course will thus provide knowledge, which is essential for drug formulation.

Pharmacology I and II: This course gives students the basic knowledge of drugs acting on various systems, pharmacotherapeutics management of some disorders and skills to carry out some selected pharmacological experiments. This course will help the students to develop the competency in pharmaceutical practice and research, in evaluating drug-interaction and drug incompatibility and providing drug information in community and clinical settings.

Medicinal Chemistry I and II: This course gives the students the knowledge and skill of synthesis and structure activity relationship of selected medicinal compounds. The basic principles of this course can be applied in pharmaceutical sciences in drug development, production and analysis as well.

Pharmaceutical Engineering: This course deals with pharmaceutical designing and operation of various equipments in the pharmaceutical field. The students will be familiar with the engineering aspects of pharmaceutical plants including industrial operations and processing.

Pharmaceutics II (Various Dosage Forms and Formulations): This course will give the students basic knowledge and skills in the formulation of different dosage forms which will help students to work in pharmaceutical fields and design drug dosage.

Biostatistics and Research Methodology: The knowledge of biostatistics and research methods are basic tools to carry on further studies of all professional pharmacy courses.

Pharmaceutics III (Industrial Pharmacy): This course provides the students the knowledge on various novel drug delivery systems, technology transfer and pilot plant scale up techniques. The

subject will also provide the students on various utilities services in pharmaceutical industries, documentation and quality management aspects.

Pharmaceutical Management: This course deals with the managerial function in the projection, production, procurement, dispensing, distribution and sale of pharmaceutical products in an innovative and cost effective manner. It will be helpful to plan, manage and evaluate retail and wholesale pharmacies and drug industries.

Community Pharmacy and First Aid: The course will provide students the knowledge and skill for competently handling dispensing, patient counseling, dose calculations, identification of incompatibilities, drug storage, formulation, procurement and assimilation of pharmaceutical care in the community pharmacy and to generate awareness. This course also helps in taking vitals and management of emergency conditions of patients.

Pharmaceutical Jurisprudence: This course gives the knowledge of legal and ethical aspects of pharmacy practice including national and international rules and regulations and their enforcing bodies. This also includes pharmaceutical ethics and the codes of conduct for pharmacists. The students will familiarize themselves with role of regulation in relation to man and animal and gain skills for applying the drug-related legislations, regulations pertaining to pharmaceutical products and practices.

Pharmaceutical analysis and quality assurance I and II: This course deals with the knowledge and skills of various analytical methods including separation and purification techniques of chemicals and pharmaceutical products to ensure the quality of raw as well as the final product. This course will also help students to develop the competency to monitor and evaluate quality assurance system in drug industry.

Clinical and Hospital Pharmacy: This course gives the students the knowledge and skills of pharmacy as practiced in hospitals and clinical settings. This will enable them to work as a member of the health care team, manage the hospital pharmacy and provide drug and poison information with the integrated knowledge of pharmacology/pharmacotherapeutics including and other courses.

Pharmacotherapeutics: This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover therapeutics of various diseases. This will enable the student to understand the common diseases and their management.

12. Teaching learning methods

- **Interactive Lectures:** Theory classes will be conducted at any working days according to the routine set by the program coordinator.
- **Simulation:** It will involve role playing in which learner performs the role in an artificially created environment.

- **Role-play:** It allows students to explore realistic situations by interacting with other people in a managed way in order to develop experience and trial different strategies in a supported environment.
- **Small group discussion:** Students will be splitted into different groups and teaching will be carried out with different approaches.
- **Case study:** A detailed analysis will be done on some specific event or series of related events. It will train students to locate, gather and process the information required to solve the problems.
- **Seminar:** It willallow the students to discuss a theme in a peer group with subject experts in an objective method.
- **Interactive Journal clubs:** Journal clubs will encourage students to practice searching for relevant research, critically appraising articles, and contributing to open discussions with peers.
- **Brainstorming:** It will be done in order to maximize the ability to generate creative ideas.
- **Demonstration:** The students have to carry out the practicals to learn the prescribed skills under the supervision of the related teachers/laboratory incharges. Some practicals may be demonstrated either manually or by video demonstration. The practicals/demonstration would be subject to change according to the need of the subject matter as decided by the department.
- **Problem oriented learning:** Problem oriented learning shall be applied whenever appropriate.
- **Problem based learning:** It is a teaching method in which complex real-world problems are used as the vehicle to promote student learning of concepts and principles as opposed to direct presentation of facts and concepts.
- **Self-directed learning:** Self-directed learning shall be applied whenever appropriate.
- **Dissertation:** In the fourth year, the research assignment will be given to students (individual), which should be completed and submitted to the department before the final examination. The designated supervisor and HOD shall approve the proposal for the Dissertation .The students will review and search the literature and carry out the experiments and prepare a thesis.The students will have to defend the thesis he/she has prepared.
- **Academia Interaction:** Experts from the regulatory bodies, pharmaceutical industries, research labs and related institutions will be invited to give insights and to share experiences in emerging areas.
- **Observation visit/Field visit:** The students shall be visiting and observing various activities undergoing in the botanical gardens, hospitals, industries, drug regulatory bodies, research laboratories, retail shops and wholesales.
- **In-plant training:** Training in hospital (4 weeks) and industry (4weeks)will be carried out in the 4th year

- **Integrated teaching:** Integrated teaching will be encouraged wherever relevant.
- **Assignment:** It is an instructional technique, which comprises the guided information, self learning, writing skills and report preparation among the learners. Assignment must be relevant to the subject taught to the student.

13. Teaching learning materials

Following are the media use for teaching and learning activities

- White board,
- MS Power Point slides
- Laboratory
- Models
- Videos
- Computer aided learning
- Different web sources
- Handouts
- Books
- Instruments
- OHP
- Real Objects

14. Evaluation

There will be internal assessments (formative) done by the teachers during the period of the course including class tests, written assignments, seminar and case studies. There will be university examinations (summative) at the end of the year.

Theory

The full marks allocated to the subjects with teaching hours 90 are 100 marks for theory and 50 marks for practicals. Out of 100 marks, 20% is allocated to the internal assessment and 80% to the final examination in each subject according to T.U. regulation. Students should obtain atleast 50% marks separately in internal assessment and final examination for passing the subject.

Practical

The full mark allocated to the practical is 50 marks out of which 20% marks (i.e. 10) is allocated to the internal assessment and 80% (i.e. 40) to the final examination in each practical according to T.U. regulation. Students should obtain atleast 50% marks separately in internal assessment and final examination for passing the practical.

Note: **Minimum number of practical in each subject should be 15.** Lab records and attendance will be compulsorily required for practical examination.

15. Dissertation and in-plant training: 100 marks each is allocated for dissertation and in-plant training. Students should obtain atleast 50% marks each in dissertation and in-plant training.

Code No.	Name of the subject	University Exam	Internal Assessment	Full Marks	Pass Marks
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(Refer to the Evaluation Chart).

16. Attendance: Minimum 75 %. Attendance will be required on each theory and practical subjects for attending final theory and practical examinations.

17. Degree awarded: The awarded degree will be Bachelor of Pharmacy (B. Pharm).

Grading system

Following are the grading system of B. Pharmacy Programme.

Grade	CGPA	Percent Equivalent	Performance Remarks
A	4.0	90 and Above	Distinction
A-	3.7	80-89.9	Very Good
B+	3.3	70-79.9	First Division
B	3.0	60-69.9	Second Division
B-	2.7	50-59.9	Pass in Individual subject
F	0	Less than 50	Fail

EVALUATION CHART (See Next Page)

FIRST YEAR					
BP 401 A	Anatomy, Physiology & Pathology-Theory	80	20	100	50
BP 402 A	Biochemistry- Theory	80	20	100	50
BP 402 B	Biochemistry-Practical	40	10	50	25
BP 403 A	Pharmaceutical Chemistry-Theory	80	20	100	50
BP 403 B	Pharmaceutical Chemistry-Practical	40	10	50	25
BP 404 A	Mediicnal Chemistry I-Theory	80	20	100	50
BP 405 A	Pharmacology I-Theory	80	20	100	50
BP 406 A	Pharmaceutical Microbiology-Theory	80	20	100	50
BP 406 B	Pharmaceutical Microbiology-Practical	40	10	50	25
SECOND YEAR					
BP 501 A	Pharmaceutics I (Physical Pharmacy)-Theory	80	20	100	50
BP 501 B	Pharmaceutics I (Physical Pharmacy)-Practical	40	10	50	25
BP 502 A	Medicinal Chemistry II-Theory	80	20	100	50
BP 502 B	Medicinal Chemistry II-Practical	40	10	50	25
BP 503 A	Biopharmaceutics and Pharmacokinetics-Theory	80	20	100	50
BP 503 B	Biopharmaceutics and Pharmacokinetics-Practical	40	10	50	25
BP 504 A	Pharmacognosy-Theory	80	20	100	50
BP 504 B	Pharmacognosy -Practical	40	10	50	25
BP 505 A	Pharmacology II-Theory	80	20	100	50
BP 505 B	Pharmacology II-Practical	40	10	50	25
BP 506 A	Pharmaceutical Analysis and Quality Assurance I-Theory	80	20	100	50
BP 506 B	Pharmaceutical Analysis and Quality Assurance I –Practical	40	10	50	25
THIRD YEAR					
BP 601 A	Pharmaceutical Engineering-Theory	80	20	100	50
BP 602 A	Pharmaceutics II (Dosage Forms and Formulation) -Theory	80	20	100	50
BP 602 B	Pharmaceutics II (Dosage Forms and Formulation) –Practical	40	10	50	25

BP 603 A	Pharmaceutical Analysis and Quality Assurance II -Theory	80	20	100	50
BP 603 B	Pharmaceutical Analysis and Quality Assurance II -Practical	40	10	50	25
BP 604 A	Ayurvedic and Herbal Technology-Theory	80	20	100	50
BP 604 B	Ayurvedic and Herbal Technology-Practical	40	10	50	25
BP 605 A	Biostatistics & Research Methodology-Theory	80	20	100	50
BP 606 A	Pharmaceutical Jurisprudence-Theory	80	20	100	50
BP 607 A	Community Pharmacy and First Aid-Theory	80	20	100	50

FOURTH YEAR

BP 701 A	Clinical and Hospital Pharmacy-Theory	80	20	100	50
BP 701 B	Clinical and Hospital Pharmacy-Practical	40	10	50	25
BP 702 A	Pharmaceutical Management-Theory	80	20	100	50
BP 703 A	Pharmaceutics III (Industrial Pharmacy) –Theory	80	20	100	50
BP 704 A	Pharmacotherapeutics-Theory	80	20	100	50
BP 705 DT	Dissertation			100	50
BP 706 IP	In-plant Training in Hospital + Industry (4 weeks each)	80	20	100	50

COURSE OF FIRST YEAR

ANATOMY, PHYSIOLOGY AND PATHOLOGY

Subject: Theory	Year: First	Code: BP 401 A
Full Marks: 100	Total Teaching hours: 90	Credit Hrs: 6

Total teaching hours (Subject-wise): (Anatomy: 20 Hrs. Physiology: 50 Hrs. Pathology: 20 Hrs)

Marks distribution

Subject	Total marks(100)	Internal assessment (20)	Final assessment (80)
Anatomy	25	5	20
Physiology	50	10	40
Pathology	25	5	20

A. ANATOMY

Total teaching hours: 25 Hrs

Course description: The course is designed to provide fundamental knowledge of human anatomy to the pharmacy students and professionals.

General objectives: At the end of this course, student will be able to:

- a. Recognize anatomical structures and explain the main physiological functions of body systems.
- b. Use anatomical knowledge to predict physiological consequences
- c. Synthesize ideas to make connections between anatomy and physiology and real-world situations
- d. Understand the effects of alterations in structures and functions of as whole.
- e. Apply the knowledge of anatomy and physiology in the practice of Pharmacy

Specific objectives:

Unit 1: Basic anatomical terminologies:

After the completion of unit, students will be able to:

- a. Define Plane, Position, Movements, Tissue in general (Epithelial, Connective)[1Hrs]

Unit 2: Skin and integumentary system: [1 Hrs]

After the completion of course, students are able to:

- a Identify different layers of skin
- b List appendages of skin

Unit 3: Musculoskeletal system [3 Hrs]

After the completion of course, students will be able to:

- a Discuss general histology of muscles, bones, cartilage
- b Classify bones and joints
- c Classify lymphatic tissue. Explain major lymphatic vessels.
- d Classify muscles: skeletal, smooth and cardiac muscles
- e Describe the structure of skeletal muscle: Actin and Myosin filaments

Unit 4: Respiratory system [2 Hrs]

After the completion of course, students will be able to:

- a Discuss general anatomy of respiratory organs
- b List the subdivisions and components of respiratory tract

Unit 5: Cardiovascular system [2 Hrs]

After the completion of course, students will be able to:

- a. Discuss general anatomy of heart and pericardium
- b. Explain types of blood vessels. Difference between arteries and vein
- c. Identify main arteries and veins of the bodies and their principal functions

Unit 6: Nervous system [3 Hrs]

After the completion of course, students will be able to:

- a Describe the structure of synapse
- b Discuss general anatomy of functional areas of cerebrum
- c Discuss general anatomy of cerebellum
- d Discuss general anatomy of mid brain, pons and medulla oblongata

Unit 7: Special senses [3Hrs]

After the completion of course, students will be able to:

- a Describe structure of retina: macula, fovea centralis, optic disc, physiological blind spot
- b Describe the structure of external and internal ear.

Unit 8: GI tract [2 Hrs]

After the completion of course, students will be able to:

- a. Explain the general architecture of GIT and peritoneum
- b. Describe the gross anatomy of GIT
- c. Describe the gross anatomy of hepatobiliary system

Unit 9: Reproductive system [1 Hrs]

After the completion of course, students will be able to:

- a. Describe the organ of male reproductive system
- b. Describe the organ of female reproductive system

Unit 10: Endocrine system [1 Hrs]

After the completion of course, students will be able to:

Describe the anatomy of pituitary gland, thyroid gland and suprarenal gland

Unit 11: Urinary system [1 Hrs]

After the completion of course, students will be able to:

Describe the anatomy of urinary system

Reference books (Latest Editions)

1. Waugh A, Grant A. Ross and Wilson's Anatomy and Physiology in Health and Illness. Churchill Livingstone, London.
2. Tortora G. J, Derrickson B. H. Principles of anatomy and physiology. John Wiley & Sons.

B. PHYSIOLOGY

Total teaching hours: 50 Hrs

Course description:

The course is designed to provide fundamental knowledge of human physiology to the pharmacy students and professionals. This course is designed in a system specific manner and organized into various organ systems, namely general physiology, hematology, musculoskeletal, respiratory, cardiovascular, digestive, urinary, nervous, endocrine and reproductive systems.

General objectives: At the end of the course, the students will be able to

- a Explain the normal functioning of all the organ systems of the body and their interactions.
- b Narrate the contribution of each organ system to the maintenance of homeostasis.
- c Elucidate the physiological aspects of normal growth and development.
- d Describe the physiological response and adaptations to environmental stresses.
- e List the physiological principles underlying pathogenesis and treatment of disease.

Specific objectives:

Unit1. General physiology [4Hrs]

After the completion of the course, students will be able to

- a. Define Physiology, branch and its importance.

- b.** Describe functional organization of the human body. [**a+b =1 Hr**]
- c.** Describe cell, cell membrane, membrane transport and cell organelles.
- d.** Describe homeostasis, positive and negative feedback mechanisms. [**c+d=1 Hr**]
- e.** Describe various body fluid compartments and their composition.
- f.** Describe various transport processes across the cell: passive transport, active transport and vesicular transport. [**e+f = 1 Hr**]
- g.** Physiology of aging, its principle and age related diseases. [**1 Hr**]

Unit 2. Blood, immune and lymphatic system [5Hrs]

After the completion of the course, students will be to

- a.** Describe composition of blood: plasma and formed elements; and list general functions of blood.
- b.** Describe structure and functions of red blood cells (RBC), white blood cells (WBC) and platelets. [**a+b= 1Hr**]
- c.** Describe major blood grouping systems: ABO and Rh; and describe their clinical importance.
- d.** State clotting mechanisms and role of platelets in blood clotting. [**c+d=1 Hr**]
- e.** Enumerate important tests of bleeding: bleeding time (BT), clotting time (CT), prothrombin time (PT).
- f.** Discuss general principles of immunity: cell mediated immunity, antibody mediated immunity, active immunity and passive immunity. [**e+f = 1Hr**]
- g.** List functions of the spleen.
- h.** List the functions of lymph and lymphatic system. [**g+h = 1Hr**]
- i.** Define the terms edema, lymphedema leukocytosis, thrombocytopenia.
- j.** Describe the basic pathophysiology of anemia, polycythemia, hemophilia, dengue hemorrhagic fever, immunodeficiency in acquired immunodeficiency syndrome (AIDS). [**i+j = 1Hr**]

Unit 3: Musculoskeletal system [4Hrs]

After the completion of the course, students will be to

- a.** Classify muscles: skeletal, smooth and cardiac muscles.
- b.** List the functions of different types of muscles. [**a+b = 1Hr**]
- c.** Describe the structure of skeletal muscle: actin and myosin filaments. [**b+c = 1Hr**]
- d.** Describe the process of neuromuscular transmission and explain mechanism of skeletal muscle contraction: sliding filament theory, isotonic and isometric contractions. [**1 Hr**]
- e.** Define the terms atrophy, hypertrophy, rigor mortis, tetany.
- f.** Describe the basic pathophysiology of myasthenia gravis, organophosphate poisoning, and muscular dystrophies. [**e+f = 1Hr**]

Unit 4: Respiratory system [4 Hrs]

After the completion of the course, students will be to

- a. List the subdivisions and components of respiratory tract.
- b. Describe pulmonary ventilation and mechanism of breathing. [**a+b =1 Hr**]
- c. List lung volumes and capacities.
- d. List the functions of lungs. [**c+d = 1 Hr**]
- e. Explain the mechanism of gaseous exchange in lungs; transport of oxygen and carbon dioxide in blood.
- f. Explain the mechanisms of neural and chemical regulation of breathing. [**e+f =1 Hr**]
- g. Define the terms apnea, hypoxia, hypercapnea.
- h. Describe the basic pathophysiology of pneumonia, chronic obstructive pulmonary disease (COPD), bronchial asthma, respiratory failure, respiratory acidosis and respiratory alkalosis. [**g+h = 1 Hr**]

Unit 5: Cardiovascular system [4 Hrs]

After the completion of the course, students will be to

- a. List the properties of cardiac muscle
- b. Explain cardiac cycle along with its various phases; define end-diastolic volume, end-systolic volume, stroke volume and ejection fraction[**a+b= 1 Hr**]
- c. Define heart rate, pulse rate, cardiac output and venous return
- d. Define the terms bradycardia, tachycardia and list their causes[**c+d =1 Hr**]
- e. Define arterial blood pressure and explain the mechanism of its regulation
- f. Describe the components of normal electrocardiogram (ECG) and list its clinical uses [**e+f = 1 Hr**]
- g. Define the terms atherosclerosis, cardiac arrhythmias, angina pectoris, myocardial infarction (MI)
- h. Describe the basic pathophysiology of hypertension, hypotension, circulatory shock, congestive cardiac failure (CCF), rheumatic heart disease [**g+h = 1 Hr**]

Unit 6: Gastrointestinal (GI) system [4 Hrs]

After the completion of the course, students will be to

- a. Enumerate functions of different parts of the GI tract: stomach, liver, small intestine and large intestine.
- b. Enumerate composition and functions of secretions of GI tract: saliva, gastric juice, pancreatic juice, bile and intestinal juice. [**a+b = 1 Hr**]
- c. Explain the process of digestion and absorption of carbohydrates, proteins and fats
- d. Describe the intestinal movements. [**c+d = 1 Hr**]
- e. List the functions of liver and describe liver function tests.
- f. Define the terms vomiting, constipation, jaundice, ascites, steatorrhoea. [**e+f = 1 Hr**]
- g. Describe the basic pathophysiology of peptic ulcer, diarrhea, cirrhosis, alcoholic liver disease, gastroenteritis, irritable bowel disease. [**1 Hr**]

Unit 7: Renal and electrolyte system [4 Hrs]

After the completion of the course, students will be to

- a. List the functions of kidneys and describe their role as homeostatic organs.
- b. Describe the mechanism of urine formation: glomerular filtration, tubular reabsorption and tubular secretion; define glomerular filtration rate (GFR) and its regulation.
[a+b = 1 Hr]
- c. Describe the structure and functions of juxtaglomerular apparatus.
- d. Explain micturition and micturition reflex. **[c+d = 1 Hr]**
- e. Describe water, acid-base and electrolyte balance.
- f. Describe normal volume and composition of urine. **[e +f = 1 Hr]**
- g. Define the terms oliguria, anuria, hemodialysis.
- h. Describe the basic pathophysiology of urinary tract infection, renal calculi, glomerulonephritis, renal failure, benign prostatic hyperplasia (BPH).
[g+h = 1 Hr]

Unit 8: Nervous system [9Hrs]

After the completion of the course, students will be to

- a. Classify nervous system; define and list properties of a neuron.
- b. Describe resting membrane potential, local potential and action potential of a neuron.
[a+b = 1 Hr]
- c. Describe the structure of synapse and process of synaptic transmission.
- d. Describe reflex and reflex arc. **[c+d = 1 Hr]**
- e. Classify receptors involved in neuronal transmission.
- f. List the ascending tracts and name the sensations carried by them: dorsal column-lemniscal system and anterolateral system. **[e+f = 1 Hr]**
- g. List the functions of descending tracts: pyramidal (corticospinal) tracts.
- h. List functions of cerebrum, cerebellum, basal ganglia, thalamus, hypothalamus, midbrain, pons, medulla and reticular formation. **[g+h = 1 Hr]**
- i. Describe functions of cerebrospinal fluid (CSF), meninges.
- j. List cranial nerves and their functions. **[i+j= 1 Hr]**
- k. Describe functions of autonomic nervous system; list their effects on various organ systems. **[1 Hr]**
- l. Explain the mechanism of maintenance of body temperature **[1 Hr]**
- m. Define the terms paralysis, paresis, fever, tetanus, upper and lower motor neuron type disease **[1 Hr]**
- n. Describe the basic pathophysiology of meningitis, encephalitis, cerebellar disease, Parkinson's disease, epilepsy, schizophrenia, depression, mania, stroke. **[1 Hr]**

Unit 9: Special senses [4Hrs]

After the completion of the course, students will be to

- a. Describe structure of retina: macula, fovea centralis, optic disc, physiological blind spot.
- b. Name the photoreceptors and their functions; and trace the visual pathway. [**a +b = 1 Hr**]
- c. Describe the functions of external, middle and inner ear and trace the pathway of hearing. [**1 Hr**]
- d. Describe the taste buds, list the primary taste sensations and trace the pathway of taste.
- e. Describe the olfactory cell and olfactory membrane; and trace the pathway of smell. [**d+e = 1 Hr**]
- f. Define the terms myopia, hypermetropia, astigmatism, presbyopia, anosmia, deafness. [**1 Hr**]

Unit 10: Endocrine system [3Hrs]

After the completion of the course, students will be to

- a. Name major endocrine glands, list their hormones and functions [**1 Hr**]
- b. List the functions of growth hormone, thyroid hormone, parathyroid hormone, insulin, glucagon, cortisol and aldosterone. [**1 Hr**]
- c. Describe the basic pathophysiology of dwarfism, gigantism, acromegaly, goiter, hyperthyroidism, hypothyroidism, hyperparathyroidism, diabetes mellitus, Cushing's disease. [**1 Hr**]

Unit 11: Reproductive system [5Hrs]

After the completion of course, students will be to:

- a. Describe the functions of male and female genital organs.
- b. List the pubertal changes in males and females. [**a +b = 1 Hr**]
- c. Describe the process of spermatogenesis and oogenesis.
- d. Describe uterine and ovarian events in menstrual cycle; and hormones responsible; define menarche, amenorrhoea and menopause. [**c+d = 1 Hr**]
- e. List the functions of testosterone and estrogen hormones.
- f. List physiological changes in females during pregnancy. [**e +f = 1 Hr**]
- g. Describe mechanism of lactation and lactation reflex.
- h. Give physiological basis of contraceptives. [**g +h = 1 Hr**]
- i. Define the terms azoospermia, subfertility, abortion, dysfunctional uterine bleeding (DUB).[**1 Hr**]

PRACTICAL DEMONSTRATION (Observation only)

After the completion of course, students will be to

- a. Collect blood samples: by capillary puncture and venipuncture.
- b. Determine blood group: ABO and Rh.
- c. Examine visual acuity, field of vision and colour vision.

- d Perform tuning fork tests: Rinne's and Weber's hearing tests, vibration sensation.
- e Record body temperature from various sites of body.
- f Perform pulmonary function test: measurement of vital capacity by spirometry.
- g Examine of pulse at different sites of body.
- h Test motor and sensory function.
- i Measure blood pressure by sphygmomanometry:
 - (a) Mercury (b) Aneroid sphygmomanometer

Reference books (Latest Editions)

1. Widmaier H. R, Kevin T. S. Vander's Human Physiology: The Mechanisms of Body Function. Eric. New York. McGraw-Hill Education.
2. Guyton A C, Hall J. E. Textbook of Medical Physiology. WB Saunders Company.
3. Barrett S. M, Barman S. B, Hedden B. Ganong's Review of Medical Physiology. Kim E. McGraw-Hill Education.
4. Mahotra N. Textbook of Pathophysiology. Kathmandu. Samiksha Publications.

C. PATHOLOGY

Total teaching hours: 20 Hrs

Course Description: This course will provide basic concept of general and systemic pathology.

General objectives: At the end of the course, the students will be able to

- a Explain the concepts of cell injury and changes produced thereby in different tissues and organs and the body's capacity for healing.
- b Understand the normal homeostatic mechanisms, the derangements of these mechanism and the effects on human systems.
- c Understand the etiopathogenesis, the pathological effects and the clinico-pathological correlation of common infectious and non-infectious diseases.
- d Understand the common metabolic and haematological disorders.
- e Correlate normal and altered morphology of different organ systems in different diseases.

Specific objectives:

Unit 1: General Pathology [10 Hrs]

After the completion of the course, students will be to

- 1.1. Describe the concept of cell injury and various change produced by such injury and necrosis. [1Hr]
- 1.2. Describe basic terminologies. [1 Hr]
- 1.3. Describe important causes of inflammation and its types. Explain the mechanism of acute and chronic inflammation and its application. [1 Hr]

- 1.4. Explain the concept of wound healing. Describe steps of wound healing and factors that affect it. [1 Hr]
- 1.5. Describe the different types of thrombosis, embolism, ischemia, infarction, shock, edema, coagulation cascade. [2 Hrs]
- 1.6. Describe the disorders of tissue growth and enumerate predisposing factors of neoplasia, mechanism of spread and metastasis. Differentiate between Benign and Malignant tumours. [1 Hr]
- 1.7. Define antigen, antibody and complement. [1 Hr]
- 1.8. Describe different types of immunity and hypersensitivity. [1 Hr]
- 1.9. Discuss the pathogenesis, sign, symptoms and diagnosis of AIDS. [1 Hr]

Unit 2: Systemic Pathology [10 Hrs]

2.1. Musculoskeletal system [1 Hrs]

After the completion of the course, students will be able to

- a. List types of fractures and describe fracture healing
- b. Describe pathophysiology and morphology of osteoarthritis, Rheumatoid arthritis and Gouty arthritis.

2.2. Cardiovascular system and Hematology [2 Hrs]

After the completion of the course, students will be to

- a. Describe pathophysiology, sign and symptom of hypertension, myocardial infarction and Atherosclerosis
- b. Classify anemia and leukemia

2.3. Respiratory system [1 Hr]

After the completion of the course, students will be to

Explain pathophysiology of Tuberculosis, List its sign and symptoms and methods of diagnosis

2.4. Endocrine System [1 Hr]

After the completion of the course, students will be to

- a. Explain pathophysiology of Diabetes Mellitus, List its sign and symptoms and its complication
- b. List features of hypothyroidism and hyperthyroidism

2.5. Gastrointestinal system [2 Hr]

After the completion of the course, students will be able to

- a. Describe pathogenesis, list sign and symptoms and diagnosis of gastritis and peptic ulcer
- b. Describe different types, sign, symptoms and diagnosis of Viral hepatitis
- c. Describe pathophysiology of alcoholic hepatitis

2.6. Female genital tract [1 Hr]

After the completion of the course, students will be able to

- a. List causes of abortion. Describe sign and symptoms
- b. Describe sign and symptoms and morphology of fibroids
- c. List causes and diagnosis of cervical carcinoma and its precursor lesions

2.7. Renal system [2 Hrs]

After the completion of the course, students will be able to

- a. List causes, sign and symptoms of renal failure
- b. Describe types, sign, symptoms and complication of renal calculi
- c. Describe and differentiate nephrotic and nephritic syndromes

Reference books (Latest Editions)

1. Robbins S. L, Kumar V. Basic Pathology. W B Saunders Company.
2. Mohan H. Textbook of Pathology. Jaypee Brothers Medical Publishers (P) Ltd
3. Kamal V. Textbook of Pathology.

BIOCHEMISTRY

Subject: Theory	Year: First	Code: BP 402 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

Course Description: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is to provide biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It also emphasizes on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

General objectives:

At the end of this course, student will be able to

- a Describe the biomolecules and their biological importance the
- b Describe the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- c Describe interry metabolism of the above biomolecules and regulation of individual metabolism.
- d Describe the metabolism of biomolecules in physiological and pathological conditions.
- e Describe the biochemical basis of normal and diseased conditions of different organ systems
- f Describe the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
- g Develop skills of performing biochemical techniques like colorimetry, spectrophotormetry, centrifugation, and interpreting the data.
- h Perform and interpret the result of the analysis of biological fluids and correlating the same in health and disease.

Specific objectives:

Unit 1: Introduction of Biochemistry [2Hrs]

After the completion of the course, students will be able to

- a Define terminologis used in biochemistry.
- b Discuss scope and importance of biochemistry
- c Discuss cell-structure & function of cell membrane and subcellular organelles

Unit 2: Biomolecules [11Hrs]

After the completion of the course, students will be able to

- a Discuss definition, classification and biological importance of carbohydrates,
- b Discuss definition, classification and biological importance of Proteins
- c Discuss definition, classification and biological importance of lipids
- d Discuss types and functions of Lipoproteins.

- e Discuss functions of DNA & RNA

Unit 3: Enzymes and Bioenergetics [6 Hrs]

After the completion of the course, students will be able to

- a Discuss definition and Classification of enzymes with examples.
- b Discuss factors affecting enzyme activity.
- c Discuss definition and clinical significance of Isoenzymes and Co-enzymes
- d Discuss enzyme inhibition & regulation of enzyme activity.
- e Describe biochemical roles of enzymes in disease processes
- f Describe regulation of Electron Transport Chain and Oxidative Phosphorylation

Unit 4: Interry Metabolism of Biomolecules and [18 Hrs]

a Carbohydrate metabolism

After the completion of the course, students will be able to

- Discuss digestion and absorption of carbohydrates, proteins and lipid.
- Regulation and Clinical Significance of Glycolysis
- Regulation and Clinical Significance of Glycogenesis and Glycogenolysis
- Regulation and Clinical Significance of Gluconeogenesis
- Regulation and Clinical Significance of HMP Shunt
- Regulation and Clinical Significance of Citric Acid Cycle
- Discuss hormonal regulation of blood glucose level and Diabetes mellitus

b Lipid metabolism

After the completion of the course, students will be able to

- Discuss oxidation of saturated and unsaturated fatty acids (alpha, beta and Omega)
- Discuss formation and utilization of ketone bodies; ketoacidosis.
- Discuss De-novo synthesis of fatty acids (Palmitic acid).
- Discuss biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D.
- Discuss disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity

c Amino acid and protein metabolism

After the completion of the course, students will be able to

- Discuss: transamination, deamination & decarboxylation.
- Discuss regulation and clinical significance urea cycle.
- Discuss catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia)
- Discuss significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline

d Nucleotide Metabolism: Purine and Pyrimidines

After the completion of the course, students will be able to

- Explain De-novo and Salvage pathway.
- Discuss Genetic Disorders related to the Salvage Pathways

e. Xenobiotics

After the completion of the course, students will be able to

Discuss different mechanisms of Xenobiotic Metabolism (Hydroxylation, Conjugation, Methylation, Acetylation)

f. Liver and Bilirubin Metabolism

After the completion of the course, students will be able to

- Discuss function of Liver and Gall Bladder.
- Discuss Bilirubin Metabolism and Jaundice.
- Explain biochemical basis of different types of jaundice and their differential diagnosis.

Unit 5: Endocrine Chemistry [11 Hrs]

After the completion of the course, students will be able to

- a. Discuss classification, functions and biochemical importance of hormones of different glands. (Pituitary, Anterior, posterior, Thyroid, Adrenal cortex, Adrenal medulla)
- b. Discuss brief description of hypothalamic hormones and hormonal Regulation

Unit 6: Acid Base Balance [3 Hrs]

After the completion of the course, students will be able to

- a. Discuss buffer systems of the body and expression of concentration of a solution in different ways,
- b. Discuss acid Base Homeostasis

Unit 7: Renal and Electrolyte system [8 Hrs]

After the completion of the course, students will be able to

- a. Discuss evaluation of renal function using laboratory tests.
- b. Discuss Water and sodium distribution in the body.
- c. Explain interrelationship between water, sodium and extracellular fluid and osmolality.
- d. Discuss causes of water and sodium depletion.
- e. Discuss causes of hyponatraemia and hypernatraemia and their biochemical implications.
- f. Discuss causes of hyperkalaemia and hypokalaemia and their biochemical implications.

Unit 8: Nutrition and Biochemistry [4 Hrs]

After the completion of the course, students will be able to

- a. Define Malabsorption, Starvation and Obesity

b. Discuss Biochemical Significance of above terminologies

Unit 9: Tumor Markers [4 Hrs]

After the completion of the course, students will be able to

Discuss introduction, classification, biochemical and clinical Significance of tumor markers

Unit 10: Organ function test [4 Hrs]

After the completion of the course, students will be able to
Discuss Liver, Cardiac, Renal and thyroid function test and their Clinical Significance

Unit 11: Molecular Biology and Genetics [16 Hrs]

After the completion of the course, students will be able to

- a. Discuss Cell Cycle and Importance
- b. Discuss Genetic information pathway
- c. Define Chromosome, Gene, Genetic code, DNA, RNA.
- d. Explain DNA Replication, Transcription (RNA synthesis) and Translation (Protein synthesis) and
- e. Discuss action of drugs on DNA and RNA metabolism
- f. Discuss defects in DNA replication.
- g. Discuss mutations
- h. Explain DNA Repair Mechanisms
- i. Discuss Hybridization and Blotting Techniques
- j. Discuss RDT and Gene Therapy
- k. Discuss Vectors, PCR and Clinical Importance.

BIOCHEMISTRY

Subject: Practical	Year: First	Code: BP 402 B
Full Marks: 50	Total Teaching hours: 90	Credit hour: 2

At the end of the course, students will be able to

1. Perform qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Test for identification of Proteins (albumin and Casein)
3. Perform quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Perform qualitative analysis of urine for abnormal constituents
5. Demonstrate working of pH meter, Colorimeter and spectrophotometer
6. Estimate the glucose in serum
7. Estimate the glucose in urea
8. Estimate the glucose in protein
9. Estimate the glucose in albumin
10. Estimate the glucose in Cholesterol
11. Estimate the glucose in triglyceride
12. Estimate the uric acid in serum
13. Estimate the calcium in serum

14. Estimate the amylase in serum
15. Estimate SGOT in serum,
16. Estimate bilirubin in serum
17. Estimate alkaline phosphate in serum.
18. Perform sugar test in urine
19. Perform the albumin test in urine
20. Prepare standard buffer solutions (acetate, borate, carbonate, citrate and phosphate) and measurement of pH.
21. Perform separation of serum proteins by electrophoresis on cellulose acetate.

Reference books (Latest Editions)

1. Jayaraman J. Laboratory Manual in Biochemistry. Wiley Eastern Limited.
2. Singh S.P. Practical Manual to Biochemistry. CBS Publisher, New Delhi.
3. Nelson D. L, Cox M. M. Lehninger Principles of Biochemistry. Macmillan Worth Publishers.
4. Stryer L. Biochemistry. WH, Freeman & Company, San Francisco.
5. Murry R. K, Granner D. K, Rodwell W. Harper's Biochemistry. Lange Medical Publication
6. Satyanarayan U, ChakrapaniU. Essentials of Biochemistry. Book and Allied Pvt. Ltd.
7. Gupta R. C, Bhargavan S. Practical Biochemistry.

PHARMACEUTICAL CHEMISTRY

Subject: Theory	Year: First	Code: BP 403 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

Course Description: This subject deals with the medicinal and pharmaceutical importance of inorganic compounds, methods of preparation and test of purity of these compounds. It also emphasizes on mechanisms and orientation of reactions in Organic chemistry.

General objectives:

At the end of this course, student will be able to

- Discuss important medicinal uses of some common inorganic compounds and methods of preparation, test for purity, principle involved in the assay.
- Explain different types of substitution, addition, elimination, oxidation and reduction reactions with mechanism.
- Discuss stereochemical centers, stereochemistry and its importance in bioactivity of an organic compound.

Specific objectives:

Unit 1. Quality control and test for purity: [10Hrs]

After the completion of the course, students will be able to

- Identify sources of impurities in pharmaceutical substances.
- Understand definition, importance and general procedure for limit test for Chlorides, Sulphate, Iron and Lead.

Unit 2. Test for purity, Assay and Medicinal uses of Inorganic medicinal compounds [10 Hrs]

2.1. Gastrointestinal agents and related compounds

After the completion of the course, students will be able to

Discuss Test for purity, Assay and Medicinal uses of:

- **Acidifiers:** Ammonium chloride.
- **Antacids:** Aluminium hydroxide, Magnesium hydroxide, Light and heavy magnesium trisilicate.
- **Adsorbents and protectives:** Bismuth sub-carbonate.
- **Saline cathartics:** Magnesium sulphate

2.2. Topical Agents [6 Hrs]

After the completion of the course, students will be able to

Discuss Test for purity, Assay and Medicinal uses of

- **Astringents:** Alum and Zinc sulphate

- **Anti-microbials:** Hydrogen peroxide, Potassium permanganate, Chlorinated lime and Iodine,

2.3. Dental products [4 Hrs]

After the completion of the course, students will be able to
Discuss Test for purity, Assay and Medicinal uses of

- **Anti-caries Agents:** Sodium fluoride.
- **Dentifrices:** Calcium carbonate, Strontium chloride, and Zinc chloride.

2.4. Electrolytes used for replacement therapy:

After the completion of the course, students will be able to
Discuss test for purity, assay and medicinal uses of sodium chloride, potassium chloride, calcium gluconate and calcium lactate. [5Hrs]

2.5. Electrolytes used in the acid-base therapy:

After the completion of the course, students will be able to
Discuss Test for purity, Assay and Medicinal uses of Sodium bicarbonate, Sodium citrate, Sodium lactate, Sodium chloride injection and Oral rehydration salt.[6 Hrs]

2.6. Essential and Trace ions:

After the completion of the course, students will be able to
Discuss Test for purity, Assay and Medicinal uses of Ferrous fumarate, Ferrous gluconate and Ferric ammonium citrate. [4 Hrs]

Unit 3. Substitution reaction

After the completion of the course, students will be able to

- Study Mechanism, kinetics, stereochemistry and evidences of SN_1 and SN_2 reactions.
- Understand the role of solvent in substitution reactions and phase transfer catalysis.
- Understand the mechanism of electrophilic aromatic substitution reaction with reference to nitration and sulphonation in benzene and its derivative.[10Hrs]

Unit 4. Elimination reaction:

After the completion of the course, students will be able to

- Study the Mechanism, kinetics and evidences of E_1 and E_2 reaction.
- Discussion of isotope effect, the element effect, absence of hydrogen exchange and the absence of rearrangement.
- Study the mechanism for dehydration of alcohols.[8Hrs]

Unit 5. Addition reaction:

After the completion of the course, students will be able to

- a. Study the mechanism and rearrangement of electrophilic and free radical addition reaction mechanism in alkene.
- b. Explain heat of hydrogenation and stability of alkenes
- c. Classify Dienes
- d. Study electrophilic addition to conjugated dienes (1,2 and 1,4 addition-rate versus equilibrium). [8Hrs]

Unit 6: Stereochemistry

After the completion of the course, students will be able to

- a. Discuss stereoisomerism, tetrahedral carbon, optical activity, enantiomers, diastereoisomers, meso structures, elements of symmetry, chirality and chiral centers.
- b. Identify R and S configuration.
- c. Explain racemic modification and resolution of racemic mixture.
- d. Explain conformational isomers of ethane and n-butane.
- e. Elaborate asymmetric synthesis, stereo-selective and stereo specific reactions with examples.
- f. Study stereo chemical mechanisms for the addition of halogen to alkenes and single step elimination reaction. [7 Hrs]

Unit 7: Name Reactions:

After the completion of the course, students will be able to

- a. Study the mechanism of Aldol condensation, Claisen condensation, Cannizzaro reaction, Benzoin condensation, Perkins's condensation, Knoevenagel reaction, Reformatsky reaction, Wittig's reaction, Michael's addition, Hoffman's rearrangement, Sandmeyer's reaction, Diazotisation and coupling reaction, Williamson's synthesis, Fries rearrangement reaction, Kolbe's reaction, Friedel craft reaction and Reimer Tieman's reaction. [12Hrs]

PHARMACEUTICAL CHEMISTRY

Subject: Practical	Year: First	Code: BP 403 A
Full Marks: 50	Total Teaching hours: 90	Credit hour: 2

At the end of the course, students will be able to

1. Identify functional groups of the different classes of organic compounds by systematic qualitative analysis including preparation of their derivatives.
2. Prepare derivatives of functional groups identified from 1 and determine their melting point.
3. Perform quantitative determination of organic compounds via functional groups.
 - a. Phenolic group by bromination method.
 - b. Alcoholic group by acetylation method.
 - c. Amino group by bromination method
 - d. Ester group by hydrolysis method
 - e. Amino acid by Formal titration method.
4. Perform **limit tests**
 - a. Limit test for chlorides
 - b. Limit test for sulphate
 - c. Limit test for Iron
 - d. Limit test for Arsenic
5. Perform **assay of the following compounds**
 - a. Ferrous Sulphate – (Redox) Cerric Ammonium sulphate titration
 - b. Copper Sulphate - (Redox) Iodometry
 - c. Calcium gluconate -- complexometry
 - d. Hydrogen Peroxide – (Redox) Permanganometry
 - e. Sodium Chloride -- ModifiedVolhard's method
6. Perform estimation of the following mixtures
 - a Sodium Hydroxide and Sodium Carbonate mixture
 - b Oxalic acid and sodium oxalate

References: (Latest Editions)

1. Chatwal G.R. Advanced Inorganic Chemistry.
2. Atherden L. M. Bentley and Driver's. Textbook of Pharmaceutical Chemistry. Oxford Universit Press
3. Beckett H, Stanlake J. B. Practical Pharmaceutical chemistry. Vol-I & II.
4. Finar I.L. Organic Chemistry. Vol. II ELBS/Longman, London.
5. Morrison R. T, Boyd R. N. Morrison & Boyd.Organic Chemistry. Prentice Hall
6. Bahl A, Bahl B. S. Advanced Organic Chemistry. S Chand Publication

MEDICINAL CHEMISTRY – I

Subject: Theory	Year: First	Code: BP 404 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

Course description: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

General objectives: At the end of the course, the student will be able to:

- a. Interpret the chemistry of drugs with respect to their pharmacological activity
- b. Explain the adverse effect and therapeutic value of drugs
- c. Describe the Structural Activity Relationship (SAR) of different class of drugs
- f. Describe the importance of Structure Activity Relationships (SAR) of drugs.
- d. Discuss the chemical synthesis of mention drugs.
- e. Introduce the structure and property of new drugs use in therapy

Specific objectives:

Unit 1: Introduction to Medicinal Chemistry [5 Hrs]

After the completion of the course, students will be able to

- 1.1. Mention the history and development of medicinal chemistry
- 1.2. Discuss the physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.
- 1.3. Describe about the drug metabolism
 - a. Differentiate and understand the Phase I and II metabolism.
 - b. Describe the Factors affecting drug metabolism including stereo chemical aspects.
 - c. Classify Drug Receptors
 - d. Draw the chemical reaction of drug receptors interactions

Unit 2: Local anesthetics [3 Hrs]

After the completion of the course, students will be able to

- a. Classify local Anaesthetics
- b. List out the ester and amide derivatives
- c. Enumerate the synthetic scheme of Lidocaine from 2,6 Xylidine.
- d. Explain the SAR and properties of local Anaesthetics

e. Mention the Mechanism of action (MOA) properties of Lignocaine HCl, Tetracaine,

Unit 3: Drugs acting on Autonomic Nervous System

3.1. Adrenergic Neurotransmitters: [9 Hrs]

After the completion of the course, students will be able to

- a. Draw a biosynthetic scheme and catabolism of catecholamine.
- b. Mention the Adrenergic receptors (Alpha & Beta) and their distribution.
- c. Classify Sympathomimetic agents
- d. Describe the SAR of Sympathomimetic agents
- e. Discuss about the structure, MOA and properties of directly acting Sympathomimetic agents: Nor-adrenaline, adrenaline, Phenylephrine, Methyldopa, Clonidine, Dopamine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol, Naphazoline, Oxymetazoline and Xylometazoline.
- f. Enumerate the synthetic scheme of Adrenaline and Ephedrine.
- g. Discuss about the structure, MOA and properties of indirect acting agents: Hydroxyamphetamine, Pseudoephedrine.
- h. Discuss about the structure and properties agents with mixed mechanism: Ephedrine, Metaraminol.

3.2. Adrenergic Antagonists: [8 Hrs]

After the completion of the course, students will be able to

- a. Classify Alpha-adrenergic blockers
- b. Discuss about the structure, MOA and properties of Phentolamine, Phenoxybenzamine, Prazosin, Ergometrine and methylergometrine.
- c. Classify Beta-adrenergic blockers
- d. Describe the SAR of beta-blockers
- e. Discuss about the structure, MOA and properties of Propranolol, Atenolol, Timolol, Metoprolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.
- f. Enumerate the synthetic scheme of Propranolol.

3.3. Cholinergic neurotransmitters: [3 Hrs]

After the completion of the course, students will be able to

- a. Draw a biosynthetic scheme and catabolism of acetylcholine.
- b. Mention the cholinergic receptors (Muscarinic & Nicotinic) and their distribution.
- c. Classify Parasympathomimetic agents: SAR of Parasympathomimetic agents [6 Hrs]
- d. Discuss about the structure, MOA and properties MOA of direct acting agents like Acetylcholine, Carbachol, Bethanechol, Methacholine, Pilocarpine.
- e. Enumerate the synthetic scheme of Carbachol and Neostigmine.
- f. Discuss about the structure, MOA and properties of indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Pyridostigmine, Edrophonium chloride, Isoflurophate, Echothiophate iodide, Parathione, Malathion.

- g. Discuss about the structure, MOA and properties cholinesterase reactivator- Pralidoxime chloride and its mechanism of reactivation with reaction scheme.

3.4. Cholinergic Blocking agents: SAR of cholinolytic agents [6 Hrs]

After the completion of the course, students will be able to

- a. Classify Solanaceous alkaloids and analogues
- b. Discuss about the structure, MOA and properties of Atropine sulphate, Hysocine butylbromide, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide.
- c. Enumerate the synthetic scheme of Atropine sulphate and Dicyclomine
- d. Discuss about the structure, structure, MOA and properties and properties of synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Glycopyrrolate, Propantheline bromide, Benztropine mesylate, Biperidine hydrochloride, Ipratropium bromide, Procyclidine hydrochloride, Tridihexethyl chloride, Oxybutinin, Favoxate and Pirenzepine.

Unit 4: Drugs acting on Central Nervous System

4.1. Sedatives and Hypnotics: [7 Hrs]

After the completion of the course, students will be able to

- a. **Benzodiazepines:** Classify Benzodiazepines
- b. Describe the SAR of Benzodiazepines
- c. Discuss about the structure, MOA and properties of Chlordiazepoxide, Diazepam, Oxazepam, Chlorazepate, Lorazepam, Alprazolam,
- d. Discuss about the structure, MOA and properties of Zolpidem, Zaleplon, Zopiclone.
- e. Classify Barbiturates
- f. Describe the SAR of barbiturates
- g. Discuss about the structure, MOA and properties of Phenobarbitone, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital,
- h. Enumerate the synthetic scheme of Phenobarbitone

4.2. Antipsychotics [7 Hrs]

After the completion of the course, students will be able to

- a. Classify Phenothiazines
- b. Describe the SAR of Phenothiazines
- c. Discuss about the structure, MOA and properties of Promazine hydrochloride, Chlorpromazine hydrochloride, Triflupromazine, Prochlorperazine maleate, Trifluoperazine hydrochloride. Chlorprothixene (Loxapine succinate, Clozapine). Fluro

buterophenones (Haloperidol, Droperidol, Risperidone). Beta amino ketones (Molindone hydrochloride) and Benzamides (Levosulpride).

4.3. Anticonvulsants [6 Hrs]

After the completion of the course, students will be able to

- a. Classify anticonvulsants
- b. Describe the SAR of Hydantoins, ,
- c. Mention anticonvulsant effect of barbiturates
- d. Enumerate the synthetic scheme of Phenytoin and Carbamazepine.
- e. Discuss about the structure, MOA and properties of Fosphenytoin, Ethotoin Oxazolindiones (Trimethadione), Succinimides (Ethosuximide), Urea and monoacylureas (Carbamazepine) and Benzodiazepines (Clonazepam), Miscellaneous: Primidone, Valproic acid, Gabapentin, Pregabalin).

4.4. General anesthetics: [7 Hrs]

After the completion of the course, students will be able to

- a. Classify Inhalation anesthetics:
- b. Discuss about the structure, MOA and properties of Halothane, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.
- c. Enumerate the synthetic scheme of Halothane, Thiopental sodium and Ketamine hydrochloride.
- d. Discuss about the structure, MOA and properties of ultra-short acting barbiturates: Thiopental sodium, Methohexital sodium, Thiamylal sodium, Dissociative anesthetics: Ketamine hydrochloride.

4.5. Narcotic and non-narcotic analgesics [7 Hrs]

After the completion of the course, students will be able to

- a. Classify narcotic analgesics.
- b. Describe the SAR of Morphine analogues
- c. Discuss about the structure, MOA and properties of Morphine sulphate, Codeine, Meperidine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate, Brupenorphone. Methadone hydrochloride, Pentazocine, Levorphanol tartarate. Narcotic antagonists: Nalorphine hydrochloride, Naltrixone, Naloxone hydrochloride.
- d. Classify non-narcotic analgesics (NSAIDs)
- e. Discuss about the structure, MOA and properties of Aspirin, Diclofenac, Nimesulide, Naproxen, Ibuprofen, Ketorolac, Mefenamic acid, Piroxicam, Paracetamol
- f. Enumerate the synthetic scheme of Ibuprofen, Mefenamic acid and Paracetamol.

Unit 5: Prostaglandin and other eicosanoids [2 Hrs]

After the completion of the course, students will be to

- a. Discuss the physiological role and therapeutic uses of PGE₁, PGE₂, Misoprostol inhibitor
- b. Discuss about the structure, MOA and properties of Oxytocin

Unit 6: Cardiovascular agents [9 Hrs]

After the completion of the course, students will be able to

- a Describe about the antianginal agents and vasodilators: Amyl nitrite, Nitroglycerine, Isosorbide.
- b Describe about the Calcium antagonists: Verapamil, Nifedipine,
- c Describe about the Antiarrhythmic drugs: Procainamide, Amiodarone, Diltiazem with Verapamil.
- d Describe about other antihypertensive drugs: Reserpine, Prazocin, Methyldopa, Clonidine, Hydralazine, Sodium nitroprusside, Minoxidil, Captopril, Enalapril, Losartan, Telmisartan.
- e Classify Antihyperlipidemic agents
- f Discuss about the structure, MOA and properties of Clofibrate, Atorvastatin, Rosuvastatin Cholestyramine.
- g Classify Coagulants and Anticoagulants
- h Discuss about the structure, MOA and properties of Ethymsylate, Protamine sulphate, Dicumorol, Warfarin, Phenindione, Dipyridamole.

Unit 7: Drugs acting on endocrine system [5 Hrs]

After the completion of the course, students will be able to

- a. Discuss the Stereochemistry and metabolism of steroids
- b. Discuss about the structure, MOA and properties of Sex hormones (testosterone, progesterone, estrogen). Oral contraceptives (mifepristone, levonorgesterol, norethindrone)
- c. Discuss about the structure, MOA and properties of drugs for erectile dysfunction – sildenafil citrate
- d. Discuss about the structure, MOA and properties of Corticosteroids (hydrocortisone, prednisolone, betamethasone, dexamethasone)
- e. Discuss about the structure, MOA and properties of Thyroid and anti-thyroid drugs.

Recommended Books (Latest Editions)

Text Books:

1. Kadam S. S, Mahadik H. R, Bothara K. G. Principles of Medicinal Chemistry, Vol I and Vol II.
2. Hoover J. E. Remington's Pharmaceutical Sciences. Mack Publishing Company.

Reference Books

1. Abraham D. J. Burger's Medicinal Chemistry. Vol I to VI. Wiley-Interscience, Hoboken, NJ.
2. Block J, Beale J. M. Wilson and Gisvold's Organic Medicinal and Pharmaceutical Chemistry.
3. Lemke T, Foye W. Foye's Principles of Medicinal Chemistry. Lippincott Williams & Wilkins
4. Lednicer. The Organic Chemistry of Drug Synthesis. Vol. 1-5.
5. Kar A. Textbook of Medicinal Chemistry. New Age International Publishers.
6. Alagarsamy V. Textbook of Medicinal Chemistry. Elsevier.
7. Finar I. L. Organic Chemistry. Vol. I & II, ELBS/ Longman, London.

PHARMACOLOGY I

Subject: Theory	Year: First	Code: BP 405 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

Course Description: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (Pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

General objectives:

At the end of the course, the student will be able to

- a. Discuss the Classification, pharmacological actions of different categories of drugs
- b. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
- c. Discuss indication, contraindication and adverse effects of different categories of drugs
- d. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- e. Observe the effect of drugs on animals by simulated experiments
- f. Understand the methods in experimental pharmacology, principles of bioassay and be able to correlate drug effects with the action of drugs at the receptors
- g. To be able to identify and monitor adverse drug reactions (ADRs) and appreciate the importance of ADR reporting

- h. Understand pharmacokinetic and pharmacodynamic principles involved in the use of drugs
- i. Discuss new molecules introduced in therapy.

Specific objectives:

Unit 1: General Pharmacology [10 Hrs]

After the completion of the course, students will be able to

- a. Discuss definition and basic terminologies of pharmacology.
- b. Discuss absorption, distribution, metabolism and excretion and various factors influencing them.
- c. Discuss principles and mechanisms of drug action.
- d. Discuss classification of receptors, Signal transduction mechanisms of ligand gated ion channels, G-Protein-coupled receptors, Kinase linked receptors and receptors that regulate transcription factors.
- e. Discuss combined effects of drugs and factors modifying drug action.
- f. Discuss definition and classification of ADRs.

Unit 2: Pharmacology of Peripheral Nervous System

A. Pharmacology of Cholinergic drugs [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Cholinergic drugs:

- a. **Cholinergic transmission, cholinergic receptors**
- b. **Cholinergic agonists:**
 - **Choline esters:** Acetylcholine, Methacholine, Carbachol, Bethanechol
 - **Alkaloids:** Pilocarpine, Muscarine
- c. **Anticholinesterases:**
 - **Reversible:** Physostigmine, Neostigmine, Pyridostigmine, Rivastigmine, Tacrine
 - **Irreversible:** Carbaryl, Propoxur, Echothiophate, Malathion

B. Pharmacology of Anticholinergic drugs [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anticholinergic drugs:

- a. **Natural alkaloids:** Atropine, Hyoscine

- b. **Semisynthetic derivatives:** Homatropine, Atropine methonitrate, Hyoscine butyl bromide, Ipratropium bromide, Tiotropium bromide
- c. **Synthetic compounds:**
 - **Mydriatics:**Cyclopentolate, Tropicamide
 - **Antisecretory-antispasmodics:** Propantheline, Oxyphenonium, Clidinium, Isopropamide, Glycopyrrolate, Dicyclomie, Valethamate, Pirenzeoine

C. Pharmacology of Ganglionic stimulants [1 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Ganglionic stimulants:

- a. **Selective nicotinic agonists:**Nicotine, Varenicline, Bupropion
- b. **Nonselective muscarinic agonists:** Ach, carbachol, Pilocarpine, Anticholine esterases

D. Pharmacology of Ganglionic blockers [1 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Ganglionic blockers:

- a. **Competitive blockers:** Hexamethonium, Pentolinium, Mecamylamine, Trimethaphan
- b. **Persistent depolarizing blockers:**Nicotine (High dose), Anticholinesterase

E. Pharmacology of Adrenergic drugs [4 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Adrenergic drugs:

- a. **Adrenergic transmission, adrenergic receptors**
- b. **Pressor agents:** Noradrenaline, Ephedrine, Dopamine, Phenylephrine
- c. **Cardiac stimulants:** Adrenaline, Isoprenaline, Dobutamine
- d. **Bronchodilators:** Isoprenaline, Salbutamol, Terbutaline, Salmeterol
- e. **Nasal decongestants:** Xylometazoline, Oxymetazoline, Naphazoline, Phenylephrine, Pseudoephedrine, Phenylpropanolamine
- f. **CNS stimulants:**Amphetamine, Dexamphetamine
- g. **Anorectics:**Fenfluramine, Dexfenfluramine, Sibutramine
- h. **Uterine relaxants:**Ritodrine, Isoxsuprine, Salbutamol, Terbutaline

F. Pharmacology of α adrenergic blocking drugs [4 Hrs]

After the completion of the course, students will be able to
Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications
of α adrenergic blocking drugs

1. Nonequilibrium type- Phenoxybenzamine.

2. Equilibrium type (competitive)

a. Nonselective

- Ergot alkaloids—Ergotamine, Ergotamine
- Hydrogenated ergot alkaloids—Dihydroergotamine (DHE), Dihydroergotamine
- Imidazoline—Phentolamine
- Miscellaneous—Chlorpromazine

b. α_1 selective—Prazosin, Terazosin, Doxazosin, Alfuzosin, Tamsulosin

c. α_2 selective—Yohimbine

G. Pharmacology of β adrenergic blocking drugs [1 Hr]

After the completion of the course, students will be able to
Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications
of β adrenergic blocking drugs

a. Nonselective (β_1 and β_2)

- Without intrinsic sympathomimetic activity: Propranolol, Sotalol, Timolol.
- With intrinsic sympathomimetic activity: Pindolol
- With additional α blocking property: Labetalol, Carvedilol

b. Cardioselective(β_1): Metoprolol, Atenolol, Acebutolol, Bisoprolol, Esmolol

H. Pharmacological action of Drugs for glaucoma [1 Hr]

After the completion of the course, students will be able to
Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications
of Drugs for glaucoma

- β -adrenergic blockers: Timolol, Betaxolol, Levobunolol
- α -adrenergic agonists: Dipivefrine, Apraclonidine, Brimonidine.
- Prostaglandin analogues: Latanoprost, Travoprost, Bimatoprost.
- Miotics: Pilocarpine
- Carbonic anhydrase inhibitors: Acetazolamide
- Osmotic diuretics: Mannitol, Glycerol (Glycerine)

Unit 3: Pharmacology of Central Nervous System

After the completion of the course, students will be able to

A. General Anaesthetics [4 Hrs]

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of General Anaesthetics.

1. Inhalational

- Gas: Nitrous oxide
- Volatile liquids: Halothane, Isoflurane, Desflurane, Sevoflurane

2. Intravenous

- Fast acting drugs: Thiopentone, Methohexitone, Propofol
- Slower acting drugs: Benzodiazepines: Diazepam, Lorazepam, Midazolam
- Dissociative anaesthetic: Ketamine, Opioid analgesic: Fentanyl

B. Sedative-Hypnotics [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Sedative-Hypnotics

- **Barbiturates:** Phenobarbitone, Pentobarbitone, Thiopentone, Methohexitone
- **Benzodiazepines:** Diazepam, Chlordiazepoxide, Lorazepam, Alprazolam, Clobazepam, Temazepam, Triazolam, Flurazepam,
- **Newer agents:** Zopiclone, Zolpidem, Zaleplon

Unit 4: Pharmacology of Central Nervous System

A. Pharmacology of Antiepileptic Drugs: [3 Hrs]

After the completion of the course, students will be to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antiepileptic Drugs

- a. **Barbiturate:** Phenobarbitone
- b. **Deoxybarbiturate:** Primidone
- c. **Hydantoin:** Phenytoin, Fosphenytoin
- d. **Iminostilbene:** Carbamazepine
- e. **Succinimide:** Ethosuximide
- f. **Aliphatic carboxylic acid:** Valproate sodium, Divalproex
- g. **Benzodiazepines:** Diazepam, Clonazepam, Clobazepam, Lorazepam
- h. **Phenyltriazine:** Lamotrigine
- i. **Cyclic GABA analogues:** Gabapentin, Pregabalin
- j. **Newer agents:** Topiramate, Zonisamide, Vigabatrin, Tiagabine, Lacosamide

B. Pharmacology of Antiparkinsonian drugs [4 Hrs]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antiparkinsonian drugs

- a. **Dopamine precursor:** Levodopa
- b. **Peripheral decarboxylase inhibitors:** Carbidopa, Benserazide
- c. **Dopaminergic agonists:** Bromocriptine, Ropinirole, Pramipexole
- d. **COMT Inhibitors:** Tolcapone, Entecapone
- e. **MAO-B Inhibitors:** Selegiline, Rasagiline
- f. **NMDA receptor agonist:** Amantadine
- g. **Central anticholinergics:** Trihexyphenidyl, Procyclidine, Biperiden
- h. **Antihistaminics:** Orphenadrine, Promethazine

C. Pharmacology of Antipsychotic drugs [2 Hrs]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antipsychotic drugs:

- a. **Phenothiazines:** Chlorpromazine, Triflupromazine, Thioridazine, Trifluoperazine, Fluphenazine
- b. **Butyrophenones:** Haloperidol, Trifluoperidol, Penfluridol
- c. **Thioxanthine:** Flupenthixol
- d. **Other heterocyclic compounds:** Pimozide, Loxapine

- e. **Atypical antipsychotics:** Clozapine, Olanzapine, Risperidone, Aripiprazole.

D. Pharmacology of Antidepressant drugs [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antidepressant drugs

- **MAO inhibitors:** Moclobemide
- **SSRIs:** Fluvoxamine, Fluoxetine, Paroxetine, Sertraline, Citalopram, Escitalopram.
- **Tricyclic antidepressants:** Amitriptyline, Imipramine, Trimipramine, Doxepine, Clomipramine, Nortriptyline, Desipramine.
- **Miscellaneous agents:** Trazodone, Venlafaxine, Duloxetine, Mirtazepine, Agomelatin

E. Pharmacology of Antianxiety drugs [2 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antianxiety drugs:

- a. **Benzodiazepines:** Diazepam, Oxazepam, Lorazepam, Chlordiazepoxide, Alprazolam
- b. **Azapirones:** Buspirone, Gepirone, Isipirone
- c. **Sedative antihistaminic:** Hydroxyzine
- d. **β- adrenergic blocker:** Propranolol

F. Pharmacology of Antimanic drugs [2 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antimanic drugs

- a. **Lithium**
- b. **Anticonvulsants:** Sodium valproate, Carbamazepine, Lamotrigine
- c. **Atypical antipsychotics:** Olanzapine, Risperidone, Quetiapine, Aripiprazole

G. Pharmacology of Narcotic analgesics and antagonists [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Narcotic analgesics and antagonists:

- a. **Opioid μ-receptor agonists:**
 - i **Natural opium alkaloids:** Morphine, Codeine
 - ii **Semisynthetic opioids:** Diacetylmorphine, Pholcodeine, Ethylmorphine
 - iii **Synthetic opioids:** Pethidine, Methadone, Fentanyl, Tramadol

- b. Complex action opioids:**
 - i Agonist-antagonists:**Nalorphine, Pentazocine, Butorphanol
 - ii Partial μ -agonist + κ -antagonist:**Buprenorphine
- c. Pure opioid antagonists:**Naloxone, Naltrexone, Nalmefene
- d. Endogenous opioid peptides**

H. Pharmacology of CNS stimulants [1 Hr]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of CNS stimulants.

- a. Convulsants:** Strychnine, Picrotoxin
- b. Analeptic:** Doxapram
- c. Psychostimulants:**Amphetamines, Cocaine, Caffeine

Unit 5: Pharmacology of Cardiovascular System [4 Hrs]

i. Pharmacology of Anti-hypertensive drugs

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anti-hypertensive drugs

- a. Diuretics:**
 - **Thiazides:** Hydrochlorothiazide, Chlorthalidone, Indapamide
 - **High ceiling:**Furosemide
 - **Potassium Sparing:**Spirolactone, Eplerenone, Amiloride
- b. RAS inhibitors:**
 - **ACE inhibitors:**Captopril, Enalapril, Lisinopril, Perindopril, Ramipril, Fosinopril, Quinapril
 - **ARBs:**Losartan, Candesartan, Valsartan, Telmisartan, Irbesartan, Olmesartan
 - **Direct Renin inhibitor:** Aliskiren
- c. CCBs:**
 - Phenyl alkylamine: Verapamil
 - Benzothiazepine: Diltiazem
 - Dihydropyridines: Nifedipine, Amlodipine, Lacidipine, Felodipine, Nitrendipine, Nicardipine
- d. Vasodilators:**
 - **Arteriolar:**Minoxidil, Hydralazine, Diazoxide
 - **Both arteriolar and venular:** Sodium nitroprusside

e. Sympathetic inhibitors:

- **β blockers:** Propranolol, Metoprolol, Atenolol
- **α+β blockers:** Carvedilol, Labetalol
- **α blockers:** Prazosin, Terazosin, Doxazosin
- **Central sympatholytics:** Methyldopa, Clonidine

ii. Pharmacology of Anti-anginal drugs [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anti-anginal drugs:

A. Nitrates:

- a. Short acting: Glyceryltrinitrate, Isosorbidedinitrate (sublingual)
- b. Long acting: Isosorbidedinitrate (oral), Isosorbidemononitrate, Erythryl tetranitrate

B. β-blockers: Propranolol, Atenolol, Metoprolol

C. CCBs:

- Phenyl alkylamine: Verapamil,
- Benzothiazepine: Diltiazem,
- Dihydropyridines: Nifedipine, Amlodipine, Lacidipine, Benidipine, Nimodipine, Felodipine, Nitrendipine, Nicardipine
- Potassium channel opener: Nicorandil
- Others: Trimetazidine, Ranolazine, Ivabradine, Dipyridamole

iii. Pharmacology of Anti-arrhythmic drugs [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anti-arrhythmic drugs:

- a. **Class I:** Quinidine, Procainamide, Disopyramide, Lidocaine, Mexiletine, Propafenone, Flecainide
- b. **Class II:** Propranolol, Esmolol
- c. **Class III:** Amiodarone, Dronedarone, Dofetilide, Ibutilide
- d. **Class IV:** Verapamil, Diltiazem
- e. **Others:** Adenosine, Digoxin

iv. Pharmacology of Drugs used in congestive heart failure [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Drugs used in congestive heart failure:

a. Inotropic agents:

- **Cardiac glycosides:**Digoxin,
- **Sympathomimetics:**Dopamine, Dobutamine
- **PDE-III inhibitors:** Amrinone, Milrinone

b. RAS inhibitors:ACEIs, ARBs

c. Diuretics:Furosemide,Thiazides

d. Vasodilators:Nitrates, Hydralazine, Sodium nitroprusside

e. β -blockers:Metoprolol, Bisoprolol, Nebivolol, Carvedilol

f. Aldosterone antagonists:Spironolactone, Eplerenone

v. Pharmacology of Anti-hyperlipidemic drugs [2 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anti-hyperlipidemic drugs:

- Statins:** Lovastatin, Simvastatin, Pravastatin, Atorvastatin, Rosuvastatin, Pitavastatin
- Bile acid sequestrants:**Cholestyramine, Colestipol
- Lipoprotein lipase activators:**Clofibrate, Gemfibrozil, Benzafibrate, Fenofibrate
- Lipolysis and TG synthesis inhibitor:** Nicotinic acid
- Sterol absorption inhibitor:** Ezetimibe

vi. Pharmacology of Anti-coagulants [3 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Anti-coagulants

a. Parenteral anticoagulant

- Indirect thrombin inhibitors: Heparin, Low molecular weight heparins
- Direct thrombin inhibitors:Bivalirudin,Argatroban

b. Oral anticoagulants: Warfarin sodium, Phenindione, Rivaroxaban

vii. Pharmacology of Fibrinolytic drugs [1 Hrs]

After the completion of the course, students will be able to

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Fibrinolytic drugs: Streptokinase, Urokinase, Alteplase, Reteplase, Tenecteplase

viii. Pharmacology of Antiplatelet drugs [2 Hrs]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antiplatelet drugs (antithrombotic drugs): Aspirin, Dipyridamole, Clopidogrel, Ticlopidine

ix. Pharmacology of Diuretics [2 Hrs]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Diuretics:

A. High-ceiling: Furosemide, Bumetadine, Torsemide

B. Medium efficacy:

a. Thiazides: Hydrochlorothiazide, Hydroflumethiazide, Benzthiazide

b. Thiazide-like: Chlorthalodone, Metolazone, Xipamide, Indapamide, Clopamide

C. Weak diuretics:

a. Carbonic anhydrase inhibitor: Acetazolamide

b. Osmotic diuretics: Mannitol, Isosorbide, Glycerol

c. Potassium sparing diuretics:

• **Aldosterone antagonist:** Spironolactone, Eplerenone

• **Renal epithelial Na⁺ channel inhibitor:** Amiloride, Triamterene

Unit 6: Pharmacology of Antidiuretics [1 Hr]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antidiuretics: Vasopressin.

Unit 7: Pharmacology of vitamins [5 Hrs]

After the completion of the course, students will be able to Discuss Classification and Pharmacological action of vitamins.

Unit 8: Pharmacology of Local Anaesthetics [2 Hrs]

After the completion of the course, students will be able to Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Local Anaesthetics

A. Injectable anaesthetic

a. Low potency, short duration: Procaine, Chlorprocaine

b. Interte potency and duration: Lidocaine (Lignocaine), Prilocaine

c. High potency, long duration: Tetracaine (Amethocaine), Bupivacaine, Ropivacaine, Dibucaine (Cinchocaine)

B. Surface anaesthetic

- a. Soluble: Cocaine, Lidocaine, Tetracaine, Benoxinate
- b. Insoluble: Benzocaine, Butamben, Oxethazaine

Unit 9: Gene Therapy [2 Hrs]

After the completion of the course, students will be able to
Discuss principle of Gene Therapy

PHARMACEUTICAL MICROBIOLOGY

Subject: Theory	Year: First	Code: BP 406 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

Course Description: Scope of microbiology is the study of all organisms that are invisible to the naked eye- that is the study of microorganisms. Microorganisms are necessary for the production of bread, cheese, beer, antibiotics, vaccines, vitamins, enzymes etc. Microbiology has an impact on medicine, agriculture, food science, ecology, immunology, molecular microbiology etc.

General objectives: At the end of this course, the student will be able to

- a. Explain methods of identification and preservation of various microorganisms
- b. Discuss importance of sterilization in microbiology.
- c. Perform sterility testing of pharmaceutical products.
- d. Describe microbiological standardization of Pharmaceuticals.
- e. Use different techniques in the production of Pharmaceutical products, quality assurance of different pharmaceutical preparations
- f. Acquire knowledge on selection of suitable antimicrobial agents for treatment of infection.

Specific objectives:

Unit 1: Introduction to microbiology [2 Hrs]

After the completion of the course, students will be able to

Discuss Historical Development of Microbiology and Scope and importance of Pharmaceutical Microbiology

Unit 2: Classification of microbes [10 Hrs]

After the completion of the course, students will be able to

Discuss classification of medical important microorganism, eukaryotes and prokaryotes (bacteria, virus, fungi and parasites).

Unit 3: Growth and preservation of bacteria. [10 Hrs]

After the completion of the course, students will be able to

Discuss nutritional requirement and environment factor for growth and preservation of bacteria

Unit 4: Control of microbes by physical and chemical method [18 Hrs]

After the completion of the course, students will be able to

- a. Explain different methods of sterilization, sterilization process control and sterility testings of products.
- b. Discuss Chemical disinfectants, antiseptics and preservatives.

Unit 5: Isolation and identification of bacteria [15 Hrs]

After the completion of the course, students will be able to

- a. Discuss different methods used in isolation and identification of bacteria with use of different culture, staining technique and biochemical reaction.
- b. Discuss methods of bacterial counts.

Unit 6: Antibiotics [13 Hrs]

After the completion of the course, students will be able to

- a. Discuss manufacture of antibiotics: Production of penicillin and streptomycin
- b. Discuss mode of action of antibiotics (cell wall cytoplasmic membrane, cytoplasm and compounds)
- c. Discuss clinical use of antimicrobial drugs in different body system
- d. Discuss mechanism and type of bacterial resistance
- e. Discuss problems in antibiotic therapy due to resistance
- f. Discuss Microbiological assay of antibiotics

- g. Discuss Antibiotic susceptibility testing [Disc diffusion technique, Dilution technique (MIC, MBC), Evaluation of Static activity (fungus, bacteria) and Evaluation of Germicidal activities (fungus, bacteria)]

Unit 7: Normal flora of human body [3 Hrs]

After the completion of the course, students will be able to

- a. Mention normal flora in human body
- b. Discuss principle of microbial pathogenicity.

Unit 8: Fundamental of immunology/Molecular microbiology [19 Hrs]

After the completion of the course, students will be able to

- a. Discuss Infection and immunity
- b. Describe Antigen and antibody reaction
- c. Discuss Toxin, toxoid and vaccine.
- d. Discuss Recombinant DNA and protein based vaccines
- e. Describe types of hypersensitivity
- f. Discuss Serodiagnostic tests and use of molecular microbiology in pharmaceutical industry.
- g. Discuss Complement system: Components of Complement system. Three pathways of complement activation
- h. Discuss Animal models and transgenic animals and their use in immunological studies, Transgenic animals
- i. Discuss Techniques in molecular immunology: Hybridoma technology (Monoclonal antibody), Antibody engineering, Chimeric antibodies, Antisense oligonucleotides and Phage display
- j. Discuss Experimental immunology: Vaccine development (Recombinant, Combined and polyvalent vaccines) and Stem cell technology. Reverse vaccinology