

R4547

Sub. Code

25MBC2C1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biochemistry

INTERMEDIARY METABOLISM AND REGULATION

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. In which part of the mitochondrion does oxidative phosphorylation occur? (CO1, K1)
 - (a) Matrix
 - (b) Outer membrane
 - (c) Inner mitochondrial membrane (Cristae)
 - (d) Intermembrane space
2. Which organ is the primary site for the metabolism (detoxification) of xenobiotics in the human body? (CO1, K2)
 - (a) Kidney
 - (b) Liver
 - (c) Pancreas
 - (d) Small Intestine

3. A 6-month-old infant presents with a “doll-like” face, hepatomegaly, and severe hypoglycemia between feedings. Laboratory tests reveal hyperlactatemia and hyperuricemia. Which enzyme is most likely deficient?
(CO2, K2)
- (a) α -1,4-glucosidase
 - (b) Glucose-6-phosphatase
 - (c) Debranching enzyme
 - (d) Glycogen phosphorylase
4. The Citric Acid Cycle begins with the condensation of an acetyl group with oxaloacetic acid (OAA) and water to form
(CO2, K1)
- (a) Succinate
 - (b) Citrate
 - (c) α -ketoglutarate
 - (d) Malate
5. Which molecule is essential for the transport of long-chain fatty acids across the inner mitochondrial membrane?
(CO3, K2)
- (a) Creatine
 - (b) Carnitine
 - (c) Coenzyme A
 - (d) Albumin
6. Fatty acid synthesis is a reductive process that occurs in the cytosol. Which molecule serves as the essential electron donor (reducing agent) for this pathway?
(CO3, K2)
- (a) NADH
 - (b) FADH₂
 - (c) NADPH
 - (d) FMN

7. Dipalmitoylphosphatidylcholine (DPPC), also known as Lecithin, is a major component of lung surfactant. A deficiency in its synthesis in premature infants leads to Respiratory Distress Syndrome (RDS). This molecule belongs to which class of phospholipids? (CO4, K1)
- (a) Phosphatidylinositol
 - (b) Phosphatidylserine
 - (c) Phosphatidylcholine
 - (d) Cephalin
8. Classical Phenylketonuria is caused by a genetic deficiency of which enzyme required to convert phenylalanine to tyrosine? (CO4, K1)
- (a) Tyrosinase
 - (b) Phenylalanine hydroxylase
 - (c) Homogentisate oxidase
 - (d) Branched-chain alpha-keto acid dehydrogenase
9. A significant elevation of Serum Glutamic Oxaloacetic Transaminase (SGOT), also known as Aspartate Aminotransferase (AST), is a classic clinical indicator of damage to which organ? (CO5, K2)
- (a) Pancreas
 - (b) Heart (Myocardium) or Liver
 - (c) Kidney
 - (d) Lung

10. Methionine must be converted into which “activated” form to serve as a universal methyl group donor for the synthesis of creatine, epinephrine, and melatonin?

(CO5, K1)

- (a) Homocysteine
- (b) S-adenosylmethionine (SAM)
- (c) S-adenosylhomocysteine (SAH)
- (d) Methyl-tetrahydrofolate

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the stabilizing forces in biomolecules.

(CO1, K4)

Or

(b) Comment on enzymes involved in oxidation and reduction.

(CO1, K2)

12. (a) Explain the major steps of glycolysis.

(CO2, K4)

Or

(b) Write a note on glycogen metabolism and its importance.

(CO2, K3)

13. (a) Explain the biosynthesis of cholesterol.

(CO3, K2)

Or

(b) Brief note on disorders of fatty liver.

(CO3, K3)

14. (a) Write about the biosynthesis of amino acids.

(CO4, K3)

Or

(b) Write a note on metabolic disorders of phenylketonuria and maple syrup Urine disease.

(CO4, K3)

15. (a) Explain Lesch-Nyhan syndrome, enzyme defect, clinical features and treatment. (CO5, K5)

Or

- (b) Write a note on degradation of Pyrimidine nucleotide. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain exergonic and endergonic reactions. (CO1, K4)

Or

- (b) Brief note on biological oxidation and redox potential. (CO1, K2)

17. (a) Describe the electron transport chain (ETC). (CO2, K2)

Or

- (b) Give a brief note on Glycogen storage diseases (GSD). (CO2, K1)

18. (a) Classify the lipids and list the name the dietary lipids. Explain digestion and absorption of fats. (CO3, K4)

Or

- (b) Explain the metabolic consequences of ketone bodies. (CO3, K4)

19. (a) Explain the biosynthesis of phospholipids. (CO3, K1)

Or

- (b) Describe the β – Oxidation of fatty acids. (CO3, K1)

20. (a) Discuss the biosynthesis of purines and their regulation. (CO5, K5)

Or

- (b) Explain the biosynthesis of Porphyrins and its clinical significances. (CO5, K5)
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R4548

Sub. Code

25MBC2C2

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biochemistry

MOLECULAR BASIS OF DEVELOPMENT

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

- Gametogenesis is the process of formation of: (CO1, K2)
(a) Zygotes (b) Gametes
(c) Embryos (d) Spores
- Primary oocytes are arrested in: (CO1, K1)
(a) Metaphase I (b) Prophase I
(c) Metaphase II (d) Telophase I
- Which structure gives rise to the Spemann organizer? (CO2, K2)
(a) Vegetal pole
(b) Animal pole
(c) Grey crescent region
(d) Blastocoel
- Which of the following is a BMP antagonist involved in dorsalization? (CO2, K2)
(a) BMP4 (b) Wnt
(c) Noggin (d) FGF

5. Both miRNA and siRNA regulate gene expression by:
(CO2, K1)
- (a) Enhancing transcription
 - (b) Modifying DNA
 - (c) RNA interference (RNAi)
 - (d) Protein degradation
6. A major biological role of miRNA is regulation of:
(CO3, K1)
- (a) DNA repair
 - (b) Cell differentiation and development
 - (c) Cell wall synthesis
 - (d) Respiration
7. Which molecules are primarily responsible for cell—cell adhesion?
(CO4, K2)
- (a) Enzymes
 - (b) Hormones
 - (c) Cell adhesion molecules (CAMs)
 - (d) Ribosomes
8. Which adhesion molecule plays a key role in tissue morphogenesis?
(CO4, K2)
- (a) Actin
 - (b) Cadherin
 - (c) Myosin
 - (d) Tubulin
9. Which of the following is a biological mutagen? (CO5, K2)
- (a) Tobacco smoke
 - (b) Retrovirus
 - (c) X-rays
 - (d) Pesticides
10. CRISPR—Cas9 system was originally discovered in:
(CO5, K1)
- (a) Viruses
 - (b) Plants
 - (c) Bacteria
 - (d) Animals

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the significance of modern biology (CO1, K2)

Or

- (b) Illustrate how disruption of sperm—egg molecular interactions can affect fertilization. (CO1, K3)

12. (a) Outline the structure and arrangement of Hox clusters in vertebrates and invertebrates. (CO2, K2)

Or

- (b) Explain the mechanism of action of Sonic Hedgehog and Wnt pathways with examples. (CO2, K4)

13. (a) Describe the process of DNA methylation. (CO3, K2)

Or

- (b) Analyze the role of stem cells in tissue regeneration and disease treatment. (CO3, K4)

14. (a) State the functions of extracellular matrix remodelling. (CO4, K2)

Or

- (b) Describe the intrinsic and extrinsic pathways of apoptosis with examples. (CO4, K2)

15. (a) Explain mutagens and their types. (CO5, K4)

Or

- (b) Write an account of organoid technology in modern biology. (CO5, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Write an account of cleavage and blastula formation in vertebrates, highlighting differences between different types of eggs. (CO1, K2)
- Or
- (b) Explain the importance and applications of model organisms in biological research. (CO1, K2)
17. (a) Write an account of gap, pair-rule, and segment polarity genes with their roles in segment formation. (CO2, K4)
- Or
- (b) Explain the BMP signaling pathway and its role in vertebrate development. (CO2, K4)
18. (a) Write an account of transcription factors involved in lineage specification and their epigenetic roles. (CO3, K1)
- Or
- (b) Compare and analyze the roles of embryonic and adult stem cells in development and tissue repair. (CO4, K4)
19. (a) Describe the factors and significance of cell migration in biological processes. (CO4, K2).
- Or
- (b) Describe the types and pathways of programmed cell death with examples. (CO4, K2)
20. (a) Describe the mechanisms and applications of CRISPR-Cas9 and other gene editing tools. (CO5, K4)
- Or
- (b) Write an account of organoid technology with examples of its use. (CO5, K4)

R4549

Sub. Code

25MBC2C3

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biochemistry

IMMUNOLOGY AND IMMUNOTECHNOLOGY

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Which of the following is NOT a major feature of the adaptive immune system? (CO1, K2)
 - (a) Specificity for distinct antigens
 - (b) Memory of previous exposures
 - (c) Immediate response within minutes of first exposure
 - (d) Ability to distinguish self from non-self
2. Monocytes move from the systemic circulatory system into general connective tissues, where they differentiate and convert to which phagocytic cell type? (CO1, K2)
 - (a) Neutrophils
 - (b) B cells
 - (c) Macrophages
 - (d) T cells

3. Which of the following is commonly used as a “solid support” to precipitate the antibody-antigen complex?
(CO2, K2)
- (a) Nitrocellulose membrane.
 - (b) Ethidium bromide.
 - (c) Protein A or Protein G coupled to beads.
 - (d) Polyacrylamide gel
4. In flow cytometry, Forward Scatter (FSC) is primarily used to measure which Characteristic?
(CO2, K1)
- (a) Internal complexity/Granularity.
 - (b) Relative cell size.
 - (c) DNA content.
 - (d) Surface marker density
5. Which property of cytokines allows a single cytokine to have multiple different effects on various cell types?
(CO3, K2)
- (a) Redundancy
 - (b) Pleiotropy
 - (c) Synergy
 - (d) Antagon
6. A “Wheal and Flare” reaction observed during a skin prick test is a classic example of which hypersensitivity?
(CO3, K1)
- (a) Type I
 - (b) Type II
 - (c) Type III
 - (d) Type IV

7. Which enzyme must the myeloma cells lack to ensure that only hybridoma cells survive in HAT selection medium? (CO4, K2)
- (a) HGPRT (Hypoxanthine-guanine phosphoribosyl-transferase)
 - (b) Alkaline Phosphatase
 - (c) Reverse Transcriptase
 - (d) DNA Polymerase
8. mRNA vaccines, such as those developed for COVID-19, work by: (CO4, K1)
- (a) Delivering pre-formed antibodies directly into the bloodstream
 - (b) Integrating viral DNA into the host cell's nucleus
 - (c) Providing instructions to cells to make a harmless piece of the 'spike protein'
 - (d) Injecting a weakened version of the SARS-CoV-2 virus
9. The process of "Cancer Immunoediting" consists of which three phases? (CO5, K2)
- (a) Induction, Proliferation, Senescence
 - (b) Elimination, Equilibrium, Escape
 - (c) Recognition, Attack, Memory
 - (d) Mutation, Hyperplasia, Metastasis

10. What is the primary target of the autoimmune attack in the central nervous system during the progression of Multiple Sclerosis? (CO5, K1)
- (a) Microglia
 - (b) Axonal transport proteins
 - (c) Acetylcholine receptors
 - (d) Oligodendrocytes

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the immunity and its types. (CO1, K2)

Or

- (b) Write a short note on Haptens, epitope and antigens. (CO1, K3)

12. (a) Describe the roles of antigen and antibody interactions. (CO2, K3)

Or

- (b) Explain the functions of Immunoprecipitation. (CO2, K4)

13. (a) Brief note on cell mediated immunity (CO3, K3)

Or

- (b) Write a short note on Hypersensitivity and its types. (CO3, K4)

14. (a) Brief note on recombinant DNA vaccines (CO4, K3)

Or

- (b) Elucidate the therapeutic applications of hybridoma technology. (CO4, K4)

15. (a) Discuss about the mechanism of multiple sclerosis. (CO5, K5)

Or

(b) Write short note on Rheumatoid arthritis. (CO5, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss the findings and contribution of Edward Jenner and Louis Pasteur in the field of Immunology. (CO1, K2)

Or

(b) Brief overview of immune system and its applications. (CO1, K2)

17. (a) Elaborate the mechanism of generation of antibody diversity. (CO2, K3)

Or

(b) Explain the principle, procedure and applications of FACS. (CO2, K2)

18. (a) Explain MHC complex pathway and the immune response. (CO3, K3)

Or

(b) Give a detailed account on immune response to bacterial and viral diseases. (CO3, K4)

19. (a) Explain the methods of immunodiagnostic techniques and its importance. (CO4, K4)

Or

(b) Write a detailed essay on monoclonal antibody production and its applications. (CO4, K5)

20. (a) Describe computational approaches and immunotherapy strategies in immunology. (CO5, K4)

Or

- (b) Brief note on Autoimmunity and its disorder. (CO5, K5)
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R4550

Sub. Code

25MBC2C4

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biochemistry

CLINICAL AND MEDICAL BIOCHEMISTRY

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Which hemoglobin variant has the highest affinity for oxygen? (CO1, K1)
 - (a) HbA
 - (b) HbF
 - (c) HbS
 - (d) HbA2
2. The primary function of 2,3-bisphosphoglycerate (2,3-BPG) in red blood cells is to: (CO1, K2)
 - (a) Increase hemoglobin synthesis
 - (b) Increase oxygen affinity of hemoglobin
 - (c) Decrease oxygen affinity of hemoglobin
 - (d) Stabilize hemoglobin structure

3. Accumulation of phenylalanine in PKU leads to increased formation of all EXCEPT: (CO2, K2)
- (a) Phenylpyruvate
 - (b) Phenyllactate
 - (c) Phenylacetate
 - (d) Homogentisate
4. The most common biochemical defect in classical homocystinuria is due to deficiency of: (CO2, K2)
- (a) Methionine synthase
 - (b) Cystathionine β -synthase
 - (c) Methylmalonyl-CoA mutase
 - (d) Serine hydroxymethyltransferase
5. AST:ALT ratio >2 is classically seen in: (CO1, K3)
- (a) Viral hepatitis
 - (b) Non-alcoholic fatty liver disease
 - (c) Alcoholic liver disease
 - (d) Acute liver failure
6. Which of the following substances is freely filtered, not reabsorbed, and not secreted by renal tubules under normal conditions? (CO3, K1)
- (a) Urea
 - (b) Inulin
 - (c) Creatinine
 - (d) Glucose

7. All of the following hormones are derived from cholesterol, EXCEPT: (CO4, K1)
- (a) Cortisol
 - (b) Aldosterone
 - (c) Testosterone
 - (d) Thyroxine
8. Hormones that act on distant target organs are classified as: (CO4, K2)
- (a) Autocrine
 - (b) Paracrine
 - (c) Endocrine
 - (d) Juxtacrine
9. Which of the following is NOT a component of GLP? (CO5, K2)
- (a) Proper documentation
 - (b) Instrument calibration
 - (c) Personal bias in reporting
 - (d) Quality assurance
10. Which of the following best defines *traceability* in calibration? (CO5, K1)
- (a) Ability to repeat measurements under identical conditions
 - (b) Comparison of instrument readings with patient data
 - (c) Unbroken chain of comparisons to a recognized standard
 - (d) Adjustment of instrument zero error

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the composition of blood and discuss the functional significance of plasma proteins. (CO1, K5)

Or

- (b) Discuss the fibrinolytic system, including plasminogen activation and its clinical significance. (CO1, K3)

12. (a) Enumerate the laboratory findings in alkaptonuria. (CO2, K4)

Or

- (b) Classify Maple Syrup Urine Disease and briefly describe each type. (CO2, K4)

13. (a) Enumerate the markers used to assess hepatocellular injury and cholestasis in LFT. (CO3, K6)

Or

- (b) Explain the significance of urinary albumin and microalbuminuria in the early detection of renal disease. (CO3, K4)

14. (a) Classify pituitary hormones and mention their major functions. (CO4, K4)

Or

- (b) Briefly discuss about somatostatin source, regulation, and functions. (CO4, K5)

15. (a) List the essential components of GLP in a diagnostic laboratory. (CO5, K5)

Or

- (b) What are the advantages of using AI-based diagnostic tools over traditional methods? (CO5, K6)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss the genetic disorders affecting blood coagulation, with examples such as hemophilia A and B. (CO1, K4)

Or

- (b) Discuss in detail about the types of white blood cells and its functions. (CO1, K5)

17. (a) Compare hepatic and muscle glycogen storage disorders with suitable examples. (CO2, K4)

Or

- (b) Diabetes mellitus is characterized by impaired carbohydrate metabolism. Explain how this affects the energy balance in the body. (CO2, K6)

18. (a) Discuss glomerular filtration rate (GFR) as a diagnostic marker of renal function. Mention methods of estimation. (CO3, K4)

Or

- (b) Discuss the sensitivity and specificity of tumor markers. Why are most tumor markers not suitable for population screening? (CO3, K5)

19. (a) Discuss in detail on pituitary hormone disorders. (CO4, K6)

Or

- (b) Explain the intra-islet hormonal regulation of pancreatic hormones. (CO4, K4)
20. (a) How does GLP contribute to quality assurance and regulatory compliance in diagnostic labs? (CO5, K6)

Or

- (b) What are the challenges in implementing AI in the diagnostic industry? (CO5, K4)
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R4551

Sub. Code

25MBC2S1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biochemistry

MOLECULAR MODELING AND DRUG DESIGN

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Which of the following is a classical force field used in molecular mechanics simulations? (CO1, K1)
 - (a) AMBER
 - (b) B3LYP
 - (c) HF
 - (d) MP2
2. In ligand-based drug design, which technique is most commonly used? (CO1, K2)
 - (a) X-ray crystallography
 - (b) QSAR
 - (c) NMR spectroscopy
 - (d) Mass spectrometry

3. Which type of molecular representation is most useful for identifying hydrogen bonding interactions in ligand—receptor complexes? (CO2, K2)
- (a) Space-filling model
 - (b) Ball-and-stick model
 - (c) Ribbon model
 - (d) Wireframe model
4. Which quantum mechanical method is most commonly used to calculate the electronic structure of small drug-like molecules? (CO2, K1)
- (a) Molecular dynamics
 - (b) Density Functional Theory (DFT)
 - (c) Monte Carlo simulation
 - (d) Finite element analysis
5. Homology modeling in protein structure prediction is based on (CO3, K1)
- (a) The similarity of protein sequences to known structures
 - (b) Predicting folding from scratch
 - (c) Electron density maps
 - (d) Mass spectrometry data
6. AlphaFold is a computational tool designed for (CO3, K1)
- (a) Predicting protein-protein interactions
 - (b) Predicting protein tertiary structures
 - (c) Visualizing protein-ligand complexes
 - (d) Sequencing proteins

7. The main purpose of QSAR modeling in drug discovery is (CO4, K1)
- (a) To predict the 3D structure of a protein
 - (b) To evaluate the pharmacokinetics of a compound
 - (c) To relate chemical structure to biological activity
 - (d) To simulate protein folding
8. Which of the following is an example of ligand-based drug design? (CO4, K2)
- (a) Homology modeling
 - (b) Molecular dynamics simulation
 - (c) Pharmacophore modeling
 - (d) X-ray crystallography
9. The induced fit model differs from the lock-and-key model because it emphasizes (CO5, K2)
- (a) Pre-formed active sites
 - (b) Ligand-induced conformational changes in the receptor
 - (c) Covalent receptor—ligand binding
 - (d) Irreversible inhibition
10. Which computational parameter is most useful for distinguishing an agonist from an antagonist during molecular docking studies? (CO5, K1)
- (a) Molecular weight
 - (b) Docking score alone
 - (c) Predicted receptor conformational changes
 - (d) Ligand solubility

Part B

(5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) What is virtual screening, and how does AI can improve it? (CO1, K5)

Or

- (b) Explain the role of molecular dynamics (MD) simulations in CADD. (CO1, K3)

12. (a) Compare classical force fields and AI-based force fields used in drug design. (CO2, K4)

Or

- (b) Write short notes on the limitations of energy optimization in drug design. (CO2, K4)

13. (a) What are the major approaches used in protein structure prediction? Briefly explain. (CO3, K6)

Or

- (b) Name and briefly describe any two threading servers or tools. (CO3, K4)

14. (a) Describe the general workflow of an HTVS campaign. (CO4, K4)

Or

- (b) Explain the role of fragment-based approaches in de novo ligand design. (CO4, K5)

15. (a) What is binding affinity? How is it predicted computationally? (CO5, K5)

Or

- (b) Describe the theoretical basis of irreversible enzyme inhibition and its computational modeling. (CO5, K6)

Part C

(5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Discuss about the challenges in applying AI for drug design. (CO1, K4)

Or

- (b) Explain the use of machine learning in computer-aided drug target identification. (CO1, K5)

17. (a) Describe the different types of energies considered during energy optimization of a drug—target complex. (CO2, K4)

Or

- (b) Describe the use of deep learning in developing next-generation force fields for drug design. (CO2, K6)

18. (a) Describe the principle of homology (comparative) modeling in protein structure prediction. (CO3, K4)

Or

- (b) Compare threading with homology modeling and ab initio protein structure prediction. (CO3, K5)

19. (a) Define High Throughput Virtual Screening (HTVS) and explain its significance in drug discovery. (CO4, K6)

Or

- (b) Explain the concept of binding energy in docking and its role in predicting ligand efficacy. (CO4, K4)

20. (a) Explain the concept of drug—receptor interaction and its importance in computational biology. (CO5, K6)

Or

- (b) Explain the different types of enzyme inhibition and how they are distinguished using kinetic parameters. (CO5, K4)
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