M.Sc. Examination, 2019
Semester-I
Biotechnology
Course : I
(Cell Biology)

3/0

Time : 3 Hours **Full Marks : 40**

Questions are of value as indicated in the margin

Answer Question No. **1** and **any four** from the rest

1. Answer **any eight** of the followings. 1×8=8

3. a) What is the difference between micelle and liposome?
   b) What is Sphingomyelin?
   c) Why are biological membranes known as 'Selectively permeable'?
   d) What is meant by 'Secretory pathway?
   e) Why is 'Cytoskeleton' named so ?
   f) Why is 'Second messenger' named so?
   g) What is 'General import pore'
   h) Is it possible to have cancer in terminally differentiated cells?
   i) Who is more prone to cancer-human or elephant? State the reason.
   j) Give two examples of IAP.

2. a) Explain with example why co-transport is considered as the secondary active transport?
   b) Illustrate how low pH is maintained in gastric lumen. 4+4=8

3. Mention the topological classes of membrane proteins. Describe how their anchorage to the ER membrane is related to their translation. What is the role of TGN?2+5+1=8

4. a) Explain the function of Rhodopsin as GPCR.
   b) Elucidate the importance of Ran protein in nuclear protein import. 4+4=8

5. a) A cell line is treated with nocodazole (spindle inhibition agent). This leads to a change in the cellular homeostasis. Explain the changes.
   b) Explain why Autophagy is considered a cell survival mechanism and not only a death mechanism.
   c) Explain Programmed necrosis with examples. 3+3+2=8

6. What is the relation between cancer and ageing? Give a schematic diagram to show their interrelation. Describe the role of telomere in aging. 3+ 2½ + 2½ =8

7. Write short notes on **any four** of the followings. 2×4=8
   a) Actin treadmilling b) MTOC c) SNARE proteins d) F class pumps
   e) Autophagosome and Autolysosome f) mTOR

M. Sc. Examination, 2019
Semester-I
Biotechnology
Course : II
(Biochemistry)

Time : 3 Hours

Full Marks : 40

Questions are of value as indicated in the margin

Answer **any four** questions

1. Describe schematically the steps of breakdown of a palmitate molecule present in the diet. Also mention the enzymes involved in the steps. 10

2. Describe the catabolism of purine nucleotides in humans. 10

3. a) Briefly describe the methods available for lysis of a microbial cell as *E. coli*.
   b) What is a coupled assay? What are the advantages of these methods for enzyme assay? 2.5+2.5=10

4. a) Discuss the significance of Vmax and K_M.
   b) Explain different types of enzyme inhibitions along with graphical representation.
   c) Discuss on a different type of enzyme regulation. 2+4.5+3.5=10

5. a) Draw the schematic pathway of ETC and explain the steps of ATP formation through ETC.
   b) What are inhibitors and uncouplers of ETC? 6+4=10

6. Write short notes :
   a) Fermentation
   b) Phenylketonuria
   c) Oxidative reactions of pentose phosphate pathway
   d) TCA cycle regulation

M.Sc. Examination, 2019
Semester-I
Biotechnology
Course : III
(Genetics and Molecular Biology)

315

Time : 3 Hours | Full Marks : 40

Questions are of value as indicated in the margin

Answer any four questions

1. Answer the following : 5×2=10
   a) How does an IS element differ from a composite tansposon?
   b) Why are some back crosses known as test crosses?
   c) What is Hybrid dysgenesis in *Drosophila*?
   d) What are the conditions for which a population follows Hardy-Weinberg principle?
   e) Explain briefly the concept of feedback inhibition in prokaryotic gene regulation.

2. What do you mean by resistance transfer factor? What is its significance in bacterial population? Discuss in details on mosaic kernel phenomenon of maize with proper diagram. 2+3+5=10

3. How does F^+ strain of *E.coli* differ from Hfr strain? What is the significance of development of Hfr strain? How can you prove whether a bacterial recombination is being taking place by transduction, transformation or conjugation. What is the importance of specialized transduction over generalized transduction? Give proper example. 2+2+3+3=10

4. What do you mean by "homeotic genes?" Describe the functions of different homeotic genes in embryonic development of Drosophila with proper diagram. What do you mean by "ABC model" for floral organ development in plants. 2+4+4=10

5. Briefly discuss with suitable diagrams and example, the concept of attenuation in the gene regulation of prokaryotes. What are transcription factors? Where are they found? Give a brief description, with suitable figures, the involvement of various transcription factors in the transcription initiation complex of an eukaryotic gene. 4+1+1+4=10

6. Write short notes : 2.5×4=10
   i) RNA splicing
   ii) Molecular markers and QTL mapping
   iii) Biological species concept
   iv) Zinc finger

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M.Sc. Examination, 2019
Semester-I
Biotechnology
Course : IV
(Biotechniques)

Time : 3 Hours **Full Marks : 40**

Questions are of value as indicated in the margin

Answer **any four** questions

1. a) Describe the working the principles of Western blotting. 5
   b) Describe each of the steps for the immunoblotting technique up to detection. 5

2. a) Describe affinity chromatography. 4
   b) How does reverse phase HPLC differ from normal phase HPLC? Explain along with schematic diagrams. 6

3. a) Describe the different types of ionizing radiations. 2
   b) What is radioactive half life? 2
   c) What are the different units of radioactivity? 2
   d) Discuss about the different applications of radioactivity. 4

4. a) What is limit of resolution of a microscope? How is it related to numerical aperture? 1+2=3
   b) What is the role of an inverted microscope? 3
   c) How is the Electron microscope useful for much higher resolution than light microscope? 4

5. a) Write and explain Beer-Lambert law. 5
   b) Explain the basic principle of operation of an absorption spectrophotometer. 5

6. Write short notes : 2.5×4=10
   a) Density gradient centrifugation
   b) Autoradiography
   c) Ion exchange chromatography.
   d) Retention time and retention factor in chromatography.

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M.Sc. Semester I Examination 2019

Biotechnology

Paper-V (Laboratory)

(Cell Biology, Biochemistry, Genetics, Molecular Biology)

Time: 6 hours × 2 days **Full Marks: 80**

1. Prepare a standard curve for BSA using a stock solution of 0.1 mg/ml BSA provided. Estimate the concentration of protein in the unknown sample supplied to you (please pick up one eppendorf tube and write the corresponding label/ no. in your answer sheet). Write the principal behind the assay and requirements of the experiment.

10+5+5 =20

2. From the given *Chironomus* larvae sample, dissect and make an appropriate salivary gland chromosomal preparation, stain properly and display under microscope. Identify your preparation and write down the identifying characters.

10

3. From the given cells, take suitable amount of aliquot, and prepare for cell cycle analysis. Present the prepared cells for data acquisition in flowcytometer. Analyze the data and right down your results and inference. 10

4. (a) The supplied sample (G) represents F_2 progeny generated from hybridization of two parents differ in seed traits. Comment on the inheritance pattern of any seed trait with proper statistical test using the supplied standard table.

(b) The supplied fingerprint profile (F) is generated from a marker based genotyping of some selected individuals for genetic loci. Find out the allele frequency of different allelic forms detected in fingerprint profile.

10+10 =20

5. Viva-voce: 10

6. Practical note books: 10

M. Sc. Examination, 2022
Semester – I
Biotechnology
Core Course – I
(Cell Biology)

Time: 3 hours **Full marks: 40**

Questions are of value as indicated in the margin

Answer any *four* questions.

1) a) Describe proto-oncogenes and tumor suppressor genes. Explain how mutation affects their functions.
b) Which mitotic structure is targeted by vincristine and colchicine, and what effect would that have on cell division?
c) Mutations in the gene for p53 generally enhance cell's ability to commit phagocytosis in response to chemotherapeutic drugs - True or False, explain.

4+3+3 = 10

2) a) Describe pro- and anti-apoptotic proteins with example. What cell-cycle events will be affected in a cell that produces mutated (non-functional) cohesin protein?
b) What steps are necessary for Cdk to become fully active?
c) "Rb is a negative regulator that blocks the cell cycle at the G1 checkpoint until the cell achieves a requisite size" - What molecular mechanism does Rb employ to halt the cell cycle?

(3+2)+2+3 = 10

3) a) Explain how an external signaling molecule can produce a cellular response without even entering the target cell. Compare Protein Tyrosine Kinases (PTKs) and Receptor Tyrosine Kinases (RTKs). What is primary target of Janus Kinase?

6+3+1=10

4) a) Illustrate different classes of ATP-powered pumps.
b) Classify CAMs

4+6 = 10

5) a) Trans-Golgi Network (TGN) is an essential protein sorting station - Justify.
b) Explain the nature of different topological types of membrane attached proteins sorted via secretory pathway.

4+6 = 10

6) Write short notes on any four of the followings

2.5 x 4 = 10

a) Caspases
b) Macroautophagy
c) GPCR
d) Regulated Necrosis
e) Ran Protein
f) Microtubule diasembly

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M. Sc. Examination, 2022
Semester – I
Biotechnology
Core Course – II
(Biochemistry)

Time: 3 hours **Full marks: 40**

Questions are of value as indicated in the margin

Answer any *four* questions.

1. Describe the catabolic pathway for breakdown of purines in humans. 10

2. Describe the forces that stabilize protein and nucleic acid structures. 5+5=10

3. Describe the technique of sequencing proteins using the Edman degradation. During dansyl chloride treatment, why are several dansylated amino acids observed? 6+4=10

4. Explain the urea cycle along with the enzymes involved. Discuss the short term regulation of the urea cycle. Briefly discuss two urea cycle disorders. 5+2.5+2.5=10

5. Write short notes on:
   a. Thermodynamically coupled reactions
   b. Phenylketonuria
   c. Laws of bioenergetics
   d. Glucose alanine cycle

   2.5x4=10

6. What is meant by allosteric regulation of enzymes? Explain one type of allosteric regulation in detail. Discuss the different methods of enzyme inhibition. 1+3+6=10

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M.Sc. Examination 2022
Semester - I
Biotechnology
Core Course - III
(Genetics and Molecular Biology)

Time: 3 hours **Full Marks: 40**

Questions are of value as indicated in the margin

Answer any *four* questions:

1. What is retroposons? How they differ from retro virus like elements? Briefly describe the genetic basis of coloured mosaic kernel of maize. Describe the role of transposable genetic elements in spread of resistance traits in Bacteria.

2+2+3+3 =10

2. Describe how molecular markers are employed in QTL mapping. What is genetic polymorphism? How DNA fingerprinting is done with DNA based molecular markers? Describe in details with proper diagram using a single marker system.

2+2+2+4=10

3. What are the main proponents Hardy-Weinberg principle? Mention the conditions for which a genetic population follow this principle? Describe the genetic basis of Alzheimer's disease. Briefly describe the procedure of genetic mapping followed in interrupted mating experiment on conjugation process of *E. coli* with proper diagram.

2+2+3+3=10

4. Draw a neatly labelled diagram showing attenuation control of tryptophan operon in *E. coli* (no description necessary). Briefly state four major examples of post-translational modifications of proteins that are known to undergo in an eukaryotic system. Define the basic function of transcription factors? 4 + 4 + 2 = 10

5. Briefly explain how GAL4 protein coordinately regulates transcription of Gal 1,10 genes in yeast. Draw a suitably labeled diagram to show the Kakidani& Ptashne experiment that indicate modular nature of eukaryotic transcription factors (no description necessary).

5 + 5 = 10

6. Write short notes on any four: 2.5 X 4 = 10

i) Hybrid dysgenesis in *Drososphila*

ii) Biological species concept

iii) Suppressor gene

iv) Homeo domain

v) Synthetic lethality

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M.Sc. Examination 2022
Semester I
Biotechnology
Core Course - IV
(Biotechniques)

Time: 3 hours **Full Marks: 40**

Questions are of values as indicated in the margin.
Answer any *four* questions

1. Characterize different types of ionizing radiations. Define radioactive half life? What are the different units of radioactivity? What are appropriate lab attires one should follow while working with radioactive materials?

4+2+2+2=10

2. What is a Dichroic mirror? Explain its role in microscopy. Write the working principle of phase contrast microscopy.

2+3+5=10

3a. Define the molar extinction coefficient. What information can be obtained from it?

3b. Biological Oxidation reduction involves the coenzyme NAD and its reduction product NADH. NADH produces two strong UV bands at λ_{max} 260 nm (ε =15000) and λ_{max} 240 nm (ε =6220), while NAD gives only one band at λ_{max} 220 nm (ε =18000). A reaction mixture taken in a cell of 1 cm path length showed the following data

λ_{max} 260 nm absorbance 1.2
λ_{max} 340 nm absorbance 0.311

Estimate the relative amounts of NAD and NADH in the reaction mixture

1+4+5=10

4. (a) Mention the principle of density gradient centrifugation. What is the utility of nomograph.
(b) Discuss about radioactive waste disposal.

(3+3)+4=10

5. Briefly state the principle of gel filtration chromatography. A protein has an isoeletric point of 7.2, what will be the net charge of this protein molecule when the pH of the solution is raised by 1.5 units above its isoelectric point? What kind of ion exchange resin will you choose so that the said protein can bind to that resin effectively in this solution at the elevated pH? For purification purposes how can you elute proteins bound to anion or cation exchangers? State the principles of a chromatographic method using which you can purify a protein sample many folds in a single step.

3+1+1+2+3=10

6. Two proteins are suspected to interact *in vivo*. Using two techniques, describe how would you prove the same experimentally

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M. Sc. Examination, 2022
Semester – I
Biotechnology
Paper – V
(Cell Biology, Biochemistry, Genetics and Molecular Biology)

Time: 6 hours x 2 days **Full marks: 80**

Questions are of values as indicated in the margin

1. Estimate the concentration of the cells in the given sample of cell suspension by counting under microscope appropriately showing your counting and calculation. Derive the formula for your counting explaining with proper diagrams.

7.5+7.5=15

2. Identify reducing and non-reducing sugars from the given samples labelled **A-L**. Prepare the appropriate solutions for executing the experiments from the provided reagents. Give the scientific explanation for preparation of the reagents and the results.

7+4+4=15

3. Quantify the amount of DNA in supplied sample (**M**) with help of a spectrophotometer. Comment on the purity of the provided sample.

6+4=10

4 (a) What do you mean by "chi square" test? (b) What is the importance of this test in Genetics. (c) From the supplied F_2 progeny (**N**) develop a genetic model for inheritance pattern. (d) From the inheritance pattern perform a chi square test to test whether the inheritance pattern follow the typical Mendelian principle or not using proper statistical test? (e) Also show how the probability rules of multiplication and addition are followed in your genetic model.

3+3+4+5+5 = 20

5. Viva voce 10

6. Laboratory notebooks 10

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M.Sc. Examination (2023)
Semester – I
Biotechnology
Paper – I (Cell Biology)

Time: 3 hours **Full Marks: 40**

Answer *any four* of the following questions

1. a) Compare the assembly and disassembly of microfilaments and microtubules.
   b) Explain how lamins maintain nuclear connection with cytoskeleton.

   6+4=10

2. a) Compare primary and secondary active transport through biological membranes.
   b) Explain the topology of the nascent polypeptides destined for the thylakoid lumens of chloroplasts.

   5+5=10

3. Justify *any four* of the following:

   2½×4=10

   a) Ras is a proto-oncogene
   b) Rb is a tumor supressor
   c) PS externalization is the hall mark of apoptosis
   d) Bcl/Bax ratio decides the fate of a cell
   e) p73 and p63 are brothers of p53
   f) Autophagy is primarily a cell survival and not a death mechanism

4. a) Define and classify caspases. Describe with example the caspase dependent extrinsic pathway of apoptosis in mammalian cells. Give two examples of IAP.
   b) Who is more prone to cancer and why – human or elephant?
   c) Explain with reason if it is possible to have cancer in terminally differentiated cells.
   d) During which phase of interphase does cell growth occur?

   (3+3+1)+1+1+1=10

5. a) Why are the MAP kinases named so? What are their substrates? Classify mammalian MAP kinases.
   b) Distinguish between stimulatory and inhibitory G-proteins with examples.

   (1+1+3)+5=10

6. Write short notes on *any four* of the following:

   2½×4=10

   a) SMAD proteins
   b) Rhodopsin
   c) Organization of basal lamina
   d) Janus kinase
   e) Receptor mediated endocytosis
   f) Nuclear pore complex

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M. Sc. Examination (2023)
Semester – I
Biotechnology
Paper – II (Biochemistry)

Time: 3 hours **Full marks: 40**

Questions are of value as indicated in the margin
Answer any four questions.

1. (a) Discuss the significance of Vmax and K_M.
   (b) Explain different enzyme inhibitors along with graphical representation.
   (c) Explain the different types of enzyme regulation.
   (1+1)+4+4=10

2. (a) Draw the schematic pathway of ETC and explain the ATP formation through ETC.
   (b) What are inhibitors and uncouplers of ETC?
   (c) Differentiate between substrate level phosphorylation and oxidative phosphorylation.
   4+4+2=10

3. Describe the steps involved in protein sequencing. What are the challenges faced? How can these challenges be resolved?
   5+2.5+2.5=10

4. (a) Describe some consequences due to abnormalities in the nucleotide metabolism.
   (b) Describe the role of nucleotide analogues in medicine.
   5+5=10

5. Describe some common techniques used for the assay of enzymes. How can you ensure that the values obtained are accurate? Describe one in detail.
   7.5+2.5=10

6. Write short notes on *any four*:
   (a) Regulation of TCA cycle
   (b)Urea cycle disorders
   (c) Pyruvate dehydrogenase complex
   (d) Glucose alanine cycle
   (e) Oxidative reactions of pentose phosphate pathway
   2.5x4=10

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M.Sc. Examination 2023
Semester-I
Biotechnology
Paper-III (Genetics and Molecular Biology)

Time: 3 hours **Full Marks: 40**

Questions are of value as indicated in the margin

Answer any four questions

1. Mention the structure and evolutionary importance of retrotransposon. Diagrammatically describe the maize aleurone colouration system in light of transposable genetic elements. Describe the molecular basis of the SSR-based molecular marker system.

3+4+3 =10

2. Define a biological species. Outline the different evolutionary processes associated with speciation. What is the homeotic gene family? Briefly describe the ABC flowering system in plants with proper diagram.

2+3+2+3=10

3. Briefly describe the following genetic phenomena:
a. QTL mapping
b. Protein folding
c. In-borne-error metabolism
d. Tetrad analysis
e. Protein glycosylation

2x5=10

4. Compare the following pair of genetic phenomena/elements
a. Monogenic trait and polygenic trait
b. Capping and polyadenylation
c. Genetics and genomics
d. Promoter and enhancer
e. Prokaryotic RNA polymerase and eukaryotic RNA polymerase

2x5=10

5. Briefly describe the genetic basis and major symptoms of the following genetic disorders
a. Cystic fibrosis
b. Sickle cell anaemia
c. Alkaptonuria
d. Phenylketonuria
e. Huntington's disease

2x5=10

6. What is the advantage of alternate splicing? Diagrammatically describe the structure of spliceosome. Briefly describe the different motifs commonly involved in DNA-protein interaction in the eukaryotic system

1+3+6=10

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M.Sc. Examination (2023)
Semester – I
Biotechnology
Paper – IV (Biotechniques)

Time: 3 hours **Full Marks: 40**

Answer *any four* of the following questions

1. What are the differences between native and SDS PAGE? What kind of information do each of these techniques provide? 5+5 =10

2. (a) Explain the fingerprint and functional group regions of an IR spectrum.
(b) Define the terms IR- active and IR-inactive with example.
(c) The diameter of lipid molecule emulsified in water to be separated is 50 μm. The effective radius of centrifuge is 5 cm, and the velocity of lipid is 3 cm/s. The density and viscosity of water are 1000kg/m^3 and 1cp respectively. The density of oil is 910 kg/m^3. Calculate the rotational speed of centrifuge.
3+2+5=10

3. (a) Draw a ray diagram of the phase contrast microscopy.
(b) Phase contrast microscopy is excellent for thin, colourless, nearly transparent specimens. If specimens are very thick, what kind of problems you may expect during analysis of image?
(c) The objective lens and the eyepiece used in a compound microscope are of focal lengths 4 cm and 10 cm respectively. An object is placed at 6 cm from the objective lens. What will be the magnifying power and length of the compound microscope?
3+2+(3+2)=10

4. (a) An unsaturated ketone (mass: 110) has an absorption band at 215 nm and ϵ =10000. A solution of this ketone showed absorbance A =2 in a 1 cm cell. Calculate the concentration of ketone in this solution expressed in grams per liter.
(b) Convert 1500 Å to erg and Hz.
(c) Indicate the different regions of electromagnetic spectrum.
(d) Define numerical aperture (NA).
3+2+3+2=10

5. (a) Dirt on **objectives, eyepieces, or in the internal parts of the microscope** can result in microscopy images that are less than ideal. Mention the techniques to determine which part (i.e. **objectives, eyepieces, slide)** of your microscope is dirty, and ultimately which parts you need to clean.
(b) UV adsorption bonds are generally broad compared to infrared - Explain.
(c) Write a short note on density gradient centrifugation and its significance.
5+2+3=10

6. (a) What are the uses of high speed centrifuges? Name the three different types of rotors used in high-speed centrifugation.
(b) How would you adjust the centrifugation time according to the k-factor?
(c) Write a short note on sedimentation coefficient and its significance.
(d) Explain why ethanol is a good solvent for UV measurement but not for IR.

3+2+3+2=10

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Department of Biotechnology, Visva Bharati

M.Sc. 1st Semester Examination 2023-2024

Paper V (Practical)

Time 6 hrs (10 AM to 4 PM) **Total marks 80**

Q1. Prepare a standard curve for BSA using a stock solution of 1 mg/ml BSA provided. Estimate the concentration of protein in the unknown sample supplied to you (please pick up one Eppendorf tube and write the corresponding label/ no. in your answer sheet). Write the principle of the assay and requirements of the experiment. (10+5+5 =20)

Q2. The supplied plant sample (G) represents F_2 progeny plant material generated from two parental plants that differ in seed traits.

(a) Construct an inheritance model system to fit the derived result with a proper flow diagram.

(b) Comment on the inheritance pattern of the said hybroidization experiment and find out whether the results are statistically significant or not with the help of the supplied statistical table. 3 + (4+3)=10

Q3. The supplied gel-based fimgerprint profile (F) represents a marker-based genotyping of few selected individual plant population for a selected genetic locus as mentioned. Find out the allelic frequency of different allelic forms of the genetic locus presented in the fingerprint profile. 10

Q4. Count the cells in the given tubes (C1-C11) under microscope with cell counting chamber. Estimate the cell conc. per mL showing the calculation. Write down the principle of cell counting with a proper diagram. 3+4+3=10

Q5. Prepare the slide and show any two mitotic stages and write down their identifying characters from the given sample. 6 + (2x2) = 10

Q6. Practical copy: 10

Q7. Viva voce: 10

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M.Sc. Examination 2024
Biotechnology
Semester-I
Paper I (Cell Biology)

Time: 3 hours

Full Marks: 40

Questions are of value as indicated in the margin

Answer *any four* questions

1. What are the types and functions of cell junctions? Distinguish between microfilaments and microtubules. What is ECM? Illustrate the constitution of basement membrane.

3+3+1+3=10

2. a) Classify biomembrane lipids with examples. What is liposome?

   b) What is active transport? Classify ATP-driven pumps with examples.

(4+1)+(1+4)=10

3. a) What are GPCRs? Schematically explain their operational mechanism.

   b) Compare the functionality of Cytokine receptors and Receptor Tyrosine kinases.

   c) 'Integrins are both cell-adhesion and signal transducing molecules' – Justify.

(1+3)+3+3=10

4. Explain the roles of cyclins and cyclin-dependent kinases (CDKs) in the cell cycle. How is CDK activity regulated by phosphorylation and CDK inhibitors (CKIs)? Explain how does the sequential activation of cyclin-CDK complexes ensure unidirectional progression through the cell cycle. Why do cyclin levels oscillate, but CDK levels remain constant during the cell cycle?

2+3+3+2=10

5. a) Describe G1/S and G2/M checkpoints. What key molecular events occur at the checkpoints to prevent genomic instability?

   b) What is the role of tumor suppressor protein p53 in inducing cell cycle arrest? Discuss its mechanism of action in response to DNA damage.

(2+3)+(2+3)=10

6. Write short notes on the followings (*any four*)

2½×4=10

   a) Kinesin walk

   b) General import pore

   c) Second messenger

   d) Secondary active transport

   e) Clathrin coated vesicles

   f) JAK/STAT pathway

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M.Sc. Examination 2024
Biotechnology
Semester-I
Paper II (Biochemistry)

Time: 3 hours

Full marks: 40

Questions are of value as indicated in the margin
Answer *any four* questions.

1. Write short notes on:
   (a) Inhibitors and uncouplers of ETC
   (b) Coupled reaction
   (c) Fermentation
   (d) Phenylketonuria

2.5x4=10

2. (a) Explain the two laws of thermodynamics with examples.
   (b) Calculate the standard free-energy change of the following reaction, using the equilibrium constant given for the reaction at 25°C and pH 7.0

Triose phosphate Isomerase

Dihydroxyacetone phosphate ⇌ glyceraldehydes 3-phospahte

$K'_{eq} = 0.0475$, $(\log 0.0475 = -1.323)$

   (c) "V_{max} and K_M can be determined by varying the substrate concentration" - explain with the help of Lineweaver-Burk plot.
   (d) Explain the Michaelis-Menten equation under the following three conditions:
      i) $[S] >> K_M$
      ii) $[S] << K_M$
      iii) $[S] = K_M$

2+3+2+3 = 10

3. (a) Outline the reactions of the urea cycle.
   (b) Name and draw the structures of the α-keto acids when the following amino acids undergo transamination with α-ketoglutarate:
      i) aspartate
      ii) alanine
   (c) Describe the non-oxidative reactions of pentose phosphate pathway and their regulations.
   (d) Draw a schematic pathway of the ETC.

3+1+3+3=10

4. Answer the following:
   (a) Describe one enzyme that is crucial in the (i) synthesis and (ii) degradation of nucleotides.

(b) Describe any one disorder which is controlled by anomalies in nucleotide metabolism.

(3.5+3.5)+3=10

5. Outline the steps involved in the β-oxidation of fatty acids. How does the number of carbon atoms influence the pathway? What is the end product of fatty acid catabolism?

5+4+1=10

6. (a) What are the different levels of protein structure? Describe each briefly.
(b) How does the structure of a protein relate to its function? Explain with a suitable example.

(2+3)+5=10

M.Sc. Examination 2024
Biotechnology
Semester-I
Paper III (Genetics and Molecular Biology)

Time: 3 hours **Full Marks: 40**

Questions are of value as indicated in the margin
Answer *any four* questions

1. Briefly describe the possible reason behind hybrid dysgenesis with special reference to m and p strains of *Drosophila*. What is the functional significance/importance of retroposon-like elements in the *Drosophila* genome as an evolutionary adaptation for maintaining telomere length? Briefly describe the procedure of QTL mapping with special reference to single marker analysis.

3+3+4=10

2. What do you mean by speciation? Describe this phenomenon with special reference to pre and post-zygotic isolation, considering proper examples. Briefly describe the evolutionary concept of "Survival of the fittest" in terms of population Genetics considering the short and extended neck of a Giraffe. How does genetic drift develop in nature? Briefly describe with relevant example.

4+3+3 = 10

3. Write short notes or comment on the following genetic phenomenon

   (a) ABC genetic model for flower development
   (b) Trisomy-associated human diseases
   (c) Synthetic lethality
   (d) Selection and fitness in evolution

4. Briefly describe the negative control mechanism of *E. coli* Operon system as proposed by Jacob and Monod. How did they prove the operating mechanism of the Operon model at the substrate level? Describe with example about the process of co-translational protein modifications and their role in protein maturation.

2+3+5=10

5. (a) What are DNA binding motifs? Describe their key features.
   (b) Briefly state the mechanism of miR maturation with proper diagrams.

5+5=10

6. Elaborate the KNF and MWC model of enzyme regulations. Which one of them is accepted and why? Explain how transcription factors regulate enzyme function.

5+1+4=10

M.Sc. Examination 2024
Biotechnology
Semester-I
Paper-IV (Biotechniques)

Time: 3 hours **Full Marks: 40**

Questions are of value as indicated in the margin
Answer *any four* questions

1. What is the basic principle of electrophoresis? What is the difference between agarose and polyacrylamide gel electrophoresis? 5+5 =10

2. (a) Discuss how the Beer-Lambert law is applied to determine the concentration of an analyte. Critically analyze the limitations of this law in practical applications such as highly concentrated solutions or scattering samples.
(b) Define the terms IR- active and IR-inactive with example.
(c) A solution of a compound absorbs light at a wavelength of 450 nm with a molar absorptivity (ε) of 2.5×10^4 L $mol^{-1}cm^{-1}$. A 1 cm cuvette is used, and the absorbance (A) of the solution is measured to be 0.75.
Calculate the concentration of the compound in the solution. Express your answer in mol/L.

(3+2)+2+3=10

3. (a) Explain the principle of phase contrast microscopy and discuss how it enhances the visualization of transparent biological specimens without staining. Provide one specific example of its application in studying live cells.
(b) In Fluorescence Microscopy, explain the concept of Stokes shift and its significance in fluorescence imaging. How does spectral overlap between excitation and emission spectra affect the specificity and sensitivity of fluorophore-based imaging?

5+(3+2)=10

4. (a) Explain the principles of differential centrifugation and density gradient centrifugation. Compare their effectiveness in separating cellular components, and identify one specific scenario where each method is preferred.

(b) How does the sedimentation coefficient influence the resolution of separation in both differential and density gradient centrifugation techniques.

(c) Critically analyze how the design of fixed-angle, swinging-bucket, and vertical rotors influence sedimentation behavior during centrifugation.

(d) Define Numerical aperture (NA)

3+2+3+2=10

5. Discuss about different types of ionizing radiation. What are appropriate lab attires one should follow while working with radioactive materials? Discuss about radioactive waste disposal.

3+4+3=10

6. (a) Describe HPLC with a schematic diagram. What is the advantage of reversed-phased HPLC over normal-phase HPLC?

(b) Write short notes on *any two* the following:

i. Affinity chromatography
ii. Radioactive half life
iii. Retention time and retention factor in chromatography

6+(2+2)=10

586

M.Sc. Examination 2025
Semester-I
Biotechnology
Course/Paper-V (Practical)

Time: 6 hours × 2 days

Full Marks: 80

Questions are of value as indicated in the margin

1. View the given cell samples (any one of C1-C14) under light microscope and count them using a cell counting chamber. Showing the calculation, estimate the cell count per ml of suspension. Derive the cell counting formula mentioning the rationale behind the counting method.

5+5+5=15

2. Suppose, along with other requirements, you have been provided with the stock solutions of 1M Na_2HPO_4 and NaH_2PO_4. To prepare a Phosphate buffer of pH 7.2, you need to mix the appropriate conc. of these two compounds in 7:3 ratio (approx.). Calculate and describe the method to prepare 500 ml of 20mM PBS using these two stock solutions.

5

3. The supplied seed sample (S) represents F_2 progeny plant material generated from two parental plants that differ in seed traits. Construct an inheritance model system to fit the derived result with a proper flow diagram. Comment on the inheritance pattern of the said hybridization experiment and find out whether the results generated are statistically significant or not with the help of the supplied statistical table.

3+4+3=10

4. The supplied gel-based fingerprint profile (F) represents a marker-based genotyping of a few selected individual plant populations for a selected genetic locus, as mentioned. Find out the allele frequency of different allelic forms of the genetic locus presented in the fingerprint profile.

10

5. Prepare a standard curve for BSA using a stock solution of 1mh/ml BSA provided. Estimate the concentration of protein in the unknown sample supplied to you (please pick up one Eppendorf tube and write the corresponding label/no. in your answer sheet). Write the principle of of the assay and requirements of the experiment.

7.5+5+2.5=15

10

6. Submit Practical copies.

15

7. Viva voce