

NORTH MAHARASHTRA UNIVERSITY
JALGAON



'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS FOR

Second Year Bachelor of Science

in

Biochemistry

(S. Y. B. Sc. Biochemistry Semester Pattern)

w. e. f. Academic Year 2016 - 2017

North Maharashtra University, Jalgaon.

Syllabus for S. Y. B. Sc. Biochemistry (Semester Pattern)

(w. e. f. Academic Year 2016 - 17)

Aim:

This syllabus is designed to impart fundamental knowledge of Biochemistry to undergraduate students at second year of three years of B.Sc. degree course. In view of the demand for trained manpower in the area, this course is broad based, expands the previous year knowledge and focus basic aspects with emphasis on practical training to the students. Each unit of the syllabus is well defined, taking into consideration the level and capacity of student. The detailed syllabus for each paper is appended with a list of suggested readings.

Course Structure at a Glance

Course Title	Semester	Marks		Credits
		Int.	Ext.	
BC - 231: Food Biochemistry	I	40	60	03
BC - 232: Human Physiology-I	I	40	60	03
BC - 233: Practical Course in Biochemistry - I	I	40	60	1.5
BC - 241: Environmental Biochemistry	II	40	60	03
BC - 242: Human Physiology-II	II	40	60	03
BC - 243: Practical Course in Biochemistry - II	II	40	60	1.5

- Each theory course is divided into four units and is to be completed in 60 periods (lectures) of 45 minutes duration each.
- Each course (theory and practical) will have 04 periods (lectures) per week.
- Practical examination for each semester will be held at the end of the respective semester.
- A Study tour of minimum one day at relevant place/institution/industry etc. is compulsory. Students should submit tour report at the time of practical examination.

BC – 231: Food Biochemistry

Unit – I: Energy value of food and its measurement

(15 lectures; 15 marks)

- Nutritive value of different foods: cereals, millets, pulses, nuts, vegetables, fruits, milk and milk products, eggs, meat, fish, fats, oils, sugar, 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.
- Unit of energy: calorie, kilo calorie, Joule, mega Joule
- Physiological energy value of food: loss in digestion and metabolism.
- Determination of energy value using Bomb 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 (RDA): definition, factors affecting RDA, RDA for adult.

Unit – II: Food adulterations, intoxication and contaminations

(15 lectures; 15 marks)

- Adulteration: Definition, types - intentional and incidental (definition and one example each)
- Common adulterants in different foods: Milk and milk products, vegetable oils and fats, wheat products, pulses, honey, beverages, spices and condiments.
- Contamination of food with harmful microorganism.
- Food intoxication: Botulism, *Clostridium perfringens*, *Bacillus cereus*, *Salmonella*, *Shigella dysenteriae*, *Listeria monocytogenes*, *Yersinia enterocolitica*.
- Fungal toxins (contamination): *Fusarium*, *Cladosporium*, *Penicillium islandicum*, *Claviceps purpurea*, *Aspergillus flavus*.
- 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, Hazard analysis critical control point (HACCP).

Unit – III: Food spoilage and food preservation

(15 lectures; 15 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, food spoilage by enzymes, and insect.
- Chemical spoilage: lipid oxidation, enzymatic oxidation, lipolysis, discolouration.
- Food preservation: Concept, principle.
- Methods of food preservation:
 - a. Preservation using low temperature: freezing, chilling/cold storage/refrigeration.
 - b. Preservation using 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.
- d. Irradiation: types - radiation sterilization, radurization, radicidation, 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, nitrites, NaCl, sulphites, dimethyl dicarbonate, phenolic antioxidants, phosphate.

Unit – IV: Food additives, food allergy and diet modification (15 lectures; 15 marks)

- Food additives: Concept, importance of food additives.
- Examples of food additives : antimicrobial agents, antioxidants, colour and adjuncts, emulsifiers, flavour enhancers, enzymes, sweeteners, non-nutritive and nutritive additives, propellants, aerating agents and gases.
- Food allergy: Concept, classification – immediate and delayed allergy. Clinical signs and symptoms.
- Food as allergen: Animal origin - cow milk, goat milk, egg, fish, meat. Plant origin – cereals, soybean, peanut, other legumes, edible fungi, fats, oils, vegetables, fruits and beverages.
- Detection of food allergy: history taking, diet diaries, elimination diet, provocative diet, pulse acceleration test, leukopenic index, x-ray, skin testing.
- Therapeutic diet / diet modification in diseases: Definition and types of therapeutic diet.
- Concept and significance of balanced diet.
- Representative diets in: diabetes mellitus, cardio vascular diseases, anaemia with brief rationale 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.

BC - 232: Human Physiology - I

Unit – I: Digestive System

(15 lectures; 15 marks)

- Digestive system: Structure and functions. Histology of alimentary tract.
- Structure and functions of different parts of digestive system: Oesophagus, stomach, small intestine, large intestine.
- Structure and functions of accessory digestive organs: Salivary glands, liver, Gall bladder, pancreas.
- Composition and functions of digestive juices: Saliva, gastric juice, pancreatic juice, intestinal juice (succus entericus), bile.
- Gastrointestinal hormones: Gastrin, Cholecystokinin, pancreaticozymin, secretin and gastric inhibitory peptide, motilin.
- Digestion and absorption of carbohydrate, protein and lipid.
- Absorption of water and electrolytes.

Unit – II: Respiratory System

(15 lectures; 15 marks)

- General structure of respiratory system. Structure and functions of trachea and lungs.
- Physical properties of lungs: surface tension, elasticity, lung volume and lung capacity.
- Respiration: Definition and functions. Mechanism of respiration/breathing: inspiration and expiration concerning diaphragm, intercostal muscle, sternum, ribs, accessory muscles.
- Respiratory process: Oxygen transport: oxygen exchange in lungs and transport in tissue, dissociation curve for haemoglobin and factors affecting it - CO₂ concentration (Bohr's effect and significance), pH, temperature, 2,3-diphosphoglycerate. Carbon dioxide transport: chemical forms in which CO₂ transports, CO₂ transport in tissue (Chloride shift), in RBCs and as carbamino compounds.
- Control of respiration: Nervous and chemical factors controlling respiration.

Unit – III: Circulatory System

(15 lectures; 15 marks)

- Composition and functions of blood and plasma. Plasma proteins: specific plasma proteins (albumins, globulins, carrier proteins, acute phase proteins) and their functions.
- Structure, functions and life span of RBCs, WBCs and platelets.
- Haematopoiesis: Erythropoiesis, granulocytopoiesis, lymphocytopoiesis and Thrombocytopoiesis.
- Haemoglobin: Structure, types (HbA, HbF, HbS) and functions.
- Blood coagulation: Definition, blood clotting factors, extrinsic and intrinsic pathways. Blood coagulation tests: Bleeding time, clotting time, prothrombin time. Blood groups: A, B, O and Rh factor, cross matching, compatibility. Blood transfusion.
- Lymphatics and lymph: Description, properties, formation and functions of lymph.

Unit – IV: Excretory System

(15 lectures; 15 marks)

- Organisation of urinary tract. Anatomy and functions of kidney. Structure and functions of nephron. Urine formation: glomerular filtration, tubular reabsorption and tubular secretion. Counter current multiplication theory of urine concentration.
- Characteristics of urine: volume, colour, reaction, specific gravity, turbidity, odour, osmotic pressure. Normal and abnormal constituents of urine.
- Role of kidney in fluid and acid-base balance.

Recommended Books:

1. Human physiology Vol. I and II. – 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. Essentials of Human Physiology, R. Suresh. Books and Allied (P) Ltd, Kolkata.
11. Concise medical Physiology, S.K. Chaudhari. New Central Book Agency Pvt. Ltd. London.
12. Medical Physiology, Asis Das. Books and Allied (P) Ltd, Kolkata.

BC - 241: Environmental Biochemistry

Unit – I: Pollution and environmental problems (15 lectures; 15 marks)

1. Pollution: Concept and introduction of pollution and pollutants. Introduction, effect and control of; water pollution, land pollution, noise pollution and air pollution.
2. Green house effect and global warming. Green house gases. Measures to control green house effect.
3. Ozone layer: Importance of ozone layer. Depletion of ozone, ozone hole, effects of ozone depletion. Measures to control ozone depletion.
4. Acid rain: Introduction, effects and measures to control acid rain.

Unit – II: Bioenergy (15 lectures; 15 marks)

- Bioenergy: Introduction. Biomass for energy production: Concept, chemical nature, sources, utilization.
- Biogas: Introduction, substrates, process, microbial production of biogas, factors affecting biogas production, advantages. Limitations for large scale production.
- Introduction to hydrogen as a biofuel. Production of bio-hydrogen by photosynthetic bacteria and fermentation.
- Energy rich crops: Sugar and starch crops, wood rich plants and petroleum plants.

Unit – III: Biodegradation and bioremediation (15 lectures; 15 marks)

- Biodegradation: Concept, microorganisms for biodegradation and bioremediation. Enzyme system for biodegradation. Factors affecting biodegradation. Xenobiotics.
- Bioremediation: Concept, types, advantages and disadvantages. Types of reaction in bioremediation.
- Bioremediation of contaminated soil, waste land and ground water.

Unit – IV: Environmental toxicology (15 lectures; 15 marks)

- Toxins: Concept and types. Introduction, sources and remedies of metal toxins (arsenic, mercury).
- Pesticides: Introduction, classification on the basis of mode of entry, mode of action and chemical nature. Application of pesticides. Environmental effects of pesticides.
- Impact of pesticide on organisms.
- Bio warfare agents: Anthrax, plague, small pox, sarin, chlorine, hydrogen cyanide, sulphur mustard, lewisite and ricin.

Recommended Books:

1. Biotechnology - U. Satyanarayana, Books and Allied (P) Ltd, Kolkata.
2. Environmental Science - S. C. Santra, New Central Book Agency (P) Ltd, Kolkata.
3. Environmental Chemistry - A. K. De, New Age International Publishers, New Delhi.
4. Environmental Biotechnology - S. N. Jogdand, Himalaya Publishing House, Mumbai.
5. Environment and Ecology - A. K. Rana, M. K. Rana, Global Vision Publishing House, New Delhi.
6. Ecology and Environmental Biology - T. K. Saha, Books and Allied (P) Ltd, Kolkata.
7. Environmental Toxicology - M. Satake, Y. Mido, H. Yasuhisa, S. Taguchi, M. S. Sethi, S. A. Iqbal, Discovery Publishing House, New Delhi.

BC - 242: Human Physiology - II

Unit – I: Nervous system

(15 lectures; 15 marks)

- Nervous system: Introduction to central and peripheral nervous system.
- Peripheral nervous system: Cranial and spinal nerves. Structure of nerve.
- Nervous tissue: Structure, functions and types of neurons (uni, di and multipolar, myelinated and non-myelinated).
- Synapse: Definition, classification, properties, types (structural basis: axo-dendritic, axo-axonic, axo-somatic; functional basis- chemical and electrical synapse). Mechanism of synaptic transmission.
- Neurotransmitters: Definition. Structure and functions of excitatory and inhibitory neurotransmitters.
- Reflex action: Definition, types (conditioned and unconditioned).
- Reflex arc: Definition, components and types.

Unit – II: Reproductive system

(15 lectures; 15 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.
- 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: Chemistry and functions of androgen, testosterone, estrogen and progesterone.
- Fertilization: Definition and molecular events during fertilization.

Unit-III: Endocrine system

(15 lectures; 15 marks)

- Endocrine system: Introduction to endocrine and exocrine glands.
- Hormones: Definition, general characteristics: 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: solubility, molecular weight, diffusion, cumulative action.
- Mode of action of hormones: Endocrine, paracrine and autocrine. 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. Functions of growth hormone, prolactin, FSH, LH, TSH, ACTH, MSH, vasopressin and oxytocin.
- Thyroid gland: Anatomy and histology. Thyroid hormones and their functions (T3, T4 and thyroxine). Parathyroid gland: anatomy and histology. Functions of parathormone.
- Endocrine pancreas: Anatomy and histology. Functions of insulin and glucagon.
- Adrenal gland: Anatomy and histology. Functions of epinephrine, nor-epinephrine, gluco-corticoid, mineral-corticoid, sex hormones/sex steroid.
- Pineal gland: Anatomy and histology. Functions of melatonin.

Unit – IV: Biochemistry of specialised tissue and receptors

(15 lectures; 15 marks)

- Taste (gustation): Histology of tongue, papillae, 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.
- Skin: Structure and functions. Glands in skin: sweat, eccrine and sebaceous gland. Mechanism of secretion of sweat, types of sweating, pigmentation of skin.
- Muscles: Structure and functions of striated and unstriated muscles. Mechanism of muscle contraction and relaxation. Role of actin, myosin, troponin, tropo-myosin, titin, nebulin, Ca²⁺ in muscle contraction and relaxation.

Recommended Books:

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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.
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9. Medical Physiology- S.K. Chaudhari. New Central Book Agency Pvt. Ltd.
10. Essentials of Human Physiology, R. Suresh. Books and Allied (P) Ltd, Kolkata.
11. Concise medical Physiology, S.K. Chaudhari. New Central Book Agency Pvt. Ltd. London.
12. Medical Physiology, Asis Das. Books and Allied (P) Ltd, Kolkata.

BC – 233: Practical Course in Biochemistry – I

1. Enumeration of RBCs for determining health status.
2. Enumeration of WBCs for determining health status.
3. Determination of ESR of the given blood sample.
4. Determination of gastric juice acidity.
5. Determination of blood groups (A, B, AB, O and Rh) and its significance.
6. Determination of energy value of food stuff using bomb calorimeter.
7. Qualitative analysis of some common food adulterants: Pulses, oil, fats, milk and milk products, beverages, spices and condiments.
8. Determination of rancidity in edible oil and its applications.
9. Microbial examination of food.
10. Determination of moisture content in food sample.

BC – 243: Practical Course in Biochemistry – II

1. Recording of blood pressure by sphygmomanometer and its significance.
2. Determination of *in vitro* protein digestibility.
3. Determination of bleeding time and clotting time and its significance.
4. Determination of sodium and potassium content in blood serum samples by flame photometer.
5. Analysis of wastewater for BOD.
6. Analysis of wastewater for COD.
7. Estimation of chlorides in water.
8. Determination of hardness of water.
9. Soil analysis : pH, salt concentration by conductometry.
10. Estimation of phosphate by Fisk-Subbarow method.

Recommended Books:

1. An Introduction to Practical Biochemistry – David T. Plummer - TATA McGRRAW-HILL.
2. Biochemical Methods – 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.
10. Experiments in Microbiology, Plant Pathology and Biotechnology - K.R.Aneja, Vishwa Prakshan