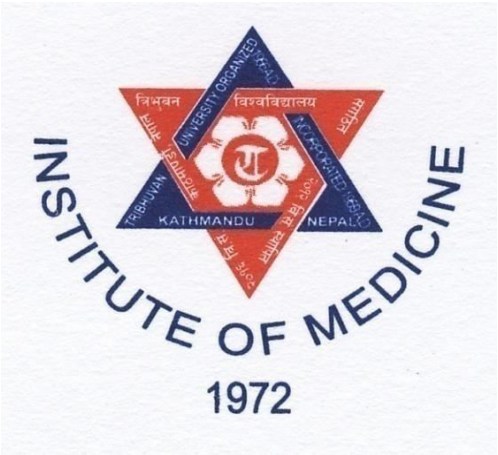
Curriculum

on

Bachelor in Pharmacy

(B. Pharm)



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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 Pharmaceutics I (Physical Pharmacy)-	3	90	6	100
BP 501 B	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 BP 503 B	Biopharmaceutics and Pharmacokinetics- Theory Biopharmaceutics and Pharmacokinetics- Practical	3 3	90 90	6 2	100 50
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

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 ted immunity, antibody ted 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-l 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 Performe 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 Sannders Company.
3. Barrett S. M, Barman S. B, Heddwen 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 andsystemic 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 casacde. **[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 facture 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 infraction 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. Decribe 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 Nuceotide 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 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

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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 **e**valuation 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 albmin
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

a. Discuss important medicinal uses of some common inorganic compounds and methods of preparation, test for purity, principle involved in the assay.

b. Explain different types of substitution, addition, elimination, oxidation and reduction reactions with mechanism.

c. 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

a. Identify sources of impurities in pharmaceutical substances.
b. 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 medicnal 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

a. StudyMechanism, kinetics, stereochemistry and evidences of SN_1 and SN_2 reactions.
b. Understand the role of solvent in substitution reactions and phase transfer catalysis.
c. Understand the mechanism of electrophilic aromatic substitution reaction with reference to nitration and sulphonation in benzene and it`s derivative.**[10Hrs]**

Unit 4. Elimination reaction:

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

a. Study theMechanism, kinetics and evidences of E_1 and E_2 reaction.
b. Discussion of isotope effect, the element effect, absence of hydrogen exchange and the absence of rearrangement.
c. 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. Discussstereoisomerism, 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 l**imit tests**

a. Limit test for chlorides
b. Limit test for sulphate
c. Limit test for Iron
d. Limit test for Arsenic

5. Perform a**ssay 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 Ephidrine.
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, Isofluorphate, 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, Ipratomium 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. ClassifyBarbiturates

f. Describe the SAR of barbiturates

g. Discuss about the structure, MOA and properties of Phenobarbitone, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, 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 Phenothiazeines

b. Describe the SAR of Phenothiazeines

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 Oxazolidine diones (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 barbitutrates: 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, Brupenorphine. 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 PGE_1, PGE_2, 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:** Acetycholine, 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, Dobutamin**e**

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 ȧ 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 ȧ adrenergic blocking drugs

1. **Nonequilibrium type**- Phenoxybenzamine.
2. **Equilibrium type (competitive)**
   a. Nonselective
      - Ergot alkaloids—Ergotamine, Ergotoxine
      - Hydrogenated ergot alkaloids—Dihydroergotamine (DHE), Dihydroergotoxine
      - Imidazoline—Phentolamine
      - Miscellaneous–Chlorpromazine

   b. ȧ1 selective—Prazosin, Terazosin,Doxazosin, Alfuzosin,Tamsulosin

   c. ȧ2 selective—Yohimbine

G. Pharmacology of ß 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 ß adrenergic blocking drugs

a. **Nonselective (ß1 and ß2)**
   - Without intrinsic sympathomimetic activity: Propranolol, Sotalol, Timolol.
   - With intrinsic sympathomimetic activity: Pindolol
   - With additional ȧblocking property: Labetalol, Carvedilol

b. **Cardioselective(ß1):** 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

- ß-adrenergic blockers: Timolol,Betaxolol, Levobunolol
- ά-adrenergic agonists:Dipivefrine, Apraclonidine,Brimonidine.
- Prostaglandinanalogues: Latanoprost, Travoprost, Bimatoprost.
- Miotics: Pilocarpine
- Carbonicanhydraseinhibitors: Acetazolamide
- Osmoticdiuretics: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, Opiod 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:**Gabaprntin, 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, Thioridazone, Trifluoperazine, Fluphenazine
b. **Butyrophenones:**Haloperidol, Trifluperidol, 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, Ispapirone
c. **Sedative antihistaminic:**Hydroxyzine
d. **ß- adrenergic blocker:**Propranolol

F. Pharmacology of Antimaniac drugs [2 Hrs]

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

Discuss Classification, Mechanism, Pharmacological action, Side effects and Contraindications of Antimaniac 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 opoid 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:**Spironolactone, 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:**
   - **ß blockers:**Propranolol, Metoprolol, Atenolol
   - **ȁ+ß blockers:**Carvedilol, Labetalol
   - **ȁ 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, Erythrityl tetranitrate

B. ß-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: A**mrinone, Milrinone
- **b. RAS inhibitors:**ACEIs, ARBs
- **c. Diuretics:**Furosemide,Thiazides
- **d. Vasodilators:**Nitrates, Hydralazine, Sodium nitroprusside
- **e. ß-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**:**

a. **Statins:** Lovastatin, Simvastatin, Pravastatin, Atorvastatin, Rosuvastatin, Pitavastatin
b. **Bile acid sequestrants:**Cholestyramine, Colestipol
c. **Lipoprotein lipase activators:**Clofibrate, Gemfibrozil, Benzafibrate, Fenofibrate
d. **Lipolysis and TG synthesis inhibitor:** Nicotinic acid
e. **Sterol absorbtion 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, Chloroprocaine
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: Introducvtion 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 is 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

PHARMACEUTICAL MICROBIOLOGY

Subject: Practical	Year: First	Code: BP 406 B
Full Marks: 50	Total Teaching hours: 90	Credit hour: 2

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

a Mention rules and regulation, code of conduct and safety precautions in microbiology laboratory.
b Demonstrate lab equipments used in microbiology.
c Prepare , chemicals, reagents and sterilize including glassware
d Perform Staining technique: Gram stains, Ziehl Neelsen stain.
e Prepare different culture for isolation of microorganisms
f Perform inoculation technique for isolation of pathogen (pure culture) from clinical specimens
g Demonstrate Biochemical and motility tests
h Perform antibiotic susceptibility test
i Determine Minimum Inhibitory Concentration (MIC)
j Antibiotic evaluation: Perform microbiological assay of antibiotics by cup plate method
k Perform sterility testing for powders, liquids and solution
l Perform isolation of antibiotic producing microorganism from soil sample
m Perform Sero-diagnosis of microbial disease by Kit and ELISA techniques
n Demonstration of molecular techniques (PCR)
o Demonstrate quality control pharmaceuticals product samples in relation to microbiology

Reference books (Latest Editions)

a. Essentials of Medical Microbiology. Apurba Sankar Sastry, Sandhya Bhat K. JP Borthers Medical Publishers. 1st edi. 2016
b. Hugo W. B, Russel A. D. Pharmaceutical Microbiology. Blackwell Scientific Publications, UK.
c. Pelczar M. J, Chan E. C, Krieg N. R, Edwards D. D, Pelczar M. F. Microbiology: concepts and applications. New York: McGraw-Hill.
d. Remington J. P, Osol A, Anderson JT, Hoover JE. Remington's pharmaceutical sciences.
e. Kokare C. R. Pharmaceutical microbiology-principles and applications. Nirali Prakashan.
f. Ghimire P. Hand book of Practical Microbiology, 2003, Pravesh Publication, Kathmandu