VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM&SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH BIOCHEMISTRY

(MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN LIFE SCIENCES with BIOCHEMISTRY
(*Under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sciences with Biochemistry	2nd	III	**SEMESTER-III**							
			Major-A2	BCMPMJ02	**T: Proteins and Enzymes; P: Practical** ***(To be studied by students taken* Biochemistry *as Discipline- A)***	4	3-0-1	15	60	75
			Major-A3	BCMPMJ03	**T: Intermediary Metabolism; P: Practical** ***(To be studied by students taken* Biochemistry *as Discipline- A)***	4	3-0-1	15	60	75
			SEC	SEC03	**P: Clinical Biochemistry** ***To be taken by the students taken Biochemistry as Discipline C.***	3	0-0-3	10	40	50
			AEC	AEC03	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor-3 (Disc.-C3)	BCMMIN03	**T: Intermediary Metabolism; P: Practical** ***(To be studied by students taken* Biochemistry *as Discipline- C)***	4	3-0-1	15	60	75
			Semester-III Total			20				375
		IV	**SEMESTER-IV**							
			Major-B2		***To be decided*** ***(Same as MajorA2 for Biochemistry taken as Discipline-B)***	4	3-0-1	15	60	75
			Major-B3		***To be decided*** ***(Same as Major–A3 for* Biochemistry *taken as Discipline-B)***	4	3-0-1	15	60	75
			Major (Elective) -1	BCMMJE-01	**T: Plant Biochemistry** ***(To be studied by students taken Biochemistry as Discipline- A)***	4	3-0-1	15	60	75
			AEC	AEC04	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor -4 (Disc.-C4)	BCMMIN04	**T: Plant Biochemistry; P: Practical** ***(To be studied by students taken Biochemistry as Discipline- C)***	4	3-0-1	15	60	75
			Summer Intern.	IA	Internship / Apprenticeship- **activities to be decided by the Colleges following the guidelines to be given later**	4	0-0-4	-	-	50
			Semester-IV Total			22				400
			TOTAL of YEAR-2			42	-	-	-	775

MJP = Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

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MAJOR (MJ)

MJA2/B2: Proteins and Enzymes **Credits 04 Full Marks: 75**

MJA2/B2T: Proteins and Enzymes **Credits 03**

Course contents:

Unit 1: Introduction to proteins
Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function.

Unit 2: Isolation and analysis of proteins
Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, IEF. Protein primary structure - sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifeld method.

Unit 3: Introduction to protein three-dimensional structures
Secondary structure- helices and sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures.

Unit 4: Myoglobin and haemoglobin - structure and function
Oxygen binding curves, cooperativity models for haemoglobin.

Unit 5: Introduction to enzyme catalysis
Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature.

Unit 6: Enzyme kinetics
Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis- Menten equation. Significance of Km and Vmax. Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

Unit 7: Mechanisms of enzyme action and regulation
Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarbamoylase.

Unit 8: Enzymes in medicine and industry
Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.

MJA2/B2P: Proteins and Enzymes **Credits 01**

Practical

1. Protein estimation by UV absorbance and Biuret method.
2. Protein assay by Lowry/Bradford method.
3. Ammonium sulphate fractionation of crude homogenate from germinated mung bean.
4. Setting up assay for acid phosphatase and activity measurements of the ammonium sulphate fractions (progress curve and effect of pH).
5. Determination of Km and Vmax of enzyme enriched fraction.
6. Inhibition of acid phosphatase activity by inorganic phosphate.

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Suggested Readings:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York),
2. Fundamentals of Enzymology (1999) 3rd ed., Price, N.C and Stevens, L., Oxford University Press Inc., (New York),

MJA3/B3: Intermediary Metabolism **Credits 04 Full Marks: 75**

MJA3/B3T: Intermediary Metabolism **Credits 03**

Course Contents:

Unit 1: Basic concepts and design of metabolism
The nature of metabolism. Role of oxidation and reduction and coupling of these. ATP as energy currency.

Unit 2: Glycolysis and Gluconeogenesis
Glycolysis a universal pathway, fructose and galactose oxidation, anaerobic glycolysis, fermentation, gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis.

Unit 3: The citric acid cycle
Pyruvate dehydrogenase complex, oxidation of acetyl CoA, amphibolic role, regulation and glyoxylate pathway.

Unit 4: Oxidative phosphorylation
The respiratory chain in mitochondria, proton gradient powering ATP synthesis, glycerol-3- phosphate and malate-aspartate shuttle, regulation of oxidative phosphorylation.

Unit 5: Photosynthesis, Calvin cycle and pentose phosphate pathway
The light reaction, chlorophyll, accessory pigments, reaction centres, two photo systems, generation of proton gradient and NADPH, Calvin cycle, synthesis of glucose, starch, sucrose, regulation, C4 pathway. Pentose phosphate pathway, importance and regulation.

Unit 6: Glycogen metabolism
Glycogenolysis, phosphorylase regulation, role of epinephrine and glucagon for glycogenolysis, glycogenesis; reciprocal regulation of glycogenesis and glycogenolysis.

Unit 7: Fatty acid synthesis and degradation

TAG as energy source, β oxidation of fatty acids in mitochondria and peroxisomes, ketone bodies. Biosynthesis of fatty acids - elongation and unsaturation of fatty acids. Regulation of fatty acid oxidation and synthesis.

Unit 8: Amino acid catabolism and anabolism
Protein degradation to amino acids, urea cycle, feeder pathways into TCA cycle. Nitrogen fixation, synthesis of non-essential amino acids.

Unit 9: Nucleotide metabolism
Biosynthesis - *de novo* and salvage pathways, regulation of nucleotide synthesis by feedback inhibition, degradation and excretion.

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Unit 10: Integration of metabolism
Brief role of hormones - catecholamines, insulin, glucagon; metabolic shifts to provide fuel to brain during fasting and starvation, role of cortisol in signalling stress - increase in gluconeogenesis and muscle protein breakdown.

MJA3/B3T P: Intermediary Metabolism (Practical) **Credits : 01**

Practical

1. Alcohol fermentation by yeast.
2. H2S production, indole production and ammonia production by bacteria.
3. Urea estimation.
4. Uric acid estimation.
5. Nitrogen fixation by cyanobacteria.

Suggested Readings

1. Biochemistry (2012) 7th ed., Campbell, M.K. and Farrel, S.O. Brooks/Cole, Cengage Learning (Boston)

Major Elective (MJE)-01: Plant Biochemistry **Credits 04 Full Marks: 75**

Major Elective (MJE)-01 T: Plant Biochemistry **Credits 03**

Course Contents:

Unit 1: Introduction to Plant cell structure
Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.

Unit 2: Photosynthesis and Carbon assimilation
Structure of PSI and PSII complexes, Light reaction, Cyclic and non-cyclic photophosphorylation, Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM), Photorespiration.

Unit 3: Respiration
Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.

Unit 4: Nitrogen metabolism
Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase.

Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit 5: Regulation of plant growth
Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.

Unit 6: Secondary metabolites

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

Unit 7: Plant tissue culture

Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

Major Elective (MJE)-01 P: Plant Biochemistry **Credits 03**

Practical

1. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
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).

Suggested Readings:

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press

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MINOR (MI)

MI-3/ C3: Intermediary Metabolism **Credits 04 (Full Marks: 75)**

MI-3/ C3T: Intermediary Metabolism **Credits 03**

Course Contents:

Unit 1: Basic concepts and design of metabolism
The nature of metabolism. Role of oxidation and reduction and coupling of these. ATP as energy currency.

Unit 2: Glycolysis and Gluconeogenesis
Glycolysis a universal pathway, fructose and galactose oxidation, anaerobic glycolysis, fermentation, gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis.

Unit 3: The citric acid cycle
Pyruvate dehydrogenase complex, oxidation of acetyl CoA, amphibolic role, regulation and glyoxylate pathway.

Unit 4: Oxidative phosphorylation
The respiratory chain in mitochondria, proton gradient powering ATP synthesis, glycerol-3- phosphate and malate-aspartate shuttle, regulation of oxidative phosphorylation.

Unit 5: Photosynthesis, Calvin cycle and pentose phosphate pathway
The light reaction, chlorophyll, accessory pigments, reaction centres, two photo systems, generation of proton gradient and NADPH, Calvin cycle, synthesis of glucose, starch, sucrose, regulation, C4 pathway. Pentose phosphate pathway, importance and regulation.

Unit 6: Glycogen metabolism
Glycogenolysis, phosphorylase regulation, role of epinephrine and glucagon for glycogenolysis, glycogenesis; reciprocal regulation of glycogenesis and glycogenolysis.

Unit 7: Fatty acid synthesis and degradation

TAG as energy source, β oxidation of fatty acids in mitochondria and peroxisomes, ketone bodies. Biosynthesis of fatty acids - elongation and unsaturation of fatty acids. Regulation of fatty acid oxidation and synthesis.

Unit 8: Amino acid catabolism and anabolism
Protein degradation to amino acids, urea cycle, feeder pathways into TCA cycle. Nitrogen fixation, synthesis of non-essential amino acids.

Unit 9: Nucleotide metabolism
Biosynthesis - *de novo* and salvage pathways, regulation of nucleotide synthesis by feedback inhibition, degradation and excretion.

Unit 10: Integration of metabolism
Brief role of hormones - catecholamines, insulin, glucagon; metabolic shifts to provide fuel to brain during fasting and starvation, role of cortisol in signalling stress - increase in gluconeogenesis and muscle protein breakdown.

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MI-3/ C3 P: Intermediary Metabolism (Practical) **Credits : 01**

Practical

1. Alcohol fermentation by yeast.
2. H2S production, indole production and ammonia production by bacteria.
3. Urea estimation.
4. Uric acid estimation.
5. Nitrogen fixation by cyanobacteria.

Suggested Readings

1. Biochemistry (2012) 7th ed., Campbell, M.K. and Farrel, S.O. Brooks/Cole, Cengage Learning (Boston)

MI-4/C-4: Plant Biochemistry **Credits 04 (Full Marks: 75)**

MI-4/C-4T: Plant Biochemistry **Credits 03**

Course Contents:

Unit 1: Introduction to Plant cell structure
Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.

Unit 2: Photosynthesis and Carbon assimilation
Structure of PSI and PSII complexes, Light reaction, Cyclic and non-cyclic photophosphorylation, Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM), Photorespiration.

Unit 3: Respiration
Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.

Unit 4: Nitrogen metabolism
Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase.

Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit 5: Regulation of plant growth
Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.

Unit 6: Secondary metabolites
Representatives alkaloid group and their amino acid precursors, function of alkaloids,
Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids.

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Unit 7: Plant tissue culture

Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

MI-4/C-4 P: Plant Biochemistry **Credits 01**

Practical

6. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
7. Extraction and assay of Urease from Jack bean
8. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
9. Separation of photosynthetic pigments by TLC
10. Culture of plant plants (explants).

Suggested Readings:

4. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science
5. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International.
6. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press

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SKILL ENHANCEMENT COURSE (SEC)

SEC 3: Clinical Biochemistry **Credits 03**

SEC3P: Clinical Biochemistry **Full Marks: 50**

Course Outline:

Unit 1: Introduction
Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.

Exercise
- Collection of blood and storage.
- Separation and storage of serum.

Unit 2: Evaluation of biochemical changes in diseases
Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.

Unit 3: Assessment of glucose metabolism in blood
Clinical significance of variations in blood glucose. Diabetes mellitus.

Exercises
- Estimation of blood glucose by glucose oxidase peroxidase method.

Unit 4: Lipid profile
Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

Exercises
- Estimation of triglycerides.

Unit 5: Liver function tests

Exercises
- Estimation of bilirubin (direct and indirect).

Unit 6: Renal function tests and urine analysis
Use of urine strip / dipstick method for urine analysis.

Exercises
- Quantitative determination of serum Creatinine and Urea.

Unit 7: Tests for cardiovascular diseases
Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

Exercises
- Estimation of Creatine kinase MB.

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Suggested Readings:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi).
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests VoI. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi),
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia),
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi),

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