Syllabus

B. Voc.

(BIOMEDICAL SCIENCES)

(w.e.f. July 2018-2021)

Deen Dayal Upadhyay KAUSHAL Kendra

Central University of Haryana
Mahendergarh, Haryana

STRUCTURE OF B.VOC. (BIOMEDICAL SCIENCES) PROGRAMME: (2017-2020) – July 2017 Batch

Module Code	Name of Course	Credits (T+P)	Marks
YEAR – 1, SEMESTER – I			
GENERAL EDUCATION COMPONENT			
BMS-101	Human Physiology	**4** (4+0)	100
BMS-102	Concepts in Chemistry-I	**4** (4+0)	100
BMS-103	English Communication	**2** (2+0)	50
BMS-104	Practical	**2** (0+2)	50
	TOTAL	**12**	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		**18**	
YEAR – 1, SEMESTER – II			
GENERAL EDUCATION COMPONENT			
BMS-201	Concepts in Chemistry-II	4 (4+0)	100
BMS-202	Environmental Science	4 (4+0)	100
BMS-203	Biomolecules and Enzymology	2 (2+0)	50
BMS-204	Practical	2 (0+2)	50
		12	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		**18**	----------
YEAR – 2, SEMESTER – III			
GENERAL EDUCATION COMPONENT			
BMS-301	Metabolism and Bioenergetics	**4** (4+0)	100
BMS-302	Microbiology	**4** (4+0)	100
BMS-303	Concepts in Chemistry-III	**2** (2+0)	50
BMS-304	Practical	**2** (0+2)	50
	TOTAL	**12**	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		**18**	----------

YEAR – 2, SEMESTER – IV			
GENERAL EDUCATION COMPONENT			
BMS-401	Analytical Techniques and Instrumentation	**4** (4+0)	100
BMS-402	Pharmacology	**4** (4+0)	100
BMS-403	Concepts in Chemistry-IV	**2** (2+0)	50
BMS-404	Practical	**2** (0+2)	50
	TOTAL	**12**	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		----------	----------
	TOTAL	**18**	
YEAR – 3, SEMESTER – V			
GENERAL EDUCATION COMPONENT			
BMS-501	Cell Biology	**4** (4+0)	100
BMS-502	Molecular Biology	**4** (4+0)	100
BMS-503	Concepts in Mathematics and Statistics	**2** (2+0)	50
BMS-504	Practical	**2** (0+2)	50
	TOTAL	**12**	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		**18**	----------
YEAR – 3, SEMESTER – VI			
GENERAL EDUCATION COMPONENT			
BMS-601	Immunology	**4** (4+0)	100
BMS-602	Concepts in Chemistry-V	**4** (4+0)	50
BMS-603	Medicinal Chemistry	**2** (2+0)	50
BMS-604	Practical	**2** (0+2)	50
	TOTAL	**12**	300
SKILL COMPONENT			
Specific job roles defined by SSCs as per guidelines of NSQF		**18**	----------

BMS-101: Human Physiology **Credits: 4**

Unit 1: Blood **(04 Lectures)**

- **Body Fluids and blood**

Composition and Function of blood and Plasma its components: WBC, RBC, platelets and Hemoglobin.

Hematopoiesis, Hemostasis. Difference between Lymphatic and Vascular system.

- **Disorders**

Basic concepts about Anemia, Abnormal hemoglobin, Polycythemia, Thalassemia, Leukemia.

Unit 2: Cardiovascular system **(10 Lectures)**

Anatomy of heart, blood circulation, blood vessels, structure and function of artery, vein and capillaries. Physiology of cardiac muscle, The Cardiac Cycle, Electrocardiogram, control of cardiac function and output, Circulatory system: General Principles of circulation and hemo-dynamics cardiovascular regulatory mechanism

- **Disorders**

Basic concepts of hypertension, congestive heart disease, atherosclerosis and Cardiac failure.

UNIT 3: Respiratory system **(04 lectures)**

Organization of the pulmonary system. Mechanism of respiration ,pulmonary ventilation, regulation of respiration, pulmonary circulation, principle of transport and exchange of gases, pulmonary oedema, regulation of pleural fluid, Hypoxia, pulmonary distress, artificial ventilation.

- **Disorders**

COPD, Asthma, Emphycema

Unit 4: Nervous System I **(10 lectures)**

- **Organization of nervous system**

Central nervous system: structure and function of cerebrum, Meninges, Ventricles of Brain, brain stem, cerebellum, spinal cord Cerebrospinal fluid, Blood brain barrier.

Peripheral nervous system: origin and functions of spinal and cranial nervous reflex arc.

Autonomous nervous system: structure and function of sympathetic and parasympathetic nervous system Reflexes: innate and acquired with suitable examples, reflex arch.

Unit 5: Nervous System II **(08 lectures)**

- **Nerve Physiology**

Structure and function of neuron, role of membrane potential and ion channels in synaptic transmission, neurotransmitters; types and functions, sensory transduction in vision, hearing and taste.

- **Disorders**

Basic concept of epilepsy, Alzheimer disease, Parkinson's disease, migraines, sleep disorders

Unit 6: Gastrointestinal and Hepatic system **(10 lectures)**

- **Anatomy and function**

Anatomy of digestive tract. General principles of gut motility and secretion. Digestion, absorption and assimilation of food. Gastrointestinal hormones and their action and regulation in digestion. Physiology of liver, pancreas and their functions.

- **Gastrointestinal dysfunction**

Vomiting nausea, Diarrhoea, mal-absorption, Gastritis, Ulcer, Hepatitis and Jaundice

Unit 7: Renal Physiology **(08 lectures)**

- **Anatomy and function**

Functional Anatomy of kidney. Function of nephron. Formation of urine. Renal regulation of urine volume. Role of kidney in electrolyte and acid-base balance. Micturition and its regulation.

- **Renal dysfunction**

An overview of acidosis and alkalosis. Kidney failure and glomerular nephritis.

Unit 8: Endocrine system **(06 lectures)**

- **General mechanism of hormone action**

Structure, function and regulation of the following glands and their secretions: Pituitary, Hypothalamus, Pineal, Thyroid, Parathyroid, Adrenal, Testis,Ovary, Thymus and Pancreas.

- **Endocrine disorders**

Basic concepts about hypo and hyper secretion of hormones from above mentioned glands.

16-8-2018

BMS:102 **CONCEPTS IN CHEMISTRY – I** **(4 Credits)**

Unit 1: **Chemical equilibrium:** Reversible reactions, law of mass action, equilibrium constant, factors influence equilibrium states, relation between Kp and Kc, van't hoff reaction isotherm, van't Hoff Equation; **Ionic Equilibrium:** Acids, bases, pH scale, buffer solutions, indicators, buffer equations and buffer capacity in general; **Buffers in pharmaceutical systems:** Preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity; **Solutions:** Protic and aprotic solvents, fundamentals of volumetric analysis, methods of expressing concentrations, primary and secondary standards.

Unit 2: **General characteristics of s, p, d and f block elements:** Periodicity in s- and p-block elements w.r.t. electronic configuration, atomic and ionic size, ionization enthalpy, electron affinity, electronegativity (Pauling, Mullikan, and Alfred-Rochow scales), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group, general group trends of d and f block elements with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties and ability to form complexes.

Unit 3: **Common and IUPAC systems of nomenclature of organic compounds** (up to 10 carbons open chain and carbocyclic compounds); **Organic intermediates:** carbocations, carbanions, free radicals, carbenes and nitrenes, formation, stability and synthetic applications; Concept of electrophiles and nucleophiles; **Preparation, properties and reactions of aliphatic compounds:** Alkanes, alkenes, conjugated dienes, alkynes, alkyl halides, alcohols, amines, aldehydes, ketones, carboxylic acids, esters and amides.

Unit 4: **Chemistry of aromatic compounds:** Preparation, properties, structure and reactions of benzene, Huckels rule of aromaticity, aromaticity of annulenes; **Structure and medicinal uses of polynuclear hydrocarbons:** Naphthalene, phenanthrene, anthracene, diphenylmethane, triphenylmethane and their derivatives; Introduction of heteroaromatic compounds; Fundamentals of soap, detergents, fats and oils.

16/8/2018

16/8/18

16/8/2018

BMS-103 **COMMUNICATION SKILLS (Theory)** **30 Hours**

UNIT – I **06 Hours**

Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context.

Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other Factors affecting our perspective – Past Experiences, Prejudices, Feelings, Environment.

UNIT – II **06 Hours**

Elements of Communication: Introduction, Face to Face Communication – Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

Communication Styles: Introduction, The Communication Styles Matrix with example For each –Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

UNIT – III **07 Hours**

Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations

Effective Written Communication: Introduction, When and When Not to Use Written Communication – Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication

Writing effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message,

UNIT – IV **11 Hours**

Interview Skills: Purpose of an interview, Do's and Dont's of an interview

Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

Correspondence: Personal, official and Business, Report writing, Drafting an email, Writing of C.V.

PRACTICAL

1. Preparation of volumetric solutions, Indicator solutions, buffer solutions and estimation of acidic or basic contents
2. Limit test for Chlorides, sulphates, iron and preparation of Potash alum
3. Functional group test: Amines, carboxylic acids, aldehydes, ketones, aromatic and halogenated hydrocarbons
4. Preparation of soap.
5. Estimation of hemoglobin and determination of blood group.
6. Determination of bleeding time and clotting time of blood.
7. Determination of total erythrocyte count.
8. Determination of total leukocyte count.
9. To perform differential leukocyte count of blood.
10. To study different human organs and their sections through permanent histological Slides. T. S. of cardiac muscles, liver, thyroid, artery, vein, pancreas, kidney (cortex and medulla), pituitary gland, heart. (Minimum 8 slides covering the systems mentioned in theory.
11. Blood Pressure recordings in humans.

Unit 1: Thermodynamics: First law, second law and third law of thermodynamics, concept of enthalpy and entropy, Hess's law; **Chemical Kincties:** Zero, first and second order reactions, complex reactions, theories of reaction kinetics; **Catalysis:** Types of catalysis, theory and applications of homogeneous and heterogeneous catalysis, biocatalysis, phase-transfer catalysis, transition metal and organo catalysis; **Disperse System:** Colloids, properties and physical stability of colloidal system, gel, surface active agents; **Properties of matter:** Viscosity: Measurement of viscosity, Newtonian and Non-Newtonian fluids, determination of flow properties, effect of rheological properties on bioavailability; density and its measurement, refractive index, absorbance, thermal properties, melting point and boiling point, surface tension; **Water chemistry:** Carbonate system in water, DO, BOD and COD, hardness of water.

Unit 2: Spectroscopy and Spectrometric: Basic principles of spectroscopy, IR spectroscopy, functional group and fingerprint regions, UV Visible spectroscopy, NMR spectroscopy, mass spectrometry, application in structure elucidation of organic molecules.

Unit 3: Organometallic chemistry: Definition and classification of organometallic compounds on the basis of bond type, 18 electron rule, Introduction and IUPAC nomenclature of coordination compounds, isomerism in coordination compounds, stereochemistry of complexes with 4 and 6 coordination numbers, Werner's coordination theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding, chelate effect, complexing and chelating agents used in therapy, metal carbonyls, metalloporphyrins.

Unit 4: Chemistry of heterocyclic compounds: Nomenclature and classification, Synthesis, properties, reactions and medicinal uses of: furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline, indole, pyrazole, imidazole, oxazole, thiazole, purine pyrimidine, acridine and azepines.

BMS-202: ENVIRONMENTAL SCIENCE **Credits: 4**

Unit 1: Introduction to Environmental Science

The multidisciplinary nature of Environmental Studies. Definition, scope and importance, need for public awareness

Unit: 2: Natural Resources

Renewable and non-renewable resources: Land resources: Land as a resource, land degradation, soil erosion and desertification. Forest resources: Use and over-exploitation, deforestation, case studies. Water resources: Use and over-utilization of surface and ground water

Unit 3: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids.

Unit 4: Bio-diversity and its Conservation

Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Hot-spots of biodiversity. Threats to biodiversity, Endangered and endemic species of India. Conservation of biodiversity.

Unit 5: Environmental Pollution

Definition, Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards.

Unit 6: Environment policies & laws

Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

Unit 7: Human Population and Environment

Human population growth, Impacts on environment, human health and welfare. Environment Movements: Chipko, silent valley, Bishnois of Rajasthan.

Unit 8: Field Work

Visit to a local polluted site: Urban/Rural/Industrial/Agricultural.

16/8/2018

BMS-203: Biomolecules and Enzymology **Credits: 2**

Unit1. Carbohydrate and lipids **(14 Lectures)**

Definition, classification, structure and functions of Carbohydrates

Monosaccharides- Glucose, Fructose, Galactose, Mannose, Stereoisomerism and optical isomerism of sugars, epimers, Ring structure and anomers, mutarotation. Biological importance of hexose derivatives with two examples.

Disaccharides- Maltose, lactose, Sucrose, Trehalose,

Polysaccharides- concept of homopolysaccharide and heteropolysaccharide, chemical nature of starch, glycogen, cellulose, bacterial cell wall polysaccharides, agar.

Biological importance of Proteoglycans, Glycoproteins, and Glycolipids

Definition and classification of lipids. Classification of fatty acids, physio-chemical properties of fatty acids, saponification and iodine number.

Structure and function of cholesterol in body

Structure and biological importance of phosphoglycerides, sphingolipids, glycosphingolipids, Eicosanoids.

Unit 2. Protein **(12 Lectures)**

Definition and classification of amino acids based on chemical nature and nutritional (essential and nonessential) requirement, zwitterions, pKa, pI, titration of amino acids, peptide bonds

Structure of protein-Primary, secondary, tertiary and Quartenary structure

Protein stability, Bonds and interaction stabilizing the protein structure, protein folding, Denaturation and Renaturation.

Functional diversity of proteins –enzymes, transporters, metalloprotein, nucleoprotein, lipoprotein, glycoprotein, membrane proteins, regulatory proteins.

Unit 3- Nucleic acids **(06 Lectures)**

Importance of nucleic acids in living system, general composition of nucleic acids, the purine and pyrimidine bases, Tautomeric forms of bases. structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and oligonucleotides.

Watson and crick model for DNA. Different types of DNA and RNA.

Unit 4: Enzymology **(14 Lectures)**

Enzymes: Introductory aspects

Introduction to enzymes, classification of enzymes based on IUB with examples.

Unit of enzyme activity – definition of IU, Katal, enzyme activity, Specific activity, enzyme turn over number

Role of coenzymes and prosthetic groups and vitamins as coenzymes precursors.

Concept of active site, enzyme specificity

Theories of enzyme catalysis – Lock and key model, Induced fit theory.

Enzyme kinetics

Factors affecting rate of enzyme catalyzed reactions. Effect of enzyme concentraton, substrate concentration, pH and temperature.

Enzyme kinetics: Michaelis – Menten equation, Lineweaver – Burk (L-B) plot. Determination of Vmax& Km from L-B plot and their significance.

Enzyme inhibition –competitive, non competitive and uncompetitive.

Isoenzymes – Detection, nature, importance with example

Regulation of enzyme activity

Allosteric regulation with ATPase as an example,

Covalent modification- glycogen phosphorylase , Zymogen activation.

Suggested Textbooks

1. Nelson, D.L. and Cox, M.M.(2009). Lehninger`s Principles of Biochemistry, W.H. Freeman and Company, New York.

2. Price, N.C. and Stevens, L.(1996). Fundamentals of Enzymology, Oxford University Press Inc. N.Y.

BMS-204 **Credits: 2**

PRACTICAL

1. Determination of the relative and absolute viscosity of a liquid dilute solution using an Ostwald's viscometer
2. Analysis and interpretation of spectrum of various organic compounds
3. Synthesis of a coordination compound [Pd (5 – methyl Uracil)$_2$ Cl$_2$]
4. Preparation of umbelliferone by Pechhman reaction and preparation of triphenyl imidazole
5. Titration curve of Glycine.
6. Qualitative tests for Carbohydrates
7. Qualitative tests for lipids.
8. Qualitative tests for Amino acids and Proteins
9. Preparation of casein from milk and determination of its isoelectric point.
10. Effect of pH and temperature on enzyme activity- Enzyme assay under optimal conditions.

BMS-301 **Credits: 4**

Metabolism and Bioenergetics

Unit 1: Bioenergetics (12 Lectures)

Introduction to bioenergetics and metabolism. Metabolism: Catabolism versus anabolism, Regulation of metabolic pathway. Principle of bioenergetics: Free energy, enthalpy and entropy, concept of high energy bond. Chemical basis of high standard free energy of hydrolysis of ATP and other phosphorylated compounds and Thioesters.

Unit 2: Carbohydrate and Lipid metabolism (15 Lectures)

Glycolysis and gluconeogenesis. Aerobic (PDH Complex) and Anaerobic (Lactic) fate of pyruvate, Regulation of glycolytic pathway. Entry of Galactose , Mannose and fructose into glycolytic pathway.

TCA cycle, Amphibolic nature, anaplerotic reactions, Regulation, pyruvate dehydrogenase complex enzyme. Glycogen metabolism: Synthesis and breakdown of glycogen and regulation.

Transport of fatty acids to mitochondria. β-Oxidation of even chain saturated fatty acid. Ketone Bodies synthesis and degradation (Ketosis).

Electron transport chain and Oxidative phosphorylation: component and sequence of electron. Role of PMP in ATP synthesis. Role of uncouplers and thermogenesis. Respiratory control (P/O ratio).

Unit 3: Amino acids and Nucleic acid (18 Lectures)

Amino Acids

General reaction of amino acid degradation – Transamination, deamination and decarboxylation. Ketogenic and glucogenic amino acids. Urea cycle and its significance.

Nucleic acid (~~DNA~~):

16/8/18 15-8-2018

Brief outline of *denovo* synthesis and degradation and Degradation of purines and pyrimidines. Salvage pathway for DNA synthesis.

Unit 4: Biochemical correlation of metabolic disorders

Disorders associated with defects in carbohydrate metabolism Lactose intolerance, fructose intolerance, Glycogen storage disorders.

Disorders associated with defects in Lipid metabolism:

Tay sach's disease, Gaucher disease

Disorders associated with defects in protein and amino acid metabolism:

Disorder associated with deficiency of Urea cycle enzymes, Hyperammonia, Phenylketonuria.

Disorders associated with defects in nucleotide metabolism- Gout, Lesch Nyhan Syndrome.

Lifestyle disorders: Diabetes, Cardiovascular disease,

Deficiency disorders: Night blindness, pernicious anaemia, Scurvy, Kwashiorkar, Marasmus

Suggested Textbooks

1. Nelson, D.L. and Cox, M.M. (2005); Lehninger Principles of Biochemistry, fourth edition, W.H.Freeman and company, N.Y. USA
2. Voet, D. and Voet, J.G.(2004). Biochemistry, John Wiley and Sons. INC

BMS- 302: Microbiology **Credits: 4**

Unit 1: Introduction to Microbiology

What is microbiology and classification of organisms. Brief history of Microbilogy.

Unit 2: Structure and function of Bacteria, Fungi and Virus

Size, shape and arrangement of bacterial cells and fungi; viruses. Cell membrane, cytoplasmic matrix, inclusion bodies, nucleoid, cell wall peptidoglycan structure, gram +ve and gram –ve cell wall, capsule, flagella and motility, mechanism of flagellar movement, bacterial endospore, Endotoxin.

Unit 3: Microbial Nutrition, Growth and control of Microorganisms by physical and chemical methods

Common nutrient requirements: requirements for C, H, O, N, P and S. Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; general concept of effect of environmental factors on growth of microbes; sterilization and disinfection; activity, use of physical methods (heat, low temperature, filtration, radiation) and chemical agents (phenolics, halogens, heavy water, sterilization gases).

Unit-4: Application of microbes in pharma industry

Role of microbes in production; Pharmaceuticals produced by microbial fermentations (Antibiotics). Understanding ferementation technology. Manufacturing procedures and in process control of pharmaceuticals; production of viral vaccines.

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants).

Techniques of removal of microbial contamination in pharma industry.

BMS-303: CONCEPTS IN CHEMISTRY – III **(Credit: 2)**

Unit 1: Organic reactions and their mechanisms: Addition, substitution (SN1/SN2) and elimination (E1/E2) reactions, free radical reactions, photochemical reaction, condensation reactions and rearrangements of electron deficient systems. **Pericyclic reactions:** Mechanism, types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples.

Unit 2: Mechanism and synthetic applications of organic name reactions: Aldol reaction, Cannizzaro reaction, Diels-Alder reaction, Grignard reaction, Michael addition, Mannich reaction, Ozonolysis, Reformatsky reaction, Sharpless epoxidation, Swern oxidation, Wittig reaction, Sandmeyer reaction, Appel reaction, Baeyer-Villiger Oxidation, Claisen Schmidt reaction, Dieckmann condensation, Fisher-indole synthesis, Fries rearrangement, Knoevenagel condensation, Mitsunobu reaction, Suzuki coupling, Stille coupling and Sonogashira coupling.

BMS-304: PRACTICAL **Credits: 2**

1. Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.
2. Sterilization techniques – Autoclave, dry heat sterilization, disinfection and fumigation, membrane filter sterilization.
3. Preparation of media – solid (LA), liquid (LB), Autoclaving.
4. Isolation of bacteria by streaking method.
5. Gram's staining
6. Acid fast staining (permanent slide only)
7. Study and plot the growth curve of *E. coli* using turbidometric method and to calculate specific growth rate and generation time.
8. Disposal of bacterial cultures.
9. Preparation of bacterial culture for storage (glycerol stock, slants).
10. Estimation of blood glucose.
11. Assay of salivary amylase.
12. Estimation of urea
13. Estimation of cholesterol
14. Drawing structures, reactions and mechanism using chem-draw software
15. Dibenzal acetone from benzaldehyde by Claisen Schmidt reaction and 1-Phenyl azo-2-napthol from aniline by diazotization and coupling reactions

BMS- 401: ANALYTICAL TECHNIQUES AND INSTRUMENTATION
Credits: 4

Unit 1 Basic laboratory Instruments

Principle and working of pH meter, Laminar-air flow. Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications. Colorimeter, Spectrophotomer.

Unit 2: General Chemistry and Wet analysis

Significant figures, Accuracy & precision, methods of expressing concentration, Titrimetric Analysis acid base, non-aqueous, complexometric and redox titrations, gravimetry, separation techniques, Buffer

Unit 3: Chromatography

Introduction, principle and applications of – adsorption, partition column chromatography, thin layer chromatography, paper chromatography

Gas chromatography, HPLC, ion exchange chromatography, general introduction of gel chromatography and affinity chromatography

Unit 4: Electrophoresis

Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing. Microscopy, flow cytometry and fluorescence, and immunoelectron microscopy.

BMS-402: Pharmacology **Credits: 4**

Unit 1: General Pharmacology principles

Nature and source of Drugs, Source of Administration

Unit 2: Pharmacokinetics and Pharmacodynamics

Absorption, distribution, metabolism and excretion (ADME) of drugs, enzyme induction and inhibition, first pass metabolism, excretion and kinetics of elimination, dose response relationships, drug potency and efficacy, therapeutic index.

Unit 3: Drugs acting on Nervous System

Introduction to Nervous system, General anaesthetics: principle, Inhalation and I.V. (halothane, propofol and ketamine). Sedatives & hypnotics: classification, valium, Cholinergics (acetylcholine, muscarine), Anti-cholinesterases (physostigmine, parathione).

Unit 4: Classification of drugs and mode of action:

Anti-inflammatory: NSAID's (probenecid, allopurinol), Antimicrobial drugs: General consideration, Antibacterial (tetracyclines), antiviral (acyclovir), antifungal (ketaconazole), protozoal (meteroinadazole), Diuretics, Anticancer, Antiseptic, Contraceptive Anti-diabetics, Anta-acids, Anti-pyretic, Anti metabolite, Anti-psycotic.

Reference Book:

1. Pharmacology by K.D. Tripathi, 6th Edition

2. Pharmacology by H.P. Rang; M.M. Dale; J.M. Ritter and P.K. Moore 5th Edition, Churchill Livingstone, 2003

16/8/18

16.8.2018

BMS-403: Concepts of Chemistry-IV **Credits: 2**

Unit 1: **Stereochemistry:** Stereoisomerism, optical activity, specific rotation, optical isomerism of lactic acid, tartaric acid, enantiomers, diasteromers, meso compounds, racemization, resolution, asymmetric synthesis, DL and RS systems of nomenclature of optical isomers, sequence rules; **Nomenclature of geometrical isomers**: Cis Trans, EZ, Syn Anti systems; **Conformations and conformational analysis:** cyclohexane, ethane and n-butane, bayer strain theory and orbital picture of angle strain.

Unit 2: **Introduction of polymer chemistry:** Classification, structures, properties and synthesis, polymerization process, molecular weight determinations; **Natural polymers:** monosaccharide, disaccharides, polysaccharides, peptides; Fundamentals of supramolecular chemistry, dendrimers, cyclodextrins, application of polymers in formulation of controlled release drug delivery systems; **Introduction of Dyes:** General introduction and classification with special reference to textile and edible dyes and fabric brighteners, Industrial preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

BMS-404: PRACTICAL **Credits: 2**

(Whereever wet lab experiments are not possible the principles & concepts can be demonstrated through any other materials or medium including videos/ virtual labs etc.)

1. Protein purification by Ammonium sulphate
2. Gel filtration
3. Agarose gel electrophoresis
4. PAGE electrophoresis
5. Introduction and preparation of stereo models: Methane, Ethane, Ethylene, Acetylene, Cis/Trans alkene, inversion of configuration
6. Preparation of nylon 66 and Malachite Green
7. Separation of amino acids by paper chromatography/TLC

BMS-501: Cell Biology **Credits: 4**

Unit 1: Introduction to cell Biology

Structure, Size and classification.

Unit 2: The Nucleus , Protein Sorting and transport

Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus.
The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.

Unit 3. Mitochondria and Peroxisomes.

Structural organization, Function, Marker enzymes, Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria DNA, Peroxisomes'assembly

Unit 4. The Plasma Membrane, the Extracellular Matrix and Cell Interactions

Structure; Transport of small molecules, Endocytosis, Extracellular matrix and cell matrix interactions; cell-cell interactions.

Unit 5: Cell Signaling

Signaling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway (GPCR, RTKs); signaling networks.

Unit 6. Cytoskeleton and Cell Movement

Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.

Unit 7. The Cell Cycle

Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization.

Unit 8. Cell Death and Cell Renewal

Programmed Cell Death (Extrinsic and intrinsic Pathways, Necrosis and Autophagy, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells.

BMS-502: Molecular Biology **Credits: 4**

Unit 1. Nucleic Acids convey Genetic Information

DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.

Unit 2. The Structures of DNA and RNA / Genetic Material

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves.

DNA topology - linking number, topoisomerases; Organization of DNA- Prokaryotes, Viruses, Eukaryotes, concept of gene, split genes, introns and exons.

RNA Structure

Organelle DNA -- mitochondria and chloroplast DNA.

Unit 3. Genome Structure, Chromatin and the Nucleosome

Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome

Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Regulation of Chromatin Structure and Nucleosome Assembly. Organization of Chromosomes

Unit 4. The Replication of DNA (Prokaryotes and Eukaryotes) (10 hours)

Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative, Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins. Replication Errors, DNA Damage and their repair.

Unit 5. Mechanism of Transcription (7 hours)

RNA Polymerase and the transcription unit. Mechanism of Transcription in Prokaryotes and Eukaryotes

Unit 6. Transcription Regulation in Prokaryotes (3 hours)

Principles of transcriptional regulation, regulation at initiation with examples from lac and trp Operons. **Regulatory RNAs**: Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X-inactivation

Unit 7. RNA Modifications (10 Hours)

Removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.

Unit 8. Translation (Prokaryotes and Eukaryotes) (5 hours)

Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA .synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis. Regulation of translation Translation-dependent regulation of mRNA and Protein Stability.

16/8/2018 16/8/2018

16/8/2018

16/8

BMS-503: Concepts in Mathematics and Statistics
Credits: 2

Unit 1:

Sets, Relation and function, Quadratic equation, Average, Ratio and Proportions, Percentage, Profit/ Loss and Discount, Simple interest and compound interest

Unit 2:

Accuracy and precision, Significant figures, Errors, Vectors and 3-D, Integration (Definite and Indefinite integration), Area under the graph, Differentiation, Probability, Tabulation, Line graph, Bar graph and Mixed graph.

Unit 3

Descriptive Statistics: Meaning, need and importance of statistics. Attributes and variables. Measurement and measurement scales. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, frequency polygon, frequency curve, ogives, stem and leaf plot, pie chart.

Unit 4

Data, Sampling, and study design, Measures of central tendency- mean, mode and median; dispersion (including box and whisker plot), skewness and kurtosis.

BMS-504: PRACTICAL **Credits: 2**

(Whereever wet lab experiments are not possible the principles & concepts can be demonstrated through any other materials or medium including videos/ virtual labs etc.)

1. Preparation of various stock solutions required for Molecular Biology Laboratory.
2. Isolation of chromosomal DNA from bacterial cultures and visualization on Agarose Gel Electrophoresis.
3. Isolation of genomic DNA from blood/ tissue.
4. Demonstration of Polymerase Chain Reaction (PCR) technique.
5. PCR based diagnostics (for any one disease).

BMS-601: Immunology **Credits: 4**

Unit 1. Introduction:

Historical background, general concepts of the immune system. (1 hour)

Unit 2. Structure, properties and functions of the immune cells & organs (5 hours)

T and B lymphocyte, NK cells, Monocytes and macrophages; Neutrophils, eosinophils, basophils, Mast cells and dendritic cells. Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and SALT.

Unit 3. Innate Immune Response:

Skin, Inflammatory responses,Role of monocytes neutrophils, macrophages NKcells in innate immune responses. Mechanisms of pathogen killing by macrophages and neutrophils.

Complement system: Components of the complement activation - classical, alternative and lectin pathways. Biological consequence of complement activation

Unit 4. Adaptive immune response: Humoral Immunity

Concepts of primary and secondary immune response. Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). B and T cell epitopes. Tdependent and T-independent antigens.

b. Major Histocompatibility Complex: Organization of MHC and inheritance in humans. Concepts of polygeny and polymorphism with respect to MHC. Antigen presenting cells, antigen processing and presentation pathway (cytosolic and endocytic).

d. Humoral immune response

Concepts of B cell development in bone marrow, generation of plasma cells and Memory B cells in lymphoid organs.

Structure, function and properties of the antibodies; Different classes and subclasses and biological activities of antibodies. Concepts of antibody diversity and class switching. (isotype, allotype and idiotype). Monoclonal antibodies and hybridoma technology

Unit 5: Adaptive immune response: Cell mediated immunity.

T cell maturation in thymus, thymic selection, self MHC restriction of T cells, T cell receptor complex, Trimolecular complex formation between APC and NaiveT cells, clonal expansion,

generation of effector and memory T cells. Cell types (CTLs, NK cells, macrophages and TDTH cells), effector mechanisms and effector molecules of cell mediated reactions. Assessment of cell-mediated cytotoxicity.

Cytokines - properties and functions of Interferon and Interleukins(IL1,IL2,IL4).

Unit 6. Immunological principles of various reactions and techniques:

Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA (indirect, sandwich, competitive, chemiluminescence, and ELISPOT assay), western blotting.

Unit 7. Vaccines

Heat killed, attenuated, Subunit Vaccine, Recombinant DNA vaccine, Synthetic peptide and multivalent peptide. Role of Adjuvants, overview of National Immunization Programme.

Unit 8. Dysfunctions of immune system

Hypersensitivity: Types with one example each.

Autoimmunity (general overview).

Immunodeficiency disorders: Animal models of primary immunodeficiency (nude mouse and SCID mouse). Specific impaired functions in lymphoid and myeloid lineage.

REFERENCE BOOKS FOR THEORY PAPER

Text Book:

1. Immunology by Kuby, 6th Edition J. W.H. Freeman and Company, New York, 2007
2. Microbiology, L. Prescott, John Ii Harley, Donald A. Klein, 7th Edition McGraw Hill.

Reference Books:

1. Essential Immunology by Roitt. I., 8th Edition, Blackwell Science, Oxford, 1994.
2. Immunology by Roitt, Brostoff and Male, 7th Edition, Mosby Edinburgh, 1991.
3. An Introduction to Immunology, Immunochemistry and Immunobiology Barrett, James T., 5th Edition, Mosby Company, St. Louis, 1988.
4. Immunology: An Introduction by I.R.Tizard, 4th Edition, Saunders College Publishing, Philadelphia, 1994.

BMS-602: CONCEPTS IN CHEMISTRY-V **Credits: 4**

Unit 1: Green Chemistry: Introduction, needs for green chemistry, goals of green chemistry, principles of green chemistry and designing a chemical synthesis, prevention of waste/by-products, maximum incorporation of the materials used in the process into the final products (Atom Economy), prevention/minimization of hazardous/toxic products, green solvents, solvent less processes, immobilized solvents and ionic liquids, examples of green synthesis/reactions, microwave assisted reactions, ultrasound assisted reactions, green synthesis of ibuprofen, paracetamol and aspirin, limitations and obstacles in the pursuit of the goals of green chemistry.

Unit 2: Chemistry of natural products: Alkaloids: occurrence, extraction and properties, connine, nicotine, atropine and therapeutically important alkaloids, chemistry and biogenesis of medicinally important lignans, flavonoids and fatty acids; **Terpenes and Steroids**: Isoprene rule, classification, isolation, properties, geraniol, pinene, camphor, vitamins, antibiotics and cholesterol.

Unit 3: Synthetic reagents and applications: NBS, diazomethane, DIAD; **Amide coupling reagents:** DCC, EDCI, HATU and BOP; **Oxidizing reagents:** Peracids, dess-martin periodinane, OsO4, KMnO4, PCC, PDC and peroxides; **Reducing reagents:** LAH, DIBAL, $NaBH_4$, $NaCNBH_3$, $NaBH(OAc)_3$, borane reagents and hydrogenation reaction.

Unit 4: Chemistry of Protection/Deprotection of functional groups: Role of protection/deprotection in organic synthesis; protection for the hydroxyl group, including 1, 2-and1, 3-diols; protection for the carbonyl group; protection for the carboxyl group; protection for the amino group and amino acids.

BMS-603: Medicinal Chemistry **Credits: 2**

Unit 1: Introduction to medicinal chemistry

History and development of medicinal chemistry.

Unit 2: Principle of drug design and QSAR

Strategies in the search for new lead compounds Analogue synthesis versus rational drug design, Pro-drugs, Physiochemical properties in relation to biological action- ionization, solubility, partition coefficient, hydrogen bonding, protein bonding, chelation, biosterism, Optical and geometrical isomerism. Concept of QSAR

Unit 3: Proteins as drug targets

Enzymes: Enzyme, Medicinal use of enzyme inhibitors.

Receptors: The receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency.

Unit 4: DNA as drug target

Classes of drugs that interact with DNA: DNA intercalators (amsacrine), Groove binders (netropsin), DNA alkylators (amines: mechlorethamine, nitrosoureas: carmustine).

BMS-604: PRACTICAL **Credit 2**

1. Green synthesis of paracetamol and aspirin and determination of partition coefficient in octanol water system.
2. Extraction of caffeine from tea leaves and extraction and Thin-Layer Chromatography of Chlorophyll a and b from Spinach
3. Synthesis of amides using amide coupling reagents and reductive amination/reductive alkylation reaction
4. Boc protection of alanine and esterification of aromatic carboxylic acid
5. Preparation of Benocaine
6. Preparation of Benzoquinone
7. Preparation of Phenacetin
8. Extraction of caffeine from Tea leaves and study its absorption properties.
9. Preparation of Hippuric acid
10. Preparation of s-benzyl thiouronium salt
11. Ouchterlony (Double diffusion method)/ Mancini (Single diffusion)
12. Elispot