THE MAHATMA GANDHI UNIVERSITY

UNDERGRADUATE PROGRAMMES (HONOURS)

SYLLABUS

MGU-UGP (Honours)

(2024 Admission Onwards)

Faculty: Science

Expert Committee: Clinical Nutrition and Dietetics

Subject: Nutritional Biochemistry

Mahatma Gandhi University
Priyadarshini Hills
Kottayam – 686560, Kerala, India

Syllabus Index

Name of the Minor: **Nutritional Biochemistry**

Semester 1

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG1DSCNBC100	Fundamentals of Nutritional Biochemistry	DSC B	4	5	3	0	2	0

Semester: 2

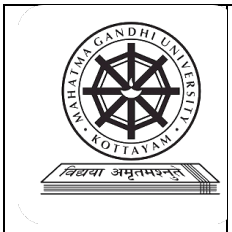
Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCNBC100	Biochemistry of Energy Transformation	DSC B	4	5	3	0	2	0

Semester: 3

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG3DSCNBC200	Nutritional Biochemistry	DSC B	4	5	3	0	2	0

Semester: 4

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG4DSCNBC200	Nutritional Biochemistry	DSC C	4	5	3	0	2	0

	**Mahatma Gandhi University** **Kottayam**

Programme						
Course Name	FUNDAMENTALS OF NUTRITIONAL BIOCHEMISTRY					
Type of Course	DSC B					
Course Code	MG1DSCNBC100					
Course Level	100-199					
Course Summary	This course offers a thorough exploration of bio-molecules and it delves into carbohydrates, proteins, and lipids, providing a well-rounded foundation that includes practical modules emphasizing laboratory awareness, safety practices, and qualitative analysis of carbohydrates through various tests.					
Semester	1	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge in science					

COURSE OUTCOMES (CO)

CO NO.	Expected Course Outcome	Learning Domains *	PO NO
CO1	Articulate essential concepts related to bio-molecules and basics of carbohydrates.	K	1
CO2	Summarize on classification, structure and comprehend the significance of protein and lipid in biological systems.	U	1
CO3	Discuss classification, structures, and properties of vitamins and its derivatives in biological systems.	U	1
CO4	Apply the principles of laboratory safety and implement awareness of good laboratory practices.	A	2, 3
CO5	Analyse the presence and characteristics of various carbohydrates and proteins.	An	2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

DSC B- FUNDAMENTALS OF NUTRITIONAL BIOCHEMISTRY

Module	Unit	Course Description	Hours	CO NO.
1		**Introduction to Bio-molecules and Carbohydrates**	**10**	**CO1**
	1.1	**Chemical composition and elements of life-** atom, molecule, chemical bonds, radioactivity and radioactive isotopes.	4	
	1.2	**Carbohydrates -** definition, classification, structure and properties of monosaccharide, oligosaccharides and polysaccharides.	6	
2		**Proteins and Lipids**	**20**	**CO2**
	2.1	**Protein-**Definition, classification, structure and properties.	5	
	2.2	**Amino acids-**Definition, classification, structure and properties.	5	
	2.3	**Lipids-**Definition, classification structure and properties, Significance of phospholipids, cholesterol and lipoproteins	5	
	2.4	**Fatty acids-**Classification, structure and properties of saturated and unsaturated fatty acids.	5	
3		**Vitamins**	**15**	**CO 3**
	3.1	**Fat soluble vitamins**- Structure, properties and biochemical role of vitamin A, D, E and K.	7	
	3.2	**Water soluble vitamins**- structure, properties and biochemical role of thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, cyanocobalamin and vitamin C.	8	

PRACTICAL

Module	Unit	Course Description	Hours	CO NO.
4		**Qualitative Analysis of Carbohydrates**	**30**	
	4.1	Code of conduct for laboratory personnel - safety measures in the laboratory chemical/reagents, storage and usage.	**2**	
	4.2	Awareness of good laboratory practices, laboratory safety and management of hazards, precautions and first aid in laboratory accidents.	**2**	
	4.3	Qualitative Analysis of monosaccharides- glucose, fructose,	**8**	**CO4**
	4.4	Qualitative Analysis of disaccharides- lactose, sucrose, maltose	**10**	**CO5**
	4.5	Precipitation reactions of protein- by salt, by heavy metals, alkaloidal reagents, strong minerals acids, heat	**8**	
5		**Teachers specific content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Direct Instructions:** ● Lecture ● E-learning **Interactive Instructions:** ● Group Assignment ● Library Work and Group Discussion ● Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory-25 Marks** ● Internal Test ● Assignment/ Oral presentation- ● Quiz ● In- class discussion and involvement **Practical-15 Marks** ● Internal Test ● Record ● Lab involvement
	B. End Semester Examination **Theory -50 Marks** ● Section A - MCQ - 6/6 (6x1=6 marks) ● Section B - Short Answer - 2/4 (2x2=4 marks) ● Section C - Short Essay - 4/6 (4x5=20 marks) ● Section D – Essay – 2/4 (2x10=20 marks) **Practical -35 Marks** ● Lab test - 20 marks ● Record - 5 marks ● Viva - 10 marks

REFERENCES

1. Ambika Shanmugam's Fundamentals of Biochemistry for Medical Students. (2016). India: Repro India Limited.
2. Deb, A. C. (2014). Fundamentals of Biochemistry. India: New Central Book Agency (P) Limited.
3. Fundamentals of Biochemistry. (2022). India: S CHAND & Company Limited.
4. Harvey, R. A., Ferrier, D. R. (2011). Biochemistry. India: Wolters Kluwer Health/Lippincott Williams & Wilkins.
5. Satyanarayana U, &Chakrapani, U. (2020). Biochemistry, (Updated and Revised Edition)-E-Book. Elsevier India.
6. Vasudevan, D. M., S, S., Vaidyanathan, K. (2013). Textbook of Biochemistry for Medical Students. India: Jaypee Brothers Medical Publishers Pvt. Limited.

SUGGESTED READINGS

1. Fundamental of Biochemistry Textbook Student, Edition. (2008). India: International Book Distributing Company.
2. John Baynes, Marek H Dominiczak (2014), "Medical Biochemistry", Elsevier Health Sciences.
3. Voet, D., Voet, J. G., Pratt, C. W. (2018). Voet's Principles of Biochemistry. United States: Wiley.

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Programme						
Course Name	BIOCHEMISTRY OF ENERGY TRANSFORMATION					
Type of Course	DSC B					
Course Code	MG2DSCNBC100					
Course Level	100-199					
Course Summary	This course offers a detailed exploration of essential biological processes related to nutrient transport, biological oxidation, and enzymes. Students will acquire a foundational understanding of how organisms acquire, utilize, and regulate nutrients, as well as the crucial role of enzymes in catalyzing biochemical reactions.					
Semester	2	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basics knowledge in science					

COURSE OUTCOMES (CO)

CO NO.	Expected Course Outcome	Learning Domains *	PO NO.
CO1	Differentiate between various transporting systems of nutrients	U	1
CO2	Discuss the concepts in biological oxidation and integrate this understanding to evaluate the electron transport chain.	U	3
CO3	Describe enzymes and nucleic acids, encompassing the basics, classification and comprehend the significance of enzyme reactions.	U	3
CO4	Apply qualitative analysis techniques for identifying different amino acids and non-protein nitrogenous substance	A	2, 3
CO5	Estimate various nutrients in body fluids through colorimetric methods and verify Beer's law.	An	2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

DSC B- BIOCHEMISTRY OF ENERGY TRANSFORMATION

Module	Unit	Course Description	Hours	CO NO.
1		**Pathways of Nutrient Transport**	**15**	**CO1**
	1.1	Passive diffusion- Simple diffusion- Definition, factors affecting diffusion, Facilitated diffusion- channel proteins and carrier proteins. Osmosis	5	
	1.2	Active transport- Pump transport- Primary active transport and secondary active transport	5	
	1.3	Vesicle transport- Exocytosis and Endocytosis- Pinocytosis and Phagocytosis, and Transcytosis	5	
2		**Biological Oxidation**	**15**	**CO2**
	2.1	Stages of oxidation in food	2	
	2.2	Oxidation, reduction, redox potential, High energy compounds- classification and functions	5	
	2.3	Electron transport chain- Enzymes involved, Components of respiratory chain, its organization and function. Sites of ATP formation, inhibitors and uncouples.	5	
	2.4	Oxidative and substrate level phosphorylation, ATP/ADP cycle	3	
3		**Enzymes and Nucleic Acids**	**15**	**CO3**
	3.1	**Enzymes** – Definition, Classification. - Apoenzymes, Coenzymes, Holoenzymes, Isoenzymes.	3	
	3.2	**Mechanism of action**- Enzyme substrate complex formation, lock and key mechanism, induced fit mechanism and ping-pong mechanism, factors affecting enzyme action. Enzyme kinetics, Enzyme inhibition and Enzyme specificity.	5	
	3.3	**Nucleic acids**- composition, functions, classification and structure of DNA and RNA, nucleotide synthesis, DNA replication, enzymes involved in DNA replication, DNA repair, recombinant DNA technology, protein synthesis, genetic code, gene mapping, gene expression, operon concept, Lac, genotype and phenotype, epigenetics, alleles and epistasis.	7	

PRACTICAL

Module	Unit	Course Description	Hours	CO NO.
4		**Qualitative and Quantitative analysis**	**30**	**CO4** **CO5**
	4.1	Tyrosine – Biuret test, Ninhydrin test, Million's test	4	
	4.2	Tryptophan- Biuret test, Ninhydrin test, Aldehyde test (Hopkins-Cole reaction)	4	
	4.3	Cysteine, Cystine- Biuret test, Ninhydrin test, Sulfur test (Lead acetate test)	4	
	4.4	Arginine- Biuret test, Ninhydrin test, Sakaguchi's test	4	
	4.5	Reaction of Non-protein Nitogenous substance- reactions of urea,reactions of uric acid, reactions of creatinine	6	
	4.6	Components and principles of colorimetry and verification of Beer's Law	2	
	4.7	Estimation of blood glucose, serum total protein	6	
5		**Teacher specific content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Direct Instructions:** ● Lecture ● E-learning **Interactive Instructions:** ● Group Assignment ● Library Work and Group Discussion ● Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory-25 Marks** ● Internal Test- ● Assignment/ Oral presentation ● Quiz ● In- class discussion and involvement **Practical - 15 Marks** ● Internal Test ● Record ● Lab involvement
	B. End Semester Examination **Theory -50 Marks** ● Section A - MCQ - 6/6 (6x1=6 marks) ● Section B - Short Answer - 2/4 (2x2=4 marks) ● Section C - Short Essay - 4/6 (4x5=20 marks) ● Section D – Essay – 2/4 (2x10=20 marks) **Practical -35 Marks** ● Lab test - 20 marks ● Record – 5 marks ● Viva – 10 marks

REFERENCES

1. B, ShivanandaNayak (2021). Essentials of Biochemistry: (for Medical Students)., Jaypee Brothers Medical Publishers, India
2. Baynes, J. W., Dominiczak, M. H. (2018). Medical Biochemistry: Medical Biochemistry E-Book. Netherlands: Elsevier Health Sciences.

3. Khurana, I., Khurana, A. (2015). Textbook of Medical Physiology - E-book. India: Elsevier Health Sciences.
4. Lodish, H. F. (2007). Molecular Cell Biology. India: W. H. Freeman.
5. Nayak B, S. (2013). Manipal Manual of Clinical Biochemistry. India: Jaypee Brothers Medical Publishers Pvt. Limited.
6. Satyanarayana, U., &Chakrapani, U. (2020). Biochemistry, (Updated and Revised Edition)-E-Book. Elsevier India.

SUGGESTED READINGS

1. Fundamentals of Biochemistry Textbook Student Edition. (2008). India: International Book Distributing Company.
2. Oppenheimer, C. H., Stern, K. G. (2014). BiologicalOxidation. Netherlands: Springer Netherlands.
3. Satyanarayana, U. (2017). Biochemistry - E-book. India: Elsevier Health Sciences.

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Programme						
Course Name	NUTRITIONAL BIOCHEMISTRY					
Type of Course	DSC B					
Course Code	MG3DSCNBC200					
Course Level	200-299					
Course Summary	This course provides a thorough exploration of macro and micro nutrients detailing the pathways, significance, and energetics involved. Students will also gain practical skills in biochemical estimations, such as total cholesterol, lipid profile, ketone bodies, urea, and creatinine.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge in science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO NO
CO1	Explain the pathways, significance, and energetics of various carbohydrate metabolic reactions.	U	1
CO2	Determine the general pathways of amino acid metabolism and ammonia detoxification.	U	1
CO3	Differentiate between synthesis and degradation of fatty acids and other fat derivatives.	U	1
CO4	Explain the metabolism and storage of vitamins.	U	1
CO5	Evaluate biochemical estimations of various body fluid constituents.	An	2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

DSC B- NUTRITIONAL BIOCHEMISTRY

Module	Unit	Course Description	Hours	CO NO.
1		**Metabolism of Carbohydrate**	**15**	**CO1**
	1.1	Glycolysis, oxidative decarboxylation of pyruvate, TCA cycle- Pathways, significance and energetics	4	
	1.2	Gluconeogenesis - Pathways, significance and energetics	3	
	1.3	HMP Shunt - Pathways, significance and energetics	3	
	1.4	Metabolism of Glycogen- Glycogenesis and Glycogenolysis	3	
	1.5	Metabolism of fructose and galactose	2	
2		**Metabolism of Protein**	**10**	**CO2**
	2.1	General pathways of aminoacid metabolism -Deamination, transamination, decarboxylation and transmethylation	7	
	2.2	Ammonia detoxification and urea cycle	3	
3		**Metabolism of Lipid**	**20**	**CO3**
	3.1	Metabolism of fatty acid- Beta-oxidation of fatty acid- saturated and unsaturated fatty acids	4	
	3.2	Metabolism of adipose tissue	3	
	3.3	Metabolism of Triacylglycerol	3	
	3.4	Metabolism of Cholesterol- Biosynthesis and catabolism	4	
	3.5	Metabolism of Ketone bodies	4	
	3.6	Synthesis of eicosanoids	2	

PRACTICAL

Module	Unit	Course Description	Hours	CO NO.
4		**Qualitative and Quantitative Estimation of Body fluid constituents**	**30**	**CO4**
	4.1	Estimation of haemoglobin in blood	6	
	4.2	Estimation of iron in blood	4	
	4.3	Estimation of urinary urea	4	
	4.4	Estimation of urinary creatinine	4	
	4.5	Qualitative analysis of urine- a. Physical characteristics- appearance, colour, odour, pH of normal urine. b. Chemical characteristics- organic and inorganic constituents. Test for inorganic constituents- chloride, phosphate, calcium, sulphate, ammonia. Test for organic constituents- urea, uric acid, and creatinine.	12	
5		**Teacher specific content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Direct Instructions:** ● Lecture ● E-learning **Interactive Instructions:** ● Group Assignment ● Library Work and Group Discussion ● Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory-25 Marks** ● Internal Test ● Assignment/ Oral presentation ● Quiz ● In- class discussion and involvement **Practical-15 Marks** ● Internal Test ● Record ● Lab involvement
	B. End Semester Examination **Theory -50 Marks** ● Section A - MCQ - 6/6 (6x1=6 marks) ● Section B - Short Answer - 2/4 (2x2=4 marks) ● Section C - Short Essay - 4/6 (4x5=20 marks) ● Section D – Essay – 2/4 (2x10=20 marks) **Practical -35 Marks** ● Lab test - 20 marks ● Record – 5 marks ● Viva – 10 marks

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Programme						
Course Name	NUTRITIONAL BIOCHEMISTRY					
Type of Course	DSC C					
Course Code	MG4DSCNBC200					
Course Level	200-299					
Course Summary	This course provides a thorough exploration of macro and micro nutrients detailing the pathways, significance, and energetics involved. Students will also gain practical skills in biochemical estimations, such as total cholesterol, lipid profile, ketone bodies, urea, and creatinine.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge in science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO NO
CO1	Explain the pathways, significance, and energetics of various carbohydrate metabolic reactions.	U	1
CO2	Determine the general pathways of amino acid metabolism and ammonia detoxification.	U	1
CO3	Differentiate between synthesis and degradation of fatty acids and other fat derivatives.	U	1
CO4	Explain the metabolism and storage of vitamins.	U	1
CO5	Evaluate biochemical estimations of various body fluid constituents.	An	2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

DSC B- NUTRITIONAL BIOCHEMISTRY

Module	Unit	Course Description	Hours	CO NO.
1		**Metabolism of Carbohydrate**	**15**	**CO1**
	1.1	Glycolysis, oxidative decarboxylation of pyruvate, TCA cycle- Pathways, significance and energetics	4	
	1.2	Gluconeogenesis - Pathways, significance and energetics	3	
	1.3	HMP Shunt - Pathways, significance and energetics	3	
	1.4	Metabolism of Glycogen- Glycogenesis and Glycogenolysis	3	
	1.5	Metabolism of fructose and galactose	2	
2		**Metabolism of Protein**	**10**	**CO2**
	2.1	General pathways of aminoacid metabolism -Deamination, transamination, decarboxylation and transmethylation	7	
	2.2	Ammonia detoxification and urea cycle	3	
3		**Metabolism of Lipid**	**20**	**CO3**
	3.1	Metabolism of fatty acid- Beta-oxidation of fatty acid- saturated and unsaturated fatty acids	4	
	3.2	Metabolism of adipose tissue	3	
	3.3	Metabolism of Triacylglycerol	3	
	3.4	Metabolism of Cholesterol- Biosynthesis and catabolism	4	
	3.5	Metabolism of Ketone bodies	4	
	3.6	Synthesis of eicosanoids	2	

PRACTICAL

Module	Unit	Course Description	Hours	CO NO.
4		**Qualitative and Quantitative Estimation of Body fluid constituents**	**30**	**CO4**
	4.1	Estimation of haemoglobin in blood	6	
	4.2	Estimation of iron in blood	4	
	4.3	Estimation of urinary urea	4	
	4.4	Estimation of urinary creatinine	4	
	4.5	Qualitative analysis of urine- a. Physical characteristics- appearance, colour, odour,pH of normal urine. b. Chemical characteristics- organic and inorganic constituents. Test for inorganic constituents- chloride, phosphate, calcium, sulphate, ammonia. Test for organic constituents- urea, uric acid, and creatinine.	12	
5		**Teacher specific content**		

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