	First stage		
No.	**المادة**	**Lecture title**	**Hours**
1	Human Biology	Biology	2
		Cell	2
		Tissues, bone and cartilages	3
		Nervous system (central & peripheral)	4
		Nutrition	2
		Digestive system (Mouth, Esophagus, Stomach)	2
		Digestive system (intestine)	1
		Excretory system & respiration	3
		Human genetics (chromosomes & semi-lethal genes)	3
		Skin	2
		Circulatory system	3
		Immunity (Inflammation, immunity & the blood , immunity to disease)	3
2	Principles of Pharmacy Practice	Some fundamentals of measurements and calculations.	4
		Interpretation of prescription or medication orders.	4
		The metric system.	4
		Calculation of doses.	4
		Reducing and enlarging formulas.	4
		Density, specific gravity and specific volume.	4
		Percentage and ratio strength calculation.	6
3	Analytical Chemistry	Review of elementary concept important to analytical chemistry: Strong and weak electrolytes; important weight and concentration units.	4
		The evaluation of analytical data: Definition of terms.	1
		An introduction to gravimetric analysis: Statistical analysis of data; rejection of data; precipitation methods; gravimetric factor.	9
		The scope of applications of gravimetric analysis: Inorganic precipitating agents; organic precipitating agents.	4

		An introduction to volumetric methods of analysis: Volumetric calculations; acid-base equilibria and pH calculations.	5
		Buffer solutions: Theory of neutralization titrations of simple system.	3
		Theory of neutralization titrations of complex system; Precipitation titrations.	5
		Calculation of pH in complex system; Volumetric methods based on complex system.	4
		Equilibria in oxidation-reduction system; theory of oxidation-reduction titrations.	6
		Spectrophotometric analysis: An introduction to optical methods of analysis; Methods based on absorption of radiation.	4
4	Computer Sciences	General concept: Information technology (IT); Computer systems (hardware, software, user); types of computers; major parts of the computer	3
		Hardware: Hardware; input and output devices; central processing unit (CPU).	4
		Memory, storage media and performance: Memory; kind of memory (RAM, ROM, cache memory, flash memory); data representation in memory; storage devices (secondary storage); kind of storage devices; computer performance.	6
		Computer software: Software (system software, application software); programming languages; generation of programming languages (machine language, assembly language, high level language, application generators, objective oriented language); compiler and interpreters; operating systems (O.S); function and type of O.S; type of software according to source; (commercial, shareware, freeware and public domain); interface, multimedia; system development.	6
		Data Communication and network: Data communication; work group computing; type of networks; local area network (LAN); wide area network (WAN); WAN Devices (HUB, router, get way, bridge, repeater); networks topologies; data communication hardware; protocols.	5

		The internet: Internet development; using the internet; internet services; search engines; electronic mail; general concept of internet; viruses and type of virus; protection from virus; security system and information security; data protection act; computer crimes.	6
5	Mathematics and Biostatistics	Mathematics: General concepts; coordinate and graph in plane; inequality; absolute value or magnitude; function and their graphs; displacement function; slope and equation for lines.	6
		Limits and continuity: Limits; theorem of limits; limit involving infinity; continuity; continuity conditions.	4
		Derivatives: Line tangent and derivatives; differentiation rules; derivative of trigonometric function; practice exercises.	6
		Integration: Indefinite integrals; rules for indefinite integrals; integration formulas for basic trigonometric function; definite integrals; properties of definite integrals; practice exercises.	6
		Biostatistics: General concepts of statistics; statistical methods; statistical theory; applied statistics; statistical operations.	2
		Probability concepts: Properties of probability; Set theory and set notation (basic notation); counting techniques-permutations and combinations; calculating the probability of an events; probability distribution of discrete variable; binomial distribution, Poisson distribution; continues probability distribution and normal distribution, review questions and exercises.	6
		The concept of central tendency: Mean of sample and mean of population; median; mode; measure of central tendency; review questions and exercises.	6
		Deviations and variation: Deviation; dispersion and variability; standard deviation and variance; coefficient of variations; standard error; correlation analysis.(regression model and sample regression equation); application of statistic in medical field; review questions and exercises.	9
	Medical Terminology	Basic word roots and common suffixes	1

6		More word roots, suffixes and prefixes related to pharmaceutical sciences (pharmacognosy, clinical pharmacy, pharmaceutics,…etc)	1
		Basic anatomical terms and abnormal conditions	2
		The genitals and urinary tract	1
		The gastrointestinal tract	1
		The heart and cardiovascular system	1
		Symptoms, diagnoses, treatments, communication qualifiers, and statistics	2
		Growth and development, and body orientation	1
		Gynecology, pregnancy, and childbirth	1
		The eye and the respiratory tract	1
		The nervous system and behavioral disorders	2
		Blood and immunity	1
7	Human Anatomy	**Circulatory system:** Location of vascular system (Heart, Arteries, Veins)	1
		Circulatory system: Location of lymphatic system (Lymphatic capillary).	1
		Lymphoid tissue: location of the (Thymus gland, Spleen & Lymph nodes)	1
		Lymphoid nodule (MALT) & Tonsils	1
		Nervous system: Central & Peripheral nervous system by location	1
		Respiratory system: -Conducting portion (Nose, Nasopharynx, Trachea Bronchus & Bronchioles). -Respiratory portion (Lung)	1
		Digestive system: -location of different parts of digestive tract (GIT) (Oral cavity, Mouth, Esophagus & Stomach) -Small intestine, Large intestine, Rectum & Anus.	2
		Digestive system: Glands associated with the digestive tract by location (Salivary glands, Pancreas, Liver & Gall bladder).	1

		Endocrine system: -location of the pituitary gland -location of the Adrenal, Thyroid, Parathyroid, Islet of Langerhans & Pineal glands.	1
		Male reproductive system: -location of the testes. -Excretory genital ducts -Excretory genital glands (Seminal vesicles, Prostate & Cowper's glands)	2
		Female reproductive system: -location of ovary, Oviduct, Uterus & Vagina.	2
		Urinary system: -location of the (kidney & nephrone) - location of the (Ureter, Bladder & Urethra).	1
8	Pharmaceutical Calculations by Stoklosa	Dilution and concentration of pharmaceutical preparations.	10
		Isotonic solutions.	6
		Electrolyte solutions (milliequivalents, millimoles and milliosmoles).	6
		Constituted solutions, I.V admixtures and flow rate calculations.	8
9	Medical Physics	General concepts: Method of physics and standards; thermodynamics system and system properties; conservation of energy principle; application of thermodynamics; the Zeroth law.	3
		Pressure; temperature and temperature scales (Celsius, Fahrenheit, Kelvin); equation of state; ideal gas and real gas; general law of gases; clauses equation and Vander Waales equation; equilibrium and types of equilibrium; compressibility factor, coefficient of volume expansion, elastic coefficient (bulk modulus).	6
		Heat and energy; work and mechanical forms of work; power; the 1st law of thermodynamics; Boyles and Charles law; practice exercises.	3
		The 2nd law of thermodynamics; reversible and irreversible process; entropy and enthalpy; internal energy; heat capacity and adiabatic process; the relation between pressure, volume, and temperature in adiabatic process.	6

		Fundamental of physics: Kinetic theory of a gas; electromagnetic waves; Maxwell equations; physical optics.	6
		Radiation: Kirshoffs law; planks law; Stefan-Boltzman law; Wiens law; Black body and Albedo; Heat transfer (radiation, convection, conduction).	6
		Production of X-Ray and X-Ray spectra; absorption of X-Ray; U.V and IR effects; medical and biological effects of radiation; radiotherapy.	3
10	Organic Chemistry I	Introduction.	3
		Alkanes and methane.	6
		Alkenes I and II	5
		Alkynes and dienes.	5
		Stereochemistry I & II	8
		Alcohols and ethers.	8
		Alkyl halides.	6
		Cycloalkanes.	4
11	Histology	**Circulatory system:** Structure of the vascular system (Heart wall, Arteries, Veins & Capillaries)	2
		Circulatory system: Structure of the lymphatic system (Lymphatic capillary).	1
		Lymphoid tissue: Structure & function of the (Thymus gland, Spleen & Lymph nodes)	1
		Lymphoid nodule (MALT) & Tonsils	1
		Nervous system: Central & Peripheral nervous system	3
		Respiratory system: -Conducting portion (Nose, Nasopharynx, Trachea Bronchus & Bronchioles). -Respiratory portion (Lung)	3
		Digestive system: -Digestive steps. -General structure of the digestive tract (GIT) (Oral cavity, Mouth, Esophagus & Stomach) -Small intestine, Large intestine, Rectum & Anus.	3
		Digestive system: Glands associated with the digestive tract (Salivary glands, Pancreas, Liver & Gall bladder0.	1

		Endocrine system: -General structure of the pituitary gland -Histophysiologies of the pituitary gland.	2
		Endocrine system: -General structure of the Adrenal, Thyroid, Parathyroid, Islet of Langerhans & Pineal glands.	2
		Male reproductive system: -General structure of the testes. -Stages of spermatogenesis.	2
		Male reproductive system: -Excretory genital ducts-Excretory genital glands (Seminal vesicles, Prostate & Cowper'sglands)	1
		Female reproductive system: -General structure of ovary, Oviduct, Uterus & Vagina. -Stages of follicle development. -Ovulation	3
		Urinary system: -Structure & Function of the (kidney & nephrone) -Histology of the nephrone (filtration, absorption & excretion). - Structure of the (Ureter, Bladder & Urethra).	3
		The skin Thick & Thin skin	2

	Second stage		
	المادة	Lecture title	hours
1	Organic Chemistry II	Aromatic Hydrocarbons (includes benzene, electrophilic aromatic substitution, arenas and their derivatives).	10
		Carboxylic acids: properties and reactions.	5
		Functional derivatives of carboxylic acids.	7
		Amines I and II.	6
		Aldehydes and ketones (include also aldol and Claisen condensation); Classification, reactions and properties.	12
		Phenols.	5
	Medical Microbiology,	Importance of microbiology, History of microbiology	2
		Anatomy of bacteria: Surface appendage, Capsule, Cell wall of G.+ve & G –ve bacteria, Cytoplasmic membrane.	2
		Bacterial physiology: Physical and chemical growth determinate, growth and growth curves, bacterial reproduction.	2
		Genetics: Definition, genetic, element, mutation (spontaneous, gene transfer, transformation, conjugation, and gene transduction).	2
		Recombinant DNA biotechnology.	2
		Sporulation and germination.	2
		Sterilization (chemical + physical Methods).	2
		Chemotherapy.	2
		Morphology of Bacteria, Staining and Classification.	1
		Staphylococci species: *Streptococcus pyogenes*; *Streptococcus pneumoniae*	3
		Aerobic Spore-forming bacteria Bacillus species (*B. anthracis*, *B. subtilis*, *B. ceseus*).	1
		Clostridium perfringens; *Clostridium tetani*; *Clostridium botuliun*	3

		Corynebacterium diphtheriae	1
		Propionibacterium acnes, *Listeria*	1
		Mycobacterium tuberculosis; *M. leprae*	1
		Chlamyadiae; Actinomycetes	2
		Identification & classification of G -ve bacteria	1
		Enterobacteriaceae: *E. coli*; Klebsiella spp.; *Cilrobacte , Sertalia,*	4
	: Physiology I	The general and cellular basis of medical physiology.	5
		Physiology of nerves and muscles: Nerve cells; excitation and conduction; Properties of mixed nerves; glia; neurotrophins; Nerve fiber types and functions; Muscles: Skeletal muscle; smooth muscle; cardiac muscle. Synaptic transmission: Reflexes; cutaneous, deep and visceral sensations; alert behavior, sleep and electrical activity of the brain; control of posture and movement; higher function of the nervous system; central regulation of visceral function; the autonomic nervous system.	16
		Respiration: Respiratory zones; Mechanics of respiration; air volumes; respiratory muscles; compliance of the lungs and chest wall; surfactants; differences in ventilation and blood flow in deferent parts of the lung; Dead space and uneven ventilation; Pulmonary circulation: Pressure, volume and flow. Gas transport between the lungs and tissue; Regulation of respiration: Neural control of breathing; Respiratory centers; Regulation of respiratory activity: Chemical factors; non chemical factors; Respiratory adjustment in health and disease; Effect of exercise; Hypoxia; Emphysema; Asthma.	8

	Renal Physiology: Introduction; innervations of the renal vessels; renal clearance; renal blood flow; glomerular filtration rate (GFR): Measurements; factor affecting GFR; Filtration fraction; reabsorption of Na^+, Cl^- and glucose. Tubuloglomerular feedback and glomerulotubular balance; water excretion in: proximal tubules; loop of henle; distal tubules; collecting ducts; the counter current mechanism; role of urea; water diuresis and osmotic diuresis; acidification of the urine: H^+ secretion; reaction with buffers; ammonia secretion; factors affecting acid secretion; bicarbonate execration; regulation of Na^+, K^+ and Cl^- excretion; uremia; acidosis; micturition.	8
	Cardiovascular system: origin and spread of cardiac excitation; the electrocardiogram; cardiac arrhythmias; electrographic findings in cardiac diseases; mechanical events of the cardiac cycle; cardiac output; cardiovascular regulatory mechanisms: Local regulatory mechanisms; systemic regulation by the nervous system; systemic regulation by hormones; Coronary circulation; Hypertension; Heart failure; Angina pectoris.	8
Physical Pharmacy I	States of matter, binding forces between molecules, gases, liquids, solid and crystalline matters; phase equilibria and phase rule; thermal analysis.	10
	Thermodynamics, first law, thermochemistry, second law, third law, free energy function and applications.	8
	Solutions of non-electrolytes, properties, ideal and real colligative properties, molecular weight determination.	7
	Solution of electrolytes, properties, Arrhenius theory of dissociation, theory of strong electrolytes, ionic strength, Debye-Huchle theory, coefficients for expressing colligative properties.	5
	Ionic equilibria, modern theories of acids, bases and salts, acid-base equilibria, calculation of pH, acidity constants, the effect of ionic strength and free energy.	8
	Buffered and isotonic solutions: Buffer equation; buffer capacity; methods of adjusting tonicity and pH; buffer and biological system.	7
	Patient-Centered Communication in Pharmacy Practice	2

Communication Skills	Principles and Elements of Interpersonal Communication	2
	Nonverbal type of communication.	2
	Barriers to communication.	2
	Listening and empathic responding during communication.	2
	Assertiveness.	2
	Interviewing and assessment.	2
	Helping patients to manage therapeutic regimens.	2
	Patient counseling; counseling check list; point-by-point discussion; counseling scenario.	2
	Medication safety and communication skills.	2
	Strategies to meet specific needs.	2
	Communicating with children and elderly about medications.	2
	Communication skills and inter-professional collaboration.	2
	Electronic communication in healthcare.	2
	Ethical behavior when communicating with patients.	2
Organic ChemistryIII	Heterocyclic system: Classes of heterocyclic systems; general structures; properties; Occurrence in nature and in medicinal products.	5
	Five-membered ring heterocyclic compounds: pyrrole; furan and thiophen.	3
	Source of pyrrole, furan and thiophen.	2
	Electrophilic substitution in pyrrole, furan and thiophen: Reactivity and orientation.	5
	Six-membered ring heterocyclic compounds: Structure & reactions of pyridine.	4
	Saturated five-membered heterocyclic compounds.	6
	Heterocyclic of five & six member rings with two & three heteroatoms.	5
Medical Virology and Parasitology	Introduction.	3
	Intestinal protozoa (Amoeba, Balantidium, Giardia, Chilomastix)	5
	Haemoflagellates: Leshmania spp.; Trypanosome spp.	4
	Sporozoa: Malarial parasites of human; Toxoplasma.	4

	Helminthes: Classification, Flukes: Hepatic flukes, Blood flukes (Schistosoma spp).Tap worms: Taenia spp., Echinococcus (Hydatid cyst).Nematods: Ascaris, Entrobius.	10
	Virology: Introduction, Comparison between viruses and bacteria and other microbes; Classification of viruses; Replication; Chemotherapy; *Herpes viridae*; Orthomyxo viruses; Paramyxo viruses; Retro viruses; Hepato viruses; Oncogenic viruses.	16
Physical PharmacyII by Alfred Martin et a	Solubility and distribution phenomena, solvent-solute interactions, solubility of gases in liquids, solubility of liquids in liquids, solubility of non-ionic solids in liquids, distribution of solutes between immiscible solvents.	10
	Complexation, classification of complexes, methods of analysis, thermodynamic treatment of stability constants.	5
	Kinetics, rate and orders of reactions, influence of temperature and other factors on reactions rate, decomposition of medicinal agents and accelerated stability analysis.	9
	Interfacial phenomena, liquid interfaces, surface free energy, measurement of interfacial tension, spreading coefficient, surface active agents and wetting phenomena.	5
	Colloids, dispersed system and its pharmaceutical application, types of colloidal systems, kinetic properties, diffusion, zeta potential, solubilization.	5
	Micrometrics, particle size, methods of determining particle size, particle shape and surface area, porosity, density.	3
	Rheology, Newtonian systems, thixotropy measurement, negative thixotropy, determination of thixotropy.	5
	Polymer science, definitions pharmaceutical applications, molecular weight averages.	3

Physiology II	Gastrointestinal function: Digestion and absorption of carbohydrates; proteins; lipids; absorption of water and electrolytes; vitamins and minerals; regulation of gastrointestinal function: Introduction; gastrointestinal hormones; mouth and esophagus; stomach; exocrine portion of the pancreas; liver and biliary system; small intestine; colon.	10
	Circulatory body fluid: Introduction; blood; bone marrow; white blood cells; immunity; platelets; red blood cells; anemia; polycythemia; blood group and Rh factor; hemostasis: The clotting mechanism / blood coagulation tests; anti clotting mechanism; the plasma; the lymph; abnormalities of hemostasis.	15
	Endocrinology: Introduction; energy balance, metabolism and nutrition; the pituitary gland; the thyroid gland; the gonads: development and function of the reproductive system; the adrenal medulla and adrenal cortex; hormonal control of calcium metabolism and the physiology of the bone; endocrine functions of the pancreas and regulation of carbohydrate metabolism.	20
Pharmacognosy I	General Introduction: The Scope of Pharmacognosy, definitions and basic principles.	3
	Drugs from natural sources, crud drugs, official and non-official drugs.	1
	Classification of natural products.	2
	Plant nomenclature and taxonomy.	2
	Production of crude drugs: Cultivation, collection, drying and storage.	3
	Deterioration of crude natural products.	1
	Chemistry of natural drug products.	3
	Quality control: Evaluation of natural products; macroscopical evaluation; physical evaluation; chemical evaluation; biological evaluation; spectroscopical evaluation.	4
	Phytochemical investigation of herbal products: Extraction of the plant material; Separation and isolation of constituents; characterization of the isolated compounds.	4
	Separation technique: Introduction; Mechanisms of separation and classification based on the type of technique; paper chromatography; Thin layer chromatography; Ion-exchange chromatography; Gel filtration chromatography; Column chromatography; Gas chromatography; HPLC; Electrophoresis; Affinity chromatography.	15
	Traditional plant medicines as a source of new drugs. Bioassay-guided fractionation	3

	Tissue culture of medicinal plant: Introduction and history; laboratory of the plant tissue culture; aseptic techniques Application of the plant tissue culture; environmental and biological control; plant growth regulators.	4

Third stage		
المادة	**Lecture title**	**hours**
Inorganic Pharmaceutical Chemistry	Atomic and molecular structure/ Complexation.	6
	Essential and trace ions: Iron, copper, sulfur, iodine.	3
	Non essential ions: Fluoride, bromide, lithium, gold, silver and mercury.	2
	Gastrointestinal agents: Acidifying agents.	1
	Antacids.	2
	Protective adsorbents.	1
	Topical agents.	2
	Dental agents.	1
	Radiopharmaceutical preparations.	6
	Radio opaque and contrast media.	6
Pharmacognosy II	Introduction: General biosynthesis pathways of secondary metabolites.	2
	Carbohydrates.	2
	Glycosides: Biosynthesis, physical and chemical properties; cardiac glycosides; saponin glycosides; anthraquinone glycosides; flavonoid glycosides; cyanophore lycosides.	5
	Glycosides: Isothiocyanate glycosides; aldehyde glycosides; alcoholic glycosides; phenolic glycosides; lactone glycosides; coumarins and chromones.	5
	Resins and resin combination; tannins.	2
	Lipids: fixed oils and waxes.	3

	Volatile oils: Introduction; chemistry of volatile oils; biosynthesis of volatile oils; hydrocarbons as volatile oils; alcohols as volatile oils; aldehydes as volatile oils.	4
	Ketones as volatile oils; Phenols as volatile oils; Oxides as volatile oils; Ester as volatile oils; Phenolic ethers as volatile oils.	3
	Non- medicinal toxic plants.	2
	Vitamins and Amino acids.	2
Pharmaceutical Technology I	Dispersed systems: their classification; comparisons between different systems.	2
	Solutions and types of solutions.	2
	Solubility: Factors affecting solubility; expression of dissolution; dissolution rate versus solubility; preparation of solutions containing non-volatile materials.	4
	Official solutions; classification of official solutions; preparation and uses.	4
	Aqueous solutions containing aromatic principles; aromatic waters; methods of preparations; stability.	4
	Syrups: sugar based syrups; artificial and sorbitol based syrups; stability of syrups.	4
	Definition and methods of clarification; filter aids in clarification.	3
	Preparation of solutions using mixed solvent systems; spirits, and elixirs.	3
	Extraction; maceration and percolation.	3
	Tinctures; fluid extracts; extracts of resins and oleoresins.	4
	Colloidal dispersions; lyophilic; lyophobic.	6
	Coarse dispersion; suspensions.	6
Biochemistry I	Introduction to the macromolecules biochemistry: Definitions and terms; proteins, enzymes, DNA; Clinical value.	2
	Amino acids: Structures of A.A (table of standard A.A abbreviation and side chain); Classification, properties, isomerism.	3
	Amino acids: Chemical reactions, Zwitter ions, titration curve calculating isoelectric point values. Examples and questions. Non standards A.A: Structures, existence and clinical value.	3

	Peptides: Peptide bond, resonance forms, isomers, physical properties and chemical reactions. Essential poly peptides in human body, structures, roles and clinical values.	3
	Proteins: Structure and conformations of proteins, Primary structure, Secondary structure (4 helix, 5 sheet), tertiary structure, quaternary structure. Classification, synthesis, cellular functions (Enzymes, cell signaling, and ligand transport, structural proteins), protein in nutrition.	3
	Denaturation of proteins and protein sequencing: Determining A.A composition, N- terminal A.A analysis, C- terminal A.A analysis, Edman degradation, prediction protein sequence from DNA/ RNA sequences. Methods of protein study: Protein purification, cellular localization, proteomics and bioinformatics, structure predication and simulation.	3
	Carbohydrates: Chemistry and classification, biomedical importance, classification of CHO, Stereochemistry of monosaccharides, metabolism of CHO; Physiologically important monosaccharides, glycosides, disaccharides, polysaccharides.	3
	Lipids: Introduction, classification of lipids, fatty acids (F.A), nomenclature of F.A, saturated F.A, unsaturated F.A, physical and physiological properties of F.A, metabolism of lipids. Phospholipids, lipid peroxidation and antioxidants, separation and identification of lipids, amphipathic lipids.	3
	Enzymes: Structures and mechanism, nomenclature, classification, mechanisms of catalysis, thermodynamics, specificity, lock and key model, induced fit model, transition state stabilization, dynamics and function, allosteric modulation. Biological function, cofactors, coenzymes, involvement in disease.	3
	Kinetics: General principles, factors effecting enzyme rates (substrate conc., pH, temperature, etc), single-substrate reaction (Michaelis-Menten kinetics), kinetic constants. Examples of kinetic questions and solutions.	2
	Enzyme inhibition: Reversible inhibitors, competitive and non competitive inhibition, mixed-type inhibition, Irreversible inhibition. Inhibition kinetics and binding affinities (*k*i), questions and solutions.	1
	Control of activity and uses of inactivators; multi-substrate reactions, ternary-complex mechanisms, ping-pong mechanisms, non-Michaelis- Menten kinetics, pre-steady-state kinetics, chemical mechanisms.	1
	Nucleic Acid: Chemical structure, nucleic acid components, nucleic acid bases, nucleotides and deoxynucleotides (Properties, base pairing, sense and antisense, super-coiling, alternative structures, quadruple structures.	3

	Biological functions of DNA: Genes and genomes, transcription and translation, replication.	2
	Biochemistry of extracellular and intracellular communication: Plasma membrane structure and function; Biomedical importance, membrane proteins associated with lipid bilayer, membranes protein composition, dynamic structures of membranes, a symmetric structures of membranes.	3
	Artificial membranes model, the fluid mosaic model, membrane selectivity, physiological functions of plasma membranes.	1
	Biochemistry of the endocrine system: Classification of hormones, biomedical importance, the target cell concept and hormone receptors, biochemistry of hormone signal transduction.	3
	Special topics: Nutrition, digestion, and absorption. Biomedical importance, digestion and absorption of carbohydrates, lipids, proteins, vitamins and minerals; energy balance. Biochemistry of hemostasis and clot formation.	3
Pathophysiology	Introduction.	1
	Cell injury and tissue response; Degeneration; Necrosis; Atrophy; Hypertrophy; Metaplasia and Calcification; Inflammation and Repair.	6
	Disorders of electrolytes and water and acid–base balances: Hyper and Hyponatremia; Hyper and Hypokalemia; Syndrome of inappropriate secretion of ADH; Diabetes insipidus; Metabolic acidosis and alkalosis; Respiratory acidosis and alkalosis.	4
	Disorders of cardiovascular system: Hyperemia; Congestion and edema; Thrombosis; embolism and infarction; Shock; Coronary heart disease and MI; Rheumatic heart disease; Heart failure; Acute pulmonary edema; Essential hypertension; Secondary hypertension; Malignant hypertension; Hypotension; Aneurysm versus varicose veins;	5
	Disorders of respiratory system: Pneumonias; Tuberculosis; Respiratory distress syndrome; Bronchial asthma; Emphysema and bronchiectasis; Cystic fibrosis; Pulmonary embolism; Pulmonary hypertension.	3
	Disorders of the renal system: Nephrotic syndrome; Glomerulonephritis; Diabetic glomerulosclerosis; Hypertensive glomerular disease; Pyelonephritis; Drug related nephropathies; Acute renal failure; Chronic renal failure.	4

	Disorders of GI and hepatobiliary systems: Peptic ulcer and Zollinger – Ellison syndrome; Irritable bowel syndrome; Crohn's disease; Diarrhea; Celiac disease; Viral hepatitis; Primary biliary cirrhosis; Liver failure; Cholelithiasis.	4
	Disorders of thyroid function: Hypothyroidism.Hyperthyroidism. Graves's disease.Thyrotoxicosis.	2
	Disorders of adrenal function: Cushing syndrome. Adrenal cortical insufficiency (primary and secondary). Congenital adrenal hyperplasia. Pheochromocytoma.	2
	Diabetes mellitus and metabolic syndrome; Dyslipoproteinemia.	5
Organic Pharmaceutical Chemistry I	Drug distribution.	4
	Acid- base properties.	3
	Statistical prediction of pharmacological activity.	3
	QSAR models.	2
	Molecular modeling (Computer aided drug design).	1
	Drug receptor interaction: force involved.	1
	Steric features of drugs.	2
	Optical isomerism and biological activity.	1
	Calculated conformation.	1
	Three- dimensional quantitative structure activity relationships and databases.	1
	Isosterism.	1
	Drug-receptor interaction and subsequent events.	1
	General pathways of drug metabolism: Sites of drug biotransformation; Role of cytochrome P450 mono-oxygenases in oxidative biotransformation; Oxidative reactions; Reductive reactions; Hydrolytic reactions; Phase II reactions.	22
	Factors affecting drug metabolism.	2
pharmacology I	General introduction to Pharmacology. Pharmacokinetics.	2 4
	Drug Receptor interaction and Pharmacodynamics. The autonomic nervous system (ANS).	4 2

	Cholinergic system.	6
	Adrenergic system.	6
	Principal of antimicrobial therapy.	2
	β- lactam and other cell wall synthesis inhibitor antibiotics	4
	Protien synthesis inhibitors	4
	Quinolones, Folate antagonists, and urinary tract antiseptics.	3
	Antimycobacterium drugs	2
	Antifungal drugs.	2
	Antiprotozoal drugs.	1
	Anthelmintic drugs.	2
	Antiviral drugs.	1
Pharmaceutical Technology II	Emulsions; purpose of emulsification; methods of emulsification; emulsifying agents; HLB system; stability of emulsions.	10
	Lotions; liniments and collodions.	5
	Suppositories.	6
	Powdered dosage forms.	10
	Semisolid dosage forms.	10
	Incompatibilities in pharmaceutical dosage forms.	4
Biochemistry II	Bioenergetics.	2
	Biologic oxidation.	2
	The respiratory chain and oxidative phosphorylation.	2
	Over view of metabolism.	2
	Citric acid Cycle.	2
	Glycolysis.	2
	Metabolism of glycogen.	4
	Gluconeogenesis.	3
	Pentose phosphate pathway and other pathways of hexose metabolism.	3
	Biosynthesis of fatty acids.	3

	Oxidation of fatty acids.	2
	Metabolism of acylglycerol and sphingolipids.	2
	Lipid transport and storage.	2
	Cholesterol synthesis, transport, and excretion.	2
	Biosynthesis of the Nutritionally Nonessential Amino Acids.	3
	Catabolism of Proteins & of Amino Acid Nitrogen	3
	Catabolism of the Carbon Skeletons of Amino Acids.	2
	Conversion of Amino Acids to Specialized Products.	2
	Porphyrins & Bile Pigments	2
Pharmacognosy III	Alkaloids: Introduction; Physical and chemical properties; pyridine, piperidine alkaloids; tropane alkaloids.	5
	Alkaloids: Quinoline tropan alkaloids; iso-quinoline alkaloids; imidazole alkaloids; indole alkaloids.	5
	Alkaloids: Steroidal alkaloids; lupinane alkaloids; alkaloidal amines; purine alkaloids.	4
	Antibiotics: Natural sources; biosynthetic pathways, isolation and purification.	6
	.phytotherapy :Introduction , principles,medicinal plants in selected health care systems.Important natural products & phytomecines used in pharmacy & medicine	10
Medical ethics	Introduction to Pharmacy Ethics (Theoretical considerations).	2
	Code of Ethics for Pharmacists.	1
	Common Ethical Considerations in Pharmaceutical Care Practice (Beneficence, Autonomy, Honesty, Informed Consent, Confidentiality, Fidelity ……).	3
	Interprofessional Relations.	2
	Making ethical decisions.	1
	Ethical issues related to clinical pharmacy research.	1
	Ethical problems in the pharmacist's clinical practice.	1
	Preventing misuse of medicines.	1
	Case studies in pharmacy ethics.	3

Fourth stage		
المادة	**Lecture title**	**hours**
Pharmacology II	Introduction to CNS pharmacology**.**	2
	CNS stimulants.	2
	Anxiolytic and Hypnotic drugs.	3
	General and Local Anesthetics.	3
	Antidepressant drugs.	3
	Antipsychotic (neuroleptic) drugs.	3
	Opioid analgesics and antagonists.	3
	Treatment of neurodegenerative diseases.	3
	Antiepileptic Drugs.	2
	Diuretics.	2
	The treatment of heart failure (HF).	2
	Antiarrhythmic drugs.	2
	Antianginal Drugs.	2
	Antihypertensive drugs.	3
	Drugs affecting the blood.	3
	Antihyperlipidemic drugs.	2
	Gastrointestinal and antiemetic drugs.	2
	Drugs acting on the respiratory system.	3
organic pharmaceutical chemistry	Cholinergic agents, cholinergic receptors and their subtypes.	3
	Cholinergic agonists; stereochemistry and structure-activity relationships (SAR); products; cholinesterase inhibitors.	5
	Cholinergic blocking agent; structure-activity relationships (SAR); Solanaceous alkaloid and analogues; synthetic cholinergic blocking agents and products; ganglionic blocking agents (neuromuscular blocking agents).	5
	Analgesic agents (SAR of morphine, SAR of meperidine type molecules; SAR of methadone type compounds; N-methylbezomorphans, antagonist type analgesics in benzomorphans).	5

	Analgesic receptors, endogenous opioids; Products; Antitusive agents; Anti-inflammatory analgesics.	5
	Adrenergic agents (Adrenergic neurotransmitters); Adrenergic receptors; Drugs affecting Adrenergic neurotransmission; Sympathomimetic agents; Adrenergic receptor antagonists.	8
	CNS depressant; Benzodiazepines and related compounds; Barbiturates; CNS depressant with skeletal muscle relaxant properties; Antipsycotics; Anticonvulsants.	7
	CNS Stimulants	3
	Steroidal & nonsteroidal hormones	4
Clinical Pharmacy1	Introduction to community pharmacy.	1
	Respiratory problems: Cough, Common cold, allergic rhinitis, Otitis media, Laryngitis & Pharyngitis	3
	G.I.T problemse: Diarrhea, Constipation, Heart burn and indigestion, IBS and Hemorrhoids	4
	Pediatric care practice : Oral thrush, pinworms and head lice	2
	Skin conditions: Acne, Scabies, Psoriasis, Hair loss, Fungal infection, Eczema and Dermatitis , Dandruff, Cold sore, Corns and Callus.	5
	Women's health care: Cystitis and vaginal thrush, primary dysmenorrhea and Premenstrual syndrome.	2
	CNS related problems: Headache, Insomnia, Motion sickness, Nausea and vomiting	3
	- Eye problems	1
	ENT problems	1
	Oral hygiene, mouth ulcer	1
	Obesity and body weight control.	1
	- Pain and musculoskeletal disorders	1
	Nicotine replacement therapy (NRT).	1
	Dietary supplements	1
	An update in reclassification of OTC drugs (simvastatin, Tamusotisin & azithromycin).	2
	Medication adherence and errors.	1
Biopharmaceutics	Introduction to biopharmaceutics.	2
	Biopharmaceutic aspects of products; drug absorption; mechanisms of absorption; physicochemical factors; dissolution rate; effects of excipients; type of dosage forms.	6

	One compartment open model.	2
	Multicompartment models.	2
	Pharmacokinetics of drug absorption.	2
	Bioavailability and bioequivalence.	2
	Clearance of drugs from the biological systems.	2
	Hepatic elimination of drugs.	2
	Protein binding of drugs.	2
	Intravenous infusion	2
	Multiple dosage regimens.	2
	Non-linear pharmacokinetics.	2
	Dosage adjustment in renal diseases.	2
Public Health	General items &ICD10	2
	Predisposing factors of infectious diseases	1
	Cardiovascular diseases	1
	Gastrointestinal diseases	2
	Skin diseases	1
	-Sexually transmitted diseases	1
	Oncogenic diseases	3
	Respiratory infections	2
	Familyplaninig include maternal infections, vaccination	2
	-Immunology	
	General introduction	1
	innate &adaptive immunity	2
	-antigen characteristics	1
	B&Tcells	2
	complements	1
	Hypersensitivity types	2

	Oncogenic immunity	3
	-Auto immune diseases	2
	Immune deficiency diseases	1
Pharmacology III	Hormones of the pituitary and thyroid glands.	3
	Insulin and oral hypoglycemic drugs.	4
	Adreno-corticosteroids.	3
	The gonadal hormones and inhibitors.	3
	Autacoids and autacoid antagonists	3
	Non-steroidal anti-inflammatory drugs (NSAIDs) and other anti-inflammatory agents.	3
	Drugs used in erectile dysfunction.	2
	Drugs used in osteoporosis.	2
	Drugs used in the management of obesity.	2
	Cancer Chemotherapy: Anticancer drugs and immunosuppressants.	5
Organic Pharmaceutical Chemistry III	β-Lactam antibiotics (Penicillins); β-Lactamase inhibitors; Cephalosporins and Monobactams.	9
	Aminoglycosides and Chloramphenicol; Tetracylines; Macrolides; Lincomycins and Polypeptides; Antiviral agents (properties of viruses, viral classification, products).	9
	Sulfonamides (chemistry, nomenclature, mechanism of action, resistance, toxicity, side effects, metabolism, protein binding, distribution and SAR); products; Sulfones.	4
	Anti-neoplastic agents: Alkylating agents; Antimetabolites; Antibiotics; Plant products; Miscellaneous compounds.	17
	Hormones and related compounds; Future anti-neoplastic agents; Monoclonal antibodies; Gene therapy of cancer.	6
Clinical Pharmacy II	Introduction to the concept of clinical pharmacy- its activities and professional responsibilities.(including current state of clinical pharmacy in Iraq) .	**1**
	overview of pharmaceutical care practice (the patient care process).	**1**

	Hematologic disorders: Anemia and sickle cell disease.	**2**
	Hypertension.	**2**
	Ischemic heart diseases	**2**
	Heart failure.	**2**
	Peripheral vascular diseases.	**1**
	- Asthma.	**2**
	Chronic obstructive pulmonary disease (COPD).	**1**
	Diabetes mellitus & Diabetic ketoacidosis (DKA) .	**2**
	Peptic ulcer disease.	**2**
	Tuberculosis	**1**
	Infective meningitis	**1**
	Respiratory tract infections	**2**
	GIT infections	**1**
	Gout and hyperuricemia	**1**
	Rheumatoid arthritis (RA) and osteoarthritis (OA)	**2**
	Osteoporosis and other metabolic bone disease.	**1**
	Infectious Endocarditis	**1**
	Surgical antibiotic prophylaxis	**1**
	Urinary tract infection (UTI)	**1**
General Toxicology	Introduction: general consideration; host factor, environmental factors of toxic effects.	3
	Carcinogenesis.	3
	Mutagenesis:	1
	Target organs and systemic toxicology; Respiratory system, Liver, Kidney, Skin, Nervous system, cardiovascular system, Blood.	16
	Toxic substances: Food additive and contaminants, Pesticides, Metals, Radiation and radio active materials, plants, Solvents,	15
	Environmental toxicology: Air pollution, water and soil pollutants, Gases (Tear gas, Pepper spray), CO, Cyanide(H_2S).	7
Industrial Pharmacy I	Principles of pharmaceutical processing; mixing; fluid mixing; flow characteristics; mechanisms of mixing; mixing equipments; batch and continuous mixing; mixer selection; solid mixing theory and particulate solid variables; forces and mechanisms.	7

	Milling; pharmaceutical application; size measurement methods; theory and energy of commenution; types of mills; factors influencing milling; selection of mill techniques; specialized drying methods.	7
	Drying: definition; purpose; humidity measurement; theory of drying; drying of solids, and classification of dryer; specialized drying methods.	7
	Clarification and filtration: Theory; filter media; filter aids; selection of drying method; non-sterile and sterile operations; integrity testing; equipments and systems (commercial and laboratory).	7
	Sterilization; validation of methods; microbial death kinetics; methods of sterilization (thermal and non-thermal); mechanisms; evaluation.	7
	Pharmaceutical dosage form design; pre-formulation; preliminary evaluation; bulk characterization; solubility and stability analysis.	3
	Pharmaceutical dosage forms; sterile products; development; formulation; production; processing; quality control.	7

Fifth stage		
المادة	**Lecture title**	**hours**
Organic Pharmaceutical Chemistry IV	Basic concept of prodrugs; Covalent bonds (cleavable); Prodrugs of functional groups; Types of prodrugs.	6
	Chemical delivery systems; Polymeric prodrugs; Types and structure of polymers; Cross-linking reagents.	6
	Drug targeting.	4
	Project.	4
	Combinatorial chemistry; Peptides and other linear structures; Drug like molecules; Support and linker; Solution-phase combinatorial chemistry.	5

	Detection, purification and analgesics; Encoding combinatorial libraries; High-throughput screening; Virtual screening; Chemical diversity and library design.	5
Industrial Pharmacy II	Pharmaceutical dosage forms: Tablets; role in therapy; advantages and disadvantages; formulation; properties; evaluation; machines used in tableting; quality control; problems; granulation, and methods of production; excipients, and types of tablets.	10
	Tablet coating; principles; properties; equipments; processing; types of coating (sugar and film); quality control, and problems.	4
	Capsules: Hard gelatin capsules; materials; production; filling equipments; formulation; special techniques.	3
	Soft gelatin capsules: Manufacturing methods; nature of capsule shell and content; processing and control; stability.	2
	Micro-encapsulation; core and coating materials; stability; equipments and methodology.	2
	Modified (sustained release) dosage forms; theory and concepts; evaluation and testing; formulation.	3
	Liquids: Formulation; stability and equipments.	3
	Suspensions: Theory; formulation and evaluation.	3
	Emulsions: Theory and application; types; formulation; equipments and quality control.	3
	Semisolids: Percutaneouse absorption; formulation; types of bases (vehicles) preservation; processing and evaluation.	3
	Suppositories: Rectal absorption; uses of suppositories; types of bases; manufacturing processes; problems and evaluation.	3
	Pharmaceutical aerosols: Propellants; containers; formulation; types and selection of components; stability; manufacturing; quality control and testing.	6
Therapeutic I	Interpretation of Lab. data.	2
	Acute coronary syndrome.	2
	Arrhythmias	2

	Thrombosis	2
	Dyslipidemia	1
	Stroke	2
	Shock	2
	Liver cirrhosis	2
	Viral hepatitis	1
	Inflammatory bowel diseases	2
	Acute renal failure (ARF)	1
	Chronic renal failure (CRF)	2
	Hemodialysis and peritoneal dialysis	1
	Systemic lupus erythematosis (SLE)	1
	Benign prostatic hyperplasia (BPH)	1
	Acid – base disorders	2
	Disorders of fluid and electrolytes	2
	Urinary incontinence and pediatric enuresis	1
	Epilepsy and status epilepticus	2
	multiple sclerosis	1
	Parkinson's disease	2
	Pain management	2
	Headache disorders	1
	glucoma	2
	Parenteral nutrition	2
	Enteral nutrition	2
	Pharmacovigilance	2
Clinical Chemistry	Disorders of Carbohydrates metabolism, Hyperglycemia & Diabetes mellitus, Hypoglycemia.	3
	Disorders of lipid metabolism.	2
	Liver Function Tests.	4
	Kidney Function Tests.	4
	Diagnostic enzymology.	4
	Hypothalamus & pituitary endocrinology, disorders of anterior pituitary hormones, disorders of adrenal gland, hypopituitrism.	8

	Reproductive system, disorders of gonadal function in males & females, biochemical assessment during pregnancy.	5
	Tumor markers.	4
	Drug interaction with laboratory Tests.	2
	Disorders of calcium metabolism	3
	Acid- Base Disorders.	4
Clinical Toxicology	Initial Evaluation and Management of the Poisoned Patient. Including pediatric poisoning and special consideration in the geriatric patient	3
	Drug Toxicity: Over the counter drugs; caffeine; theophylline; antihistamine and decongestant; non-steroidal anti-inflammatory drugs; vitamins.	3
	Prescription Medications: Cardiovascular drugs; beta blockers; ACE inhibitors; Digoxin; Calcium channel blocker; Antiarrhythmic agents; hypoglycemic drugs; Opiods; CNS depressants; tricyclic antidepressants; anti-cholinergic phenothiazines; CNS stimulant.	13
	Drug of Abuse: Opioids; Cocaine; phencyclidine; marijuana; Lysergic acid.	4
	Chemical and Environmental Toxins: Hydrocarbones; Household toxins; Antiseptic; Disinfectants; Camphor; moth repellents.	3
	Botanicals and plants-derived toxins: Herbal preparation; Toxic plants; Poisonous mushrooms.	4
جميع الفروع	**Project.**	(1 hours) ,
Pharmacoeconomy	Course overview & basic principle of pharmacoeconomics	2
	Cost analysis	6
	Cost effectiveness analyses (CEA).	2
	1st mid-term examination.	2
	Cost utility analyses (CUA).	2
	Cost-benefit analysis (CBA)	2
	Critical assessment of economic evaluation	4
	2nd mid-term examination.	2

	Drug-focused versus disease-focused frame work for conducting pharmacoeconomic analyses.	2
	Introduction to epidemiology.	2
	Project presentation.	2
	Project presentation.	2
Therapeutic Drug Monitoring	**Review of basic pharmacokinetic (PK) and pharmacodynamic (PD)**	2
	Clinical PK equations and calculations	3
	Clinical PK in special population and cases	3
	Clinical PK/PD for Aminoglycosides	2
	Clinical PK/PD for Vancomycin	2
	Clinical PK/PD for Digoxin	2
	Clinical PK/PD for Phenytoin	3
	Clinical PK/PD for other Anticonvulsants (e.g., Carbamazepine, Valproic Acid, Phenobarbitone/Primidone, Ethosuxsimide	3
	Clinical PK/PD for Theophylline	2
	Clinical PK/PD for Immunossprasants (e.g., Cyclosporine, Tacrolimus	2
	Clinical PK/PD for other Cardiovascular agents (e.g., Lidocaine, Procainamide/N-Acetyl Procainamide	2
	Clinical PK/PD of other drugs (e.g., Lithium), Anticancer agents, and Anticoagulats	4
Hospital Training	Clinical Pharmacy Practice in Internal Medicine: Clinical observation of cases; evaluation of the case sheets; case presentation; discussion and evaluation.	10
	Clinical Pharmacy Practice in Surgery wards: Clinical observation of cases; evaluation of the case sheets; case presentation; discussion and evaluation.	5
	Clinical Pharmacy Practice in Gynecology and Obstetrics Ward: Clinical observation of cases; evaluation of the case sheets; case presentation; discussion and evaluation.	5
	Clinical Pharmacy Practice in Pediatric Ward: Neurology , Cardiology , GIT , Birth defects , Sepesis , Meningitis	10
Therapeutic II	Thyroid and parathyroid disorders	2
	Contraception	1
	Endometriosis	1
	Menstruation related disorders	1
	Hormonal replacement therapy (HRT)	2
	Cancer treatment and chemotherapy	2

	Leukemias	2
	Lymphomas and Multiple myeloma	2
	Breast and prostate cancers	2
	Adverse effects of chemotherapy	1
	Human immunodeficiency viruse	2
	Adrenal gland disorders	1
	Pituitary gland disorders	1
	Alzheimer's disease	1
	Schizophrenia	2
	Depressive disorders	2
	Anxiety disorders	1
	Sleep disorders	1
	Bipolar disorders	2
	colorectal cancer	1
Clinical Laboratory Training	Diagnostic test basics, collecting &transporting specimens, venipuncture, urine specimen, stool specimen.	4
	Biochemical tests: Fasting blood glucose, Post-prandial glucose, Oral glucose tolerance test.	4
	Blood urea, Blood creatinine, Creatinine clearance, Uric acid.	4
	Cholesterol, Lipoproteins, triglycerides.	4
	Blood proteins, Bilirubin.	4
	Calcium, Inorganic phosphate, Serum chloride	4
	Alkaline phosphatase, Acid phosphatase, Alanine amiotransferase, Aspartate aminotransferase, Lactate dehydrogenase, Creatine phosphokinase.	4
	Serological tests: VDRL, ASO- Titer, Hepatitis tests.	4
	C-reactive protein test, Rheumatic factor test, Rosebengal test, Typhoid fever test(Widal test), Pregnancy Test.	4
	General urine examination, urine specimen collection.	4
	Hematological tests: RBC count, Hb, PCV, RBC indices, WBC count, Platelets count.	4

	Blood typing, Coombs test, Bleeding time, ESR.	4
	Microbiological tests: culture and sensitivity tests, Staining methods	4
	Culture media, Enriched culture media for general use	4
	Tests for identification of bacteria, Disk diffusion tests of sensitivity to antibiotics, Choice of drugs for disk test, bacterial disease and their laboratory diagnosis.	4
pharmaceutical biotechnology	Biotechnology - introduction	1
	Formulation of biotechnology product (biopharmaceutical consideration) Microbial consideration- sterility-pyrogen viral decontamination Excipients of parentral products - solubility enhancer-anti adsorption agents buffer components-preservatives – osmotic agents	4
	Route of administration Parentral route Oral route Alternative routes (nasal-pulmonary-rectal-buccal transdermal)	5
	Pharmacokinetic of peptides and proteins Introduction Elimination of proteins (proteolysis-excretion-metabolism)	5
Dosage form Design	Pharmaceutical consideration: The need for the dosage form.	1
	General consideration for the dosage form.	3
	Pre-formulation; physical description, microscopic examination.	2
	Melting point; phase rule; particle size; polymorphism; solubility.	2
	Permeability; pH; partition coefficient; pka; stability; kinetics; shelf life.	2
	Rate reaction; enhancing stability.	2
	Formulation consideration: Excipients; definition and types; appearance; palatability; flavoring.	2
	Sweetening; coloring pharmaceuticals; preservatives; sterilization; preservatives selection.	2
	Biopharmaceutical considerations: Principle of drug absorption**;** dissolution of the drugs**.**	4
	Bioavailability and bioequivalancy; FDA requirements.	3
	Assessment of bioavailability; bioequivalence among drug products**.**	3
	Pharmacokinetic principles: Half life; clearance; dosage regimen considerations.	4
Advanced Pharmaceutical Analyses	UV / visible spectroscopy; Sample handling and instrumentation; Characteristic absorption of organic compounds; Rules for calculation of lambda max and application; Application of UV/visible; spectroscopy; Problems and solutions.	6

	Infra Red spectroscopy (theory and H-bonding effect; Sampling techniques and interpretation of spectra; Characteristic group frequencies of organic compounds; Application of IR spectroscopy; Problems and solutions.	14
	H^1 –Nucleomagnetic Resonance (NMR) and C^{13}-NMR spectroscopy; Introduction, the nature of NMR absorption, chemical shifts and factors affecting them, information obtained from NMR spectra, more complex spin-spin splitting patterns, application of H_1-NMR spectroscopy; C_{13}-NMR spectroscopy: introduction and characteristics, DEPT C^{13}-NMR spectroscopy.	12
	Mass spectroscopy: Introduction and interpreting Mass spectra; interpreting Mass spectra fragmentation patterns, Mass behavior of some common functional groups.	11
	elemental microanalysis CHNSO	2