

SYLLABUS

B.Sc. (Honours) - Biochemistry

(5th Semester)

Three/Four Years Undergraduate Degree Course [CBCS Semester Mode]

[As per the "Guidelines for Multiple Entry and Exit in Academic Programmes offered in Higher Education Institutions" issued by UGC New Delhi under NEP 2020]

Session: 2021-25

**SCHOOL OF STUDIES IN BIOCHEMISTRY
JIWAJI UNIVERSITY
GWALIOR - 474 011 (MP)**

Y. Jaiswal

Neelam Bhandari

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Jiwaji University, Gwalior
B.Sc. (Honours) Biochemistry (2021-25)

Course Structure and Scheme of Examination

FIFTH SEMESTER (Examination Dec 2023)

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
BCH CC-IX-T (Major Course)	Plant Biochemistry (Theory)	100	4	60	21	40	14
DSE-I-T (Major Course)	Nutritional Biochemistry (Theory)	100	4	60	21	40	14
BCH CC-IX-P (Major Course)	Plant Biochemistry and Nutritional Biochemistry- Lab	100	2	60	21	40	14
SEC-III-T	Basics of Microbiology (Theory)	100	4	60	21	40	14
FP-I	Field Project/Internship-I	100	6	60	21	40	14
	Grand Total		20				

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B.Sc. [Honors] Biochemistry [CBCS Structure]

Courses

(BCH CC – IX, DSE – I, SEC-III-T & FP-I)

BCH CC – IX – T: Plant Biochemistry (Theory)

DSE – I – T: Nutritional Biochemistry (Theory)

**BCH CC – IX – P: Plant Biochemistry & Nutritional Biochemistry –
Lab (Practical)**

SEC – III – T: Basic Microbiology (Theory)

FP – I: Field Project/Internship – I

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BCH CC – IX – T: PLANT BIOCHEMISTRY (THEORY)

Total Hrs: 60

Credit: 4

UNIT-I Introduction to Plant cell structure and Photosynthesis

1. Plant cell structure; Plasma membrane and Cell wall
2. Vacuole and tonoplast membrane, plastids and peroxisomes
3. Photosynthesis: Structure of PSI and PSII complexes
4. Light reaction, Cyclic and non-cyclic photophosphorylation

UNIT-II Carbon Assimilation and Respiration

1. Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM),
2. Photorespiration
3. Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis
4. Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.

UNIT-III Nitrogen metabolism

1. Biological Nitrogen fixation by free living and in symbiotic association
2. Structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase.
3. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway.
4. Seed storage proteins in legumes and cereals.

UNIT-IV Secondary Metabolites

1. Representatives alkaloid group and their amino acid precursors, function of alkaloids
2. Phenolics: Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin
3. Biological role of plant phenolics
4. Classification of terpenoids and representative examples from each class, biological functions of terpenoids.

UNIT-V Regulation of plant growth and Plant Tissue Culture

1. Introduction to plant hormones and their effect on plant growth and development,
2. Regulation of plant morphogenetic processes by light.
3. Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture.
4. Plant regeneration pathways: organogenesis and somatic embryogenesis; Applications of cell and tissue culture and somoclonal variation.

SUGGESTED READINGS

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science ISBN 978-0-8153-4121-5

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2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749

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Discipline Specific Elective Course I (DSE – I – T)

BCH DSE – I – T: Nutritional Biochemistry (Theory)

Total Hrs: 60

Credit: 4

UNIT-I Introduction to Nutrition and Energy Metabolism, Dietary Carbohydrates

1. Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff, measurement of energy content of food, Physiological energy value of foods, SDA.
2. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance
3. Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.
4. Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose.
5. Dietary requirements and source of carbohydrates, Dietary fibre, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

UNIT-II Dietary lipid and health

1. Review of classification, sources, functions, digestion, absorption, utilization and storage.
2. Essential Fatty Acids; Functions of EFA, RDA
3. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.
4. Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids.
5. Amino Acid Availability Antagonism, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances
6. PEM and Kwashiorkor.

UNIT-III Fat and water soluble Vitamins

1. Vitamin A, C, E, K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion (ADME), Deficiency.
2. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis.
3. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP.
4. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms.
5. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

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UNIT-IV Minerals

1. Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia.
2. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

UNIT-V Assessment of Nutritional status and Food and drug interactions and Nutraceuticals

1. Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios.
2. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis
3. Assessment of Anaemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate
4. Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition.
5. Food as medicine and Nutraceuticals

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for health, fitness and sport (2013); Williams, M.H, Anderson, D.E, Rawson, E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings, S.E, Raymond, J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7. 5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

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BCH CC – IX – P: PLANT BIOCHEMISTRY AND NUTRITIONAL BIOCHEMISTRY - LAB (PRACTICAL)

Total Hrs: 30

Credit: 2

Plant Biochemistry

1. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination 2
2. Extraction and assay of Urease from Jack bean
3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
4. Separation of photosynthetic pigments by TLC
5. Culture of plant plants (explants)
6. Visit to the Botanical Garden and Charak Udyan of the University

Nutritional Biochemistry

1. Determination of lactose in milk by picric acid method
2. Extraction and determination of soluble sugars from food samples
3. Extraction and determination of starch from dried food sample
4. Isolation of casein from milk
5. Determination of isoelectric pH of casein
6. Bioassay for vitamin B₁₂/B₁.
7. Homocystiene estimation.
8. Serum/ urine MMA estimation.
9. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
10. Vitamin A/E estimation in serum.
11. Visit to the Health Centre of the University/ to a nearby clinic

SUGGESTED READINGS

1. Bala, M., Gupta, S., Gupta, N.K., and Sangha, M.K. (2016) Practical in Plant Physiology and Biochemistry, Scientific Publishers, ISBN 9789386102638
2. Dua, A and Davar, V. (2018) Nutritional Biochemistry: A Practical Approach, ISBN 9789390480128

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Skill Enhancement Course III (SEC – III – T)

BCH DSE – II – T: Basic Microbiology (Theory)

Total Hrs: 60

Credit: 4

UNIT-I History of Development of Microbiology

1. Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming.
2. Role of microorganisms in fermentation
3. Germ theory of disease, Development of various microbiological techniques and golden era of microbiology,
4. Establishment of fields of Medical Microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff and Edward Jenner

Exercises

- Microbiology Laboratory Practices and Biosafety
- To acquire the knowledge about the principle, working and applications of various instruments routinely used in a microbiology laboratory (e.g., biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter etc)

UNIT-II Diversity of Microbial world

1. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.
2. Difference between prokaryotic and eukaryotic microorganisms.
3. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Exercises

- Preparation and sterilization of culture media for bacterial cultivation
- Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs

UNIT-III Viruses, viroids and prions

1. An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage
2. Lytic and lysogenic cycles.
3. Viroids: Structure, life cycle, diseases caused by them and significance
4. Prions: Structure, life cycle and diseases caused by them

Exercises

- Study of the structure and lifecycle of viruses, viroids and prions using pictographs

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UNIT-IV Bacteria and Algae

1. An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaeobacteria (extremophiles).
2. Applications of bacteria in industry, environment and food.
3. History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction.
4. Applications of Algae in agriculture, industry, environment and food.

Exercises

- Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs
- Staining of bacteria using Gram stain

UNIT-V Fungi and Protozoa

1. Historical developments in the field of Mycology, significant contributions of eminent mycologists.
2. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, Thallus organization and aggregation, fungal wall structure and synthesis
3. Asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins
4. General characteristics, life cycle and biological significance of Amoeba

Exercises

- Isolation of pure cultures of bacteria by streaking method
- Estimation of CFU count

SUGGESTED READINGS

1. Atlas, RM. (2014) Principles of Microbiology. 2nd edition. WMT Brown Publishers
2. Pelczar, MJ, Chan ECS and Krieg NR. (1993) Microbiology. 5th edition. McGraw Hill Book Company

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