

**SCIENCE FACULTY**

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**



**SYLLABUS FOR**

**S.Y. B.Sc.**

**BIOCHEMISTRY**

**(WITH EFFECT FROM JUNE, 2013)**

**North Maharashtra University, Jalgaon**  
**Syllabus S. Y. B. Sc. Biochemistry**  
**[With effect from June 2013]**

1. Each theory course has to be completed in 60 lectures in each semester.
1. Practical examination of laboratory course shall be conducted annually.
2. Each Theory course will be of 50 marks  
(10 marks internal and 40 marks external examination)
3. Practical course will be of 100 marks  
(20 marks internal and 80 marks external examination)
4. BC YSC [Y for year, S for semester and C for course number].
5. A Study tour of minimum one day is compulsory for the S.Y. B.Sc. students. The students should. Submit their tour reports at the time of practical examination
6. Each course is having weightage four periods per week and each practical course is having weightage four periods per week.

**Theory Courses**

<b>FIRST SEMESTER</b>	
<b>BC 211: Food Biochemistry-I</b>	<b>BC 212: Human Physiology-I</b>
<b>Unit-I</b> :Energy value of food and its measurement	<b>Unit-I</b> : Digestive System
<b>Unit-II</b> : Protein and nutrition	<b>Unit-II</b> : Respiratory System
<b>Unit-III</b> :A)Lipid and nutrition B) Carbohydrate and nutrition	<b>Unit-III</b> : Circulatory system
<b>Unit-IV</b> :Minerals and Trace elements in nutrition	<b>Unit-IV</b> : Excretion and osmoregulation

<b>SECOND SEMESTER</b>	
<b>BC 221: Food Biochemistry-II</b>	<b>BC 222: Human Physiology-II</b>
<b>Unit-I</b> : A) Water electrolyte balance B) Methods of cooking	<b>Unit-I</b> : Nervous System
<b>Unit- II</b> : Food adulterations and Food Allergy	<b>Unit-II</b> : Reproductive system
<b>Unit-III</b> : Food spoilage and food preservation	<b>Unit-III</b> : Endocrine system
<b>Unit-IV</b> : A) Evaluation of food quality : B) Therapeutic diet/diet modification in diseases	<b>Unit-IV</b> :Biochemistry of specialised tissue and receptors

**Practical Course (Annual)**

<b>Annual</b>
<b>BC 203: Practical Course</b> Laboratory course in food biochemistry and physiology

Chairman B.O.S.

Dean Sci. Faculty

**First semester**  
**BC-211 Food Biochemistry-I**

**Unit-I Energy value of food and its measurement (15 lectures/10 marks)**

- Nutritive value of different foods: cereals and millets, pulses, nuts and oils, vegetables, fruits, milk and milk products, eggs, meat, fish and other animal foods, fats and oils, sugar and other carbohydrate food, condiments and spices
- Classification of food based on function: energy yielding, body building and protective food
- Five food group plan as per ICMR
- Energy value of food: carbohydrate, protein, lipid
- Energy unit: Kilo calorie, mega joule
- Physiological energy value of food: loss in digestion and metabolism
- Determination of energy value using Bomb calorimeter, Benedict's oxy-calorimeter
- Relation between oxygen requirement and calorific value
- Direct calorimetry: Atwater-Benedict respiration calorimeter
- Respiratory quotient: definition, RQ for carbohydrate, fat and protein
- Relation between RQ and energy output
- Specific dynamic action of food (SDA)
- Basal Metabolic Rate: definition, determination, factors affecting BMR
- Recommended dietary allowance: definition, factors affecting RDA, RDA for adult man
- Recommended allowance for energy for Indians (ICMR 1981): adults- reference man and woman, pregnancy and lactation, infants, children, age

**Unit-II Protein and nutrition (15 lectures/10 marks)**

- Protein: definition, functions, important dietary sources, nutritional classification
- Amino acids: nutritional significance of amino acids, classification- Essential and non-essential amino acids
- Essential amino acids content of food: cereals, legumes, oil seeds and nuts, egg, milk, meat and fish
- Nutritive value determination: protein efficiency ratio, digestibility coefficient, biological value, net protein utilization, net protein ratio
- Amino acid imbalance, amino acid antagonism and amino acid toxicity
- Dynamic aspects of protein metabolism: half life of tissue protein, rate of protein synthesis in body, removal of free amino acids from circulation, circadian changes in plasma amino acid, N<sub>2</sub> metabolism on nitrogen free diet, body protein loss during starvation, nitrogen balance
- Estimation of nitrogen requirements by factorial method
- Safe level of intake of egg/milk protein
- RDA for protein for Indians as per ICMR 1981
- Mutual supplementation
- Factors affecting utilization of dietary protein
- Protein-calorie malnutrition in children: Kwashiorkor and Marasmus

### **Unit-III A. Lipid and nutrition**

**(15 lectures/10 marks)**

- Lipids: definition and functions
- Functions of fats, phospholipids and cholesterol
- Essential fatty acids: definition, types, functions, deficiency in human being and infants, EFA content of oil and fats, Effects of excess EFA
- Transport of lipid in blood: alimentary lipemia, lipid transformation in liver, lipoproteins of plasma, lipoprotein lipase, lipemia and significance of high serum lipoproteins
- Storage of lipids: white and brown adipose tissue, deposition of fat in adipose tissue
- Role of liver in lipid metabolism
- Fatty liver and lipotropism
- Ketogenesis
- Atherosclerosis and ischaemic heart disease
- Obesity: nutritional basis, body mass index and genetic basis.

### **B. Carbohydrate and nutrition**

- Carbohydrate: definition, classification and functions
- Importance of different carbohydrates in diet: starch, lactose, sucrose, glucose and fructose
- Carbohydrate content of the body
- utilization of absorbed carbohydrates in the body
- Glycemic index
- Carbohydrate fibers: beneficial and adverse effects, sources
- Regulation of blood glucose level: food intake and starvation, role of liver, role of hormones, muscular work, role of kidney
- Glycosuria: in normoglycemia and due to hyperglycemia
- Glucose tolerance test: GTT curve
- Some other aspects of carbohydrate: protein sparing action of carbohydrate, conversion of carbohydrate to fat, formation of carbohydrate from protein and fat, carbohydrate as source of energy for muscular work, special function of carbohydrates in liver

### **Unit-IV Minerals and Trace elements in nutrition**

**(15 lectures/10 marks)**

#### **Minerals:**

- Biochemical functions, dietary requirements, sources, absorption, excretion, diseases state: Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine, Sulfur, Iron

#### **Trace elements:**

- Biochemical functions, dietary requirements, sources, absorption, excretion, diseases state: Iodine, Copper, Zinc, Manganese, Fluorine, Molybdenum, Selenium, Chromium, Cobalt, Silicon

**Second semester**  
**BC- 221      Food Biochemistry-II**

**Unit-I    A. Water electrolyte balance** **(15 lectures/10 marks)**

- Water- distribution of water in body, water intake and loss.
- Composition of body fluids
- Water exchange between plasma and interstitial fluids, Regulation of water metabolism
- Effect of excess water intake and deprivation on water balance in body
- Effect of excess NaCl and depletion on water balance in body
- Dehydration
- Water intoxication- water excretion by kidney and thirst
- Electrolyte- concentration in intra and extra cellular fluid permeability of cell membrane
- Active transport across cell membrane
- Excretion of electrolytes by the kidney
- Variation of electrolyte conc. and ECF volume
- Hypo and hypernatremia and kidney

**B. Methods of cooking**

- Cooking- Objectives and limitations
- Methods of cooking
  - a. Moist: boiling, simmering, pouching, stewing, blanching, steaming, pressure cooking.
  - b. Dry heat: Air as medium of cooking- grilling, roasting, baking; Fat as medium of cooking- sauting, shallow, fat frying, deep fat frying
  - c. Combination cooking- Braising
- Effect of cooking on- carbohydrates, Fat, Protein, vitamins and Minerals

**Unit- II    Food adulterations and Food Allergy** **(15 lectures/10 marks)**

- Adulteration: Definition, types- Intentional and incidental (definition and one example)
- Common adulterants in different foods: Milk and Milk product, vegetable oils, and fats, wheat products, pulses, honey, beverages, spices and condiments, miscellaneous.
- Contamination of food with: toxic metals, pesticide, food additives, solvent residues, animal feed additives.
- Contamination of food with harmful microorganism:
  - a. Bacterial infection: Typhoid, paratyphoid, botulism, clostridium, perfringers, bacillus cereus, salmonella, staphylococci, streptococci, shigella
  - b. Fungal contamination- Fusarium and cladosporium, penicilliumislandicum, claviceps purpurea, Aspergillus flavus
  - c. Parasitic infection, toxicants naturally occurring in some food, insect and rodent contamination of stored food.
- Food laws and standards: Prevention of food adulteration act 1954; Bureau of Indian Standards: AGMARK, , Consumer protection act 1986, Codex alimentarius, Hazard analysis critical control point (HACCP)
- Food allergy: classification- delayed allergy, immediate allergy
- Chemical nature of causative agent
- Characteristics of allergic reactions: histamine, plasma kinin, allergen, reagins
- Clinical sign and symptoms
- Detection of food allergy: history taking, diet diaries, elimination diet, provocative diet, pulse acceleration test, leukopenic index, x-ray, skin testing
- Food as allergen: animal origin- cow' milk, goat's milk, egg, fish, meat; Plant origin: cereals, soybean, peanut, other legumes, edible fungi, fats and oils, vegetables and fruits, beverages
- Food contaminants as allergens

### **Unit-III Food spoilage and food preservation**

**(15 lectures/10 marks)**

- Food spoilage, factors determining food spoilage- intrinsic, extrinsic modes of processing and preservation, implicit parameters
- Micro-organisms involved in food spoilage: bacteria, yeast and moulds, enzymes
- Chemical spoilage: lipid oxidation, enzymatic oxidation, lipolysis, discoloration
- Food spoilage of: Dairy products, Egg products, fruits and vegetables, Meat products
- Food preservation: Principle
- Methods of food preservation
  - a. Preservation by low temperature: freezing, chilling/cold storage/refrigeration
  - b. Preservation by high temperature: heating below 100°C (pasteurization), heating at 100°C, heating above 100°C
  - c. Preservation by drying: conventional air drying, microwave drying, osmotic dehydration, freeze drying, mechanical drying, spray drying, foam-mat drying, drying by smoking, Chemical/physical/nutritional factors influenced by drying
  - d. Irradiation: Types- radiation sterilization, radurization, radication, thermoradiation; ionizing radiation used for food irradiation- electron beam, x-rays, gamma rays and UV; uses of food irradiation, effect of ionizing radiation on nutrients of food
  - e. Chemicals: acids and their salts, fatty acid esters, nitrites, parabens, NaCl, sulphites, dimethyl dicarbonate, phenolic antioxidants, phosphates

### **Unit-IV A. Evaluation of food quality**

**(15 lectures/10 marks)**

- Sensory evaluation: Sensory characteristics of food- appearance, colour, flavour
- Types sensory tests: difference tests, rating tests, sensitivity tests, descriptive tests
- Objective evaluation: advantages, disadvantages, Types of tests- Chemical methods, microscopic examination, Physical methods- weight, volume, specific volume, index to volume, specific gravity, moisture, wettability, cell structure, size of grain, photography, measurement of colour

#### **B. Therapeutic diet / diet modification in diseases**

- Balanced Diet: - Concept and significances
- Types of therapeutic diet.
- Representative diets in various ailments – diabetes mellitus, cardio vascular diseases, kidney, peptic ulcer, anemia and gastrointestinal diseases, brief rational for each type of diet.

#### **Recommended Books:**

1. Essentials of food and Nutrition. ( Vol I & Vol II) – M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.
2. Food Science - B. Srilakshmi. New Age International Publishers
3. Food Microbiology - K. Vijaya Ramesh. MJP Publishers
4. Food Science & Processing technology, Vol-2 Commercial Processing & Packaging- Mridula Mirajkar, Sreelata Menon. Kanishka Publishers
5. Handbook of food & Nutrition- M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.
6. Biochemistry- U. Satyanarayana, U. Chakrapani. Books and allied (P) Ltd.
7. Lehninger Principles of Biochemistry- D.L. Nelson, M.M. Cox. W.H. Freeman and Company. Fourth Edition
8. Biochemistry- J.M. Berg, J.L. Tymoczko, L.Stryer. W.H. Freeman Palgrave Macmillan. Eleventh Edition
9. Fundamentals of Biochemistry- J.L. Jain, S. Jain, N. Jain. S. Chand

## **First semester**

### **BC-212 Human physiology-I**

#### **Unit-I Digestive System**

**(15 lectures/10 marks)**

- Generalised structure of digestive system, Histology of alimentary tract, Functions of digestive system
- Structure and functions of different parts of digestive system: Tongue, pharynx/throat cavity, Oesophagus (+ histology), Stomach (+ histology), Small intestine (+ histology), Large intestine
- Structure and functions of accessory digestive organs: Teeth, Salivary gland (+ histology), Liver (+ histology), Gall bladder, Pancreas
- Composition and functions of digestive juices: Saliva, Gastric juice, Pancreatic juice, Intestinal juice (Succus entericus), Bile
- Digestion and absorption of carbohydrate, protein and lipid
- Absorption of water and salt
- Composition of faeces

#### **Unit-II Respiratory System**

**(15 lectures/10 marks)**

- Definition of respiration, general structure of respiratory system, functions of respiration
- Structure and functions of different parts of respiratory system:  
Conducting zone- Nose, pharynx, Larynx, Trachea  
Respiratory zone- Main bronchi, Lungs
- Physical properties of lungs: surface tension, elasticity, lung volume and lung capacity
- Mechanism of respiration/breathing: Inspiration and expiration concerning diaphragm, intercostal muscle, sternum, ribs, accessory muscles
- Partial pressure of gases in inspired air, expired air and alveolar air
- Respiratory process:
  - a. Diffusion: process and factors controlling it
  - b. Perfusion: process
  - c. Oxygen transport: oxygen exchange in lungs and transport in tissue, dissociation curve for haemoglobin and factors affecting it- CO<sub>2</sub> concentration (Bohr's effect and significance), pH, Temperature, 2,3-diphosphoglycerate
  - d. CO<sub>2</sub> transport: chemical forms in which CO<sub>2</sub> transports, CO<sub>2</sub> transport in tissue (Chloride shift), in RBCs and as carbamino compounds
- Control of respiration: nervous and chemical factors

#### **Unit-III Circulatory system**

**(15 lectures/10 marks)**

- Blood: composition and functions
- Plasma proteins: composition, chemistry, separation and functions
- Properties of blood: specific gravity, viscosity, ESR, blood volume- definition, normal blood volume, variation under physiological conditions, regulation of blood volume, causes of decrease and increase in blood volume
- Elements of blood:
  - a. RBCs: Structure, composition, red cell count, abnormal forms, stages of development, functions

- b. WBCs: Chemistry, total number and variation, classification- granular and agranular, development of leucocytes and lymphocytes, functions
- c. Platelets: Histology, functions, development, total number
- Blood coagulation: definition, blood clotting factors, extrinsic and intrinsic pathways
- Bleeding time, clotting time, prothrombin time
- Anticoagulant: natural and artificial
- Blood groups: A, B, O and Rh factor, Blood transfusion
- Description and schematic representation of blood circulation
- Anatomy of heart, histology of arteries, veins and capillaries
- Lymphatics and lymph: description, properties, formation and functions of lymph

#### **Unit-IV Excretion and osmoregulation**

**(15 lectures/10 marks)**

- Organisation of urinary tract
- Anatomy and functions of kidney, renal blood supply
- Structure and functions of nephron
- Urine formation: glomerular filtration, tubular reabsorption and tubular secretion
- Factors affecting urine formation: water intake, intravenous saline injection, drinking saline solution, effects of salt and water deprivation, exercise
- Characteristics of urine: volume, colour, reaction, specific gravity, turbidity, odour, osmotic pressure
- Composition of urine: normal and abnormal constituents
- Osmosis, osmotic pressure and its importance
- Diffusion and its importance
- Counter current multiplication theory of urine concentration
- Fluid, electrolyte and acid-base balance: role of kidney
- Kidney dialysis

## **Second semester BC-222 Human physiology-II**

#### **Unit-I Nervous System**

**(15 lectures/10 marks)**

- Nervous system: central and peripheral nervous system
- Central Nervous System: Structure and functions of different parts of brain- cerebrum, cerebellum, brain stem, pons, medulla oblongata, thalamus, hypothalamus
- Spinal cord: structure and functions
- Peripheral Nervous System: Structure of nerve, cranial and spinal nerves, autonomic nervous system (Sympathetic and parasympathetic), somatic nervous system
- Nervous tissue: Neurons: structure, functions and types (uni, di and multipolar, myelinated and non-myelinated)
- Synapse: definition, classification, mechanism of synaptic transmission, properties of synapse
- Types of synapse: structural basis- axo-dendritic, axo-axonic, axo-somatic; functional basis- chemical and electrical synapse
- Neurotransmitters: excitatory and inhibitory- structure and functions
- Reflex action: definition, types- conditioned and unconditioned
- Reflex arc: components and types



## Unit-II Reproductive system

(15 lectures/10 marks)

- Male reproductive system: anatomy
- Histology and functions of testis
- Structure of sperm, spermatogenesis, hormonal control of spermatogenesis
- Semen: accessory glands- seminal vesicles, prostate, bulbourethral gland, semen
- Female reproductive system: anatomy and histology
- Ovary: anatomy, histology and functions
- Maturation of graafian follicle and ovum
- Menstrual cycle
- Oogenesis and its hormonal regulation
- Hormones secreted by gonads:  
Male gonads: androgen- types, testosterone- chemistry and functions  
Female gonads: types, chemistry and functions of estrogen and progesterone
- Fertilization: molecular events during fertilization
- In-vitro fertilization, abnormal fertilization
- Twins- homozygotic and dizygotic

## Unit-III Endocrine system

(15 lectures/10 marks)

- Concept of endocrine system: endocrine and exocrine gland, hormones
- General characteristics of hormone: action in low concentration, storage, destruction and excretion, rate limiting action, dual control, multiple secretion, chemical nature, inter-relation of endocrines, inter-relation with vitamin, dysfunction of endocrine glands, therapeutic administration of hormones
- General properties of hormones: solubility, molecular weight, diffusion, cumulative action
- Molecular mechanism of hormone action: protein, peptide, lipid/steroid hormones
- Control of endocrine system
- Transport and clearance of hormones from blood
- Pituitary gland: anatomy- adenohypophysis and neurohypophysis
- Adenohypophysis: hormones and their functions- growth hormone, prolactin, FSH, LH, TSH, ACTH, MSH
- Neurohypophysis: hormones and their functions- vasopressin, oxytocin
- Thyroid gland: anatomy and histology
- Thyroid hormones and their functions: T<sub>3</sub>, T<sub>4</sub> and thyroxine
- Parathyroid gland: anatomy and histology
- Parathyroid hormones and their functions: parathormone
- Endocrine pancreas: anatomy and histology
- Endocrine pancreas hormones and their functions: insulin and glucagon
- Adrenal gland: anatomy and histology
- Adrenal gland hormones and their functions: epinephrine, nor-epinephrine, gluco-corticoid, mineral-corticoid, sex hormones/sex steroid
- Pineal gland: anatomy and histology
- Pineal gland hormones and their functions: Melatonin
- Functions of some other hormones: gastrin, erythropoietin, histamine and heparin, prostaglandin, leptin, beta-hcG

**Unit-IV Biochemistry of specialised tissue and receptors (15 lectures/10 marks)**

- Taste (gustation): histology of tongue, papillae, histology of taste buds
- Taste sensations and constitution related to taste- sweet, bitter, sour, salt
- Mechanism of taste perception
- Factors affecting taste sensation
- Smell (olfaction): olfactory receptors, physiology of olfaction, pathways of olfactory impulses
- Vision: Anatomy of eye, structure and function of different parts of eye- crystalline lens, conjunctiva, cornea, iris, pupil, retina, rods and cones, lacrimal apparatus
- Visual cycle, light and dark adaptation
- Muscles: structure and functions of striated and unstriated muscles
- Mechanism of muscle contraction and relaxation
- Role of actin, myosin, troponin, tropo-myosin, titin, nebulin,  $Ca^{2+}$  in muscle contraction and relaxation
- Skin: structure and functions
- Glands in skin: sweat, eccrine, sebaceous gland
- Mechanism of secretion of sweat, types of sweating, pigmentation of skin
- Hearing: anatomy of ear
- Structure and functions of external, middle and inner ear
- Central auditory mechanism

**Recommended Books:**

1. Human physiology Vol. II and I – C.C. Chatterjee, Medical allied Agency
2. Textbook of Medical physiology –Guyton- International Edition, Elsevier Inc.
3. Text book of Human Biochemistry- G. P. Talwar, Prentice Hall of India Pvt. Ltd.
4. Essentials of Human Anatomy & physiology- Elaine N. Marieb - Pearson Education Inc, International Edition - Ninth edition
5. Essentials of anatomy & physiology.- Rod R. Seeley, Trent D. Stephens- Mosby. Second Edition.
6. Human Physiology - Stuart Ira Fox- Wm.C.Brown publisher - Fifth Edition.
7. Harper's illustrated Biochemistry- R.K. Murray, D.K. Granner, V.W. Rodwell. Mcgraw Hill. 27th Edition.
8. Review of Medical Physiology- W.F. Ganong. Prentice-Hall International Inc.
9. Medical Physiology- S.K. Chaudhari. New Central Book Agency Pvt. Ltd.
10. Human Physiology- E. Basky, B.Khodorox, G. Kositsky, A. Zubkov. MIR Publishers Moscow

## **BC 203: Practical course**

### **Laboratory course in food biochemistry and physiology**

1. Identification of histological specimen --- liver, Stomach, lungs, kidney, nephron, nervous tissue, adrenal, pancreas, thyroid, testis and ovary.
2. Preparation of blood smear and Differential leucocyte count and its significance
3. Enumeration of RBCs and WBCs for determining health status
4. Bleeding time and Clotting time and its significance
5. Determination of blood groups (A, B, AB, O and Rh) and its significance
6. Recording of blood pressure by sphygmomanometer and its significance
7. Determination of gastric juice acidity
8. *In vitro* protein digestibility determination
9. Determination of energy value of food stuff using bomb calorimeter
10. Determination of crude protein by Kjeldahl's method
11. Determination of sodium and potassium content in blood serum samples by flame photometer
12. Determination of calcium by titration method.
13. Estimation of phosphorus by Fiske and Subbrow method
14. Determination of iron content in apple Juice by colorimetric method
15. Qualitative analysis of some common food adulterants: oil and fats, milk and milk products, beverages, spices and condiments, pulses
16. Determination of rancidity in edible oil and its applications
17. Extraction of oil from oil seed by Soxhlet method and determination of oil content in oil seed by colorimetric method
18. Microbial examination of food
19. Determination of moisture content in food sample
20. Determination of ash content in food sample

### **Recommended Books:**

1. An Introduction to Practical Biochemistry – David T. Plummer - TATA McGRAW-HILL.
2. Biochemical Method – S. Sadasivam and A. Manickam New age international publishers.
3. Experimental Biochemistry- A student companion - Beedu Sahidhar Rao . Vijay Deshpande I.K. International Pvt. Ltd. New Delhi.
4. Introductory practical biochemistry- S.K. Sawhney, Randhir Singh, Narosa publication.
5. Laboratory manual in biochemistry- J. Jayaraman, New age international publishers.
6. Experiments in microbiology, plant pathology and biotechnology- K.R. Aneja, New age international publishers.
7. Practical Microbiology Principles and Techniques- V. Kale, K. Bhusari. Himalaya Publishing House.
8. Textbook of Medical Laboratory Technology- P.B. Godkar, D.P. Godkar. Bhalani Publishing House. Second Edition.
9. Practical Biochemistry- G.Rajgopal, B.D.Toora. Ahuja Book Company Pvt.Ltd.