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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. Semester II Examination (2022)
Biotechnology
Course/Paper – VI (Microbiology)

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

Questions are of value as indicated in the margin

Answer **any four** questions

1. a) What are the main features of the subclass, Basidiomycota? What are the economic importances of these groups of organisms?
   b) Describe some of the unique features of *Dictyostelium* spp. (2+3) +5 = 10

2. What are the basic differences between purple sulfur bacteria and purple non-sulphur bacteria? How do purple bacteria differ from green bacteria? What are the basic differences between bacterial photosynthesis and photosynthesis in a higher group of plants? Give a brief account of photosynthetic prokaryotes with special reference to photosynthetic machineries and pigment systems. Briefly describe the role of Nif and Nod factors in symbiotic nitrogen fixation of Bacterial system. 2+2+1+2+3=10

3. a) What are the main types of archaebacteria? Why one particular type is high salt tolerant while the other type is heat tolerant?
   b) What is pathogenesis? Briefly discuss the parasitic strategies for transmission and establishment with suitable examples 1.5+2+ (1.5+5) =10

4. Discus the different Methods of measuring bacterial growth in a batch culture. Describe the Helmstetter-Cummings method for obtaining synchronous culture of bacteria for a long time. What is diauxic growth? 4+4+2=10

5. a) Why Carl Woese used 16S rRNA gene as "Chronometer" for classifying the three domains of living system?
   b) What is Bergey's manual?
   c) State two important differences between Archaea and Bacteria.
   d) State the three purposes of fixation before staining of microbial cells.
   e) State in bulleted form two advantages and uses of ribotyping method.
   2+1.5+1+1.5+ (2+2) =10

6. Write short notes on any four of the following: 2.5 X 4=10
   a) ATP synthesis in anaerobic condition by Halobacterium sp.
   b) Mode of action of sulfa-drugs as antibacterial agents.
   c) Antifungal antibiotic
   d) Exotoxins
   e) Endemic, Epidemic and Pandemic
   f) Antibiotic grouping by mechanism

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M.Sc. Semester II Examination (2022)
Biotechnology
Course/Paper – VII (Immunology)

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

Questions are of value as indicated in the margin

Answer **any four** questions

1. With proper diagram describe the ultra-structure of any secondary lymphoid organ/tissue. Mention the functional significance of different internal zones of the organ/tissue you described. What is Common lymphoid progenitor?

5+4+1=10

2. a) What was the immunological 'puzzle' solved by Tonegawa and his coworkers based on their classic experimental results published in 1976? Schematically explain how they solved it.

b) Explain Receptor editing mechanism.

(2+4)+4=10

3. a) Why are the complements named so? Explain Jules Bordet's experimental strategy and findings to discover the complements.

b) TLR function bridges between innate and adaptive immunity – Justify.

(1+4)+5=10

4. a) Distinguish with example between recombinant- and DNA vaccination strategies. What is toxoid?

b) How are the antigens processed in the cytosolic pathway? What are the roles of CD4 and CD8 costimulatory molecules?

(4+1)+(3+2)=10

5. Elucidate the general properties of cytokines. With appropriate diagram and example explain the classification scheme of chemokines. What is lymphocyte homing?

5+4+1=10

6. Write Short note on *any four* of the followings.

2½×4=10

a) Opsonization
b) 12/23 rule
c) Thymic selection
d) Structure of Class-I MHC
e) PAMP
f) Ig domain

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M.Sc. Semester II Examination (2022)
Biotechnology
Course/Paper – VIII (Virology)

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

Questions are of value as indicated in the margin.

Answer question no. **1** and ***any three*** from the rest.

1. Answer any five questions: 5X2=10
   a) Show with example the structural symmetry of viruses.
   b) Would a person who has never been in contact with the varicella-zoster virus be at risk of developing chickenpox or shingles if they come in close contact with a person with shingles? Explain your reasoning.
   c) A 44-year-old CMV antibody negative man is given a lung transplant from a CMV antibody positive donor. Comment on it with explanation.
   d) Describe Zika Virus.
   e) Plant viral disease transmission.
   f) It was observed that the radius of an approximately circular plaque of infected cells grew to 1.45 mm in just 3 days. They measured the distance between adjacent cells to be 0.037 mm to obtain the apparent time for the lytic cycle (from infection to lysis). They compared this time to the actual rate at which new virions are formed: 5 to 6 hours. Predict the radius of infection if the infection process involved a sequence of entry, replication, lysis, and infection of an adjacent cell.
   g) Which step in the replication cycle of viruses do you think is most critical for the virus to infect cells? Explain why
   h) All DNA viruses must replicate in the nucleus and all RNA virus must replicate in cytoplasm. Explain whether the statement is true or false.

2. Explain with Justification (any four): 2.5×4=10
   a) Interferon acts as an anti-viral drug.
   b) Fluorouracil is a pro-drug.
   c) Antiviral not work during latency
   d) EBV can cause different disease depending on condition
   e) Acyclovir is a broad-spectrum antiviral but Cidofovir not
   f) HAART - Highly active antiretroviral therapy

3. Define and classify Human herpesvirus. Describe the properties of human herpes viruses Compare different human herpes virus with example. 3+2+5=10

4. a) Explain Acute and Persistent infection with example.
   b) Describe the basic structure of Influenza virus? Define the role of Haemagglutinin and Neuraminidase. Define antigenic shift and Antigenic drift with example?
   c) Compare between the different viruses which directly causes Hepatic infections
   2+(1+1+2) + 4 = 10

5. What are the classical symptoms of plant viral infections? Describe life cycle of a typical plant virus with proper diagram. Describe viral penetration and intracellular migration in plant viral invasion. 2+4+4=10

6. Short Notes (any four): 2.5×2=10
   a) Baltimore classification
   b) Zoonosis
   c) Viroids
   d) Nuclear Entry to virus
   e) Prions
   f) Blue tongue virus

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M.Sc. Semester II Examination (2022)
Biotechnology
Course/Paper – IX (Computer Application and Biostatistics)

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

Questions are of value as indicated in the margin

Group–A

Answer any two questions

1. A) Write a C Program to convert Celsius to Fahrenheit.
   B) What is an array ? 8+2=10

2. A) Write a C Program to check a given integer is Prime Number or not.
   B) What are the basic data types associated with C ? 7+3=10

3. A) Create your homepage using HTML. It should contain link to favourite sites and image of the owner of the homepage (Assume image is available in the same directory.).
   B) Create a table using HTML containing two rows and two columns. 7+3=10

4. A) Write a JavaScript to find the maximum of three given integers.
   B) Write a C-program to find the variance of a given set of numbers. 4+6=10

Group–B

Answer any two questions

1. A) What do you mean by statistical hypothesis testing? Define null and alternate hypothesis.
   B) Mention the aim and utility of ANOVA test. Define 2-way-ANOVA.
   C) How correlation differs from regression? Which statistical expression is indicatedby R^2 value in regression analysis?
   3+4+3=10

2. A) What is "paired t test"? What is the parameter by which one can decide whether the t test will "paired t test" or "non-paired t test"?
   B) What is the utility of "one sample Z test"? Define the phenomenon "5% level of probability" for rejection of a null hypothesis in "Z test"
   5+5=10

3. A) Define "sum rule" and "product rule" in probability. How can you apply both the rules at the same time in a Mendelian dihybrid cross?
   B) What will be the probability of different kinds of gametes produced by the F_1 plants generated from a cross between a pure strain of tall pea plant with a pure strain of dwarf pea plant?
   8+2=10

4. A) What is the utility of Chi square test?

   B) In a typical Mendelian experiment, a Tall pea plant with Red flower was crossed with a Dwarf pea plant with White flower.The F_1 plants generated were all Tall plants with Red flower. The F_1 plants were crossed with the parental plant (Dwarf with white flower). The generated progeny showed a population of 35 Tall plants with Red flower, 39 Tall plants with white flower, 29 dwarf plants with red flower and 30 dwarf plants with white flower. Comment on the inheritance pattern of the genes associated with plant height and flower colour. (chi square value at 5% level for df 3 is 7.82)

   2+8=10

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M.Sc. Semester-II Examination - 2022
Biotechnology
Paper X - (Practical)
(Microbiology, Immunology, Virology, Biostatistics)

Time: 6 h + 6 h (2 days) **Full Marks: 80**

1. Solve the following problems with proper computer programme.

a) In supplied plant sample (S-I), there are two different types of leaf. One set of leaf was collected before application of insecticide and another set of leaf is collected after application. Is there any significant difference in leaf length between the two leaf samples. Justify your answer with proper statistical test and briefly describe your remark.

b) In supplied plant sample (S-II), there are two different types of leaf from two different plants. Is there any significant difference in leaf length between these two leaf samples. Justify your answer with proper statistical test and briefly describe your remark.

c) In supplied plant sample (S-III), there are three different types of leaf. Are there significant amount of variation present in the studied sample. Justify your answer with proper statistical test and briefly describe your remark.

5+5+5=15

2. Dissect the supplied sample (S-IV) and identify the cyanobacterial sample present. Draw rough diagram, describe and identify the cyanobacterial species.

3+3+1½ =7½

3.a) You are being provided with a bacterial culture. Using Gram's staining, identify the culture as Gram positive or Gram negative. Mention the identifier of the culture provided to you.

b) What is the basis of this protocol?

5+2½=7½

4. Write the working principle of plaque assay. Prepare a hard agar plate. Prepare the soft agar and perform the phage assay from the given sample. Count the colonies from the phage plate. Comment on your result.

3+3+5+3+1=15

5. Estimate the specific protein concentration (IL-10) from the given sample (any one out of C1, C2, C3, C4 & C5) by performing sandwich ELISA. Show the calculation of the serial dilution of the standards, plot the standard curve with your readings and write down the estimation procedure.

8+4+3=15

6. Viva-voce.

10

7. Submit your laboratory note books.

10

6/9/22 N Das 6/9/2022 7.9.22 6/9/2022 6/9/2022

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M.Sc. Examination 2022
Semester III
Biotechnology
Core Course - XI
(Genetic Engineering)

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

Questions are of value as indicated in the margin

Answer any four questions

1. With suitable diagram/s, briefly explain the mechanisms of DNA methylation in *E. coli*. Draw the schematic diagram of a typical yeast expression cum secretion vector with appropriate labelling (No description necessary).

7 + 3 = 10

2. Draw a suitably labelled schematic diagram showing the method of synthesis of total double strand cDNA from the total mRNA sample of an organism (no description necessary). Briefly explain the method of creating a point mutation in a cloned DNA sequence using PCR method.

5 + 5 = 10

3. With a suitably labelled diagram briefly discuss the method of dideoxy sequencing technique of a piece of DNA sample. Briefly state, in bulleted form, three disadvantages of Maxam-Gilbert technique.

7 + 3 = 10

4. Draw a schematic diagram with proper labelling, the general principle of PCR amplification of a DNA sample in a thermal cycler (no description necessary). Briefly discuss in bulleted form the applications of PCR method in forensics and molecular diagnostics (one each).

5 + 5 = 10

5. What do you mean by heterologous gene expression? What is a His-tagged recombinant protein? How you can purify a his-tagged protein using affinity chromatography? Briefly state in bulleted form how you can optimise the expression of a recombinant gene in a bacterial host.

2 + 2 + 3 + 3 = 10

6. Write short notes on any two: 2 x 5 = 10
   a) Southern Blotting.
   b) Non-radioactive labeling of DNA.
   c) Transgenesis using embryonic stem cell.
   d) Klenow enzyme.

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M.Sc. Examination 2022
Semester III
Biotechnology
Core Course - XII
(Animal & Plant Biotechnology)

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

Questions are of values as indicated in the margin

Group A - Animal Biotechnology

Answer any two questions **10 x 2 = 20**

1. a) Describe the typical set up of an animal cell culture laboratory. What are the protection measures necessary for animal cell culture?
   b) What is meant by subculture or passage? Draw and explain a typical growth cycle. What are the general characters of a cell line?

   (3+2)+(1+2+2)=10

2. a) What is the difference between totipotent and pluripotent stem cells? What are the potential therapeutic applications of iPSCs?

   b) What is Fate map – explain with example. Mention the distinctive features of the ova of sea-urchin and mammals.

   (1+4)+(2+3)=10

3. a) Schematically explain the gradual development of Lentiviral vectors.

   b) Write short notes on (any two)
   i) Adenovirus vectors
   ii) MTT assay
   iii) Class III Biosafety cabinet

   5+(2.5x2)=10

Group B - Plant Biotechnology

Answer any two questions **10 x 2 = 20**

4. What is somaclonal variation? How these variations develop in plant tissue culture derived plants? Give a brief description on genetic engineering of crop plants for abiotic stress tolerance. What are the advantages of "Calgen's Flavr Savr" tomato over normal tomato? How this tomato was developed?

   1+1+4+1+3=10

5. What is co-integrated vector? How it differs from binary vector? What are the advantages of binary vector over co-integrated vector? Diagrammatically describe the different constructs employed for development of golden rice I and II with proper line diagram?

   2+2+2+4=10

6. What do you mean by disease triangle in plant pathology? How humans influence this triangle? Discuss the R-avr interactions in plant pathology along with the "guard hypothesis". Describe the different types of plant R proteins with structural features.

   2+1+3+4=10

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M.Sc. Examination 2022
Semester III
Biotechnology
Core Course - XIII
(Bioprocess Engineering and Technology, Bioentrepreneurship)

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

Questions are of values as indicated in the margin

Group A - Bioprocess Engineering and Technology

Answer any *three* questions **10x3 = 30**

1. (a) Prove that a tubular plug flow reactor is always smaller than the stirred tank reactor for a given conversion when kinetics are in positive order.
   (b) You were asked to produce a cellobiose dehydrogenase enzyme using *T. clypeatus*. You have a bubble column reactor, stirred tank reactor and fluidized bed reactor. Suggest your preferences and rejection reasons with justifications.

   5+5=10

2. (a) Explain the effect of permeability on glutamic acid production.
   (b) Draw a schematic diagram for mass culturing of *Rhizobia*.

   5+5=10

3. (a) Derive the design equation for a plug flow and stirred tank reactor.
   (b) Explain the surface culture method of citric acid production.

   5+5=10

4. (a) Write short notes on
   (i) Dirac-delta function,
   (ii) Airlift bioreactor.
   (b) Estimate the theoretical growth and product yield coefficient for ethanol fermentation by *S. cerevisiae* as described by the following equation

   $$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

   (2.5+2.5)+5=10

Group B - Bioentrepreneurship

Answer any *one* questions **10 x 1 = 10**

5. (a) what are the qualities necessary to be a successful entrepreneur?
   (b) What is business opportunity? What are its different elements?

   3+(3+4) =10

6. What are the different sources of funding available for an entrepreneur?

   10

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M.Sc. Examination 2022
Semester III
Biotechnology
Core Course - XIV
(Ecology, Environmental Biotechnology and Emerging Technologies)

Full Marks : 40 **Time 3 Hrs**

Questions are of value as indicated in the margin

Group A - Ecology, Environmental Biotechnology

Answer any *two* questions **10x2= 20**

1. Define second and third -generation biofuel with examples. What is Saccharification process? Explain how the different pretreatment methods affect Saccharification process.

5+ 1+ 4= 10

2. Draw and explain with examples about different types of survivorship curves. Define vermicomposting. What are the advantages of vermicomposting vis-a-vis other methods of composting?

5
4+1+4=10

3. What are the different steps of waste water treatment? Elaborate the preliminary and primary steps of waste water treatment. Define algal bloom. Discuss about the controlling methods of HABs.

2+4+1+3=10

Group B- Emerging Technologies

Answer any *two* questions **10x2= 20**

4 Y. a) Sketch and describe the basic components of a mass spectrophotometer. Differentiate between EI and MALDI. How m/z ratio related with TOF? Compare hard and soft ionization.
b) Write the Principle of FRET

(3+2+1+1) +3=10

5 Z. a) Give a basic structure of flow cytometry. Define ADC in flow cytometry. Describe the basic principle of cell sorting in flow cytometry.
b) Write the basic principle of TEM. Mention two drawbacks of SEM

3+1+3+(2+1)=10

6 B. a) Explain the fingerprint and functional group regions in an IR spectrum. "IR spectroscopy can be called rotational and vibrational spectroscopy" do you agree? Justify your answer. Why are the IR peaks not very sharp?
b) Derive Bragg's law expression

(3++2+1)+4=10

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M.Sc. Examination, 2022
Semester - III
Biotechnology
Course: XV (Laboratory-III)
(Genetic Engineering, Animal and Plant Biotechnology)

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

1. Briefly describe the principle, methodology and precaution of any one of the following tissue culture experiments in detail. You have to demonstrate the respective technique properly in presence of examiners:

a) Embryo culture for supplied plant material (A)

b) Anther culture for supplied material (B)

2.5+5+2.5+10=20

2. Perform MTT assay with the samples provided and assess the percent reduction of cellular dehydrogenase activity. Show your calculation and results properly.

10+10=20

3. a) Briefly describe the protocol for digestion of a piece of DNA with a restriction enzyme.

b) Briefly describe the protocol for transformation of *E. coli* cells with plasmid DNA using $CaCl_2$ method.

10+10=20

4. Viva-voce. 10

5. Submission and evaluation of practical record copies. 10

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M.Sc. Examination, 2022
Semester –IV
Biotechnology
Course/Paper: XVI
(Genomics, Proteomics and Bioinformatics)

Time: 3 hrs **Full marks: 40**

Questions are of value as indicated in the margin

Answer any four questions

1a. Discuss the principle and applications of DNA barcoding.
b. Why we should not consider DNA barcoding as a taxonomic technique?
c. What is BOLD?
6+2+2=10

2a. Define Homology Modeling.
b. What are the assumptions in homology modeling methods?
c. Write down the different steps in homology modeling.
d. Describe Dynamic Programming.
e. Differentiate local and global alignment in terms of algorithm.
1+2+2+2+3=10

3a. Discuss four characteristics of DNA markers.
b. Why molecular marker systems are better than classical markers in detecting variation?
c. Compare the relative advantages and disadvantages of the following molecular markers.
i) SNPs ii) SSRs
2+2+(3+3)=10

4.a. What are degenerate primers?
b. Describe the steps of primer designing using any primer designing software.
c. What are the critical parameters of primer designing?
d. Describe any one technique of next generation sequencing. 1+2+2+5=10

5a. Discuss one non-gel based proteomic technique.
b. Describe the main features of human genome project along with its ethical issues.
5+5=10

6. Write notes on any four of the following. 4x2.5 = 10

(i) MSAP
(ii) PDB
(iii) Pyrosequencing
(iv) cDNA microarray
(v) Needleman-Wunsch algorithm.
(vi) BLAST

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M. Sc. Examination 2022
Semester IV
Biotechnology
Course/Paper XVII
(Bioethics, Intellectual property rights, Biosafety and Research Methodologies)

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

Questions are of value as indicated in the margin

Answer any four questions

1. What do you understand by assisted reproductive technologies? Briefly describe the reservations regarding these technologies.

4+6=10

2. (a) What are the advantages and concerns regarding gene therapy?
   (b) Describe briefly the controversy regarding ownership of Basmati.

(3+3)+4=10

3. Describe briefly the different sections of a patent application.

10

4. Describe briefly:
   (a) Field trials of GM crops
   (b) Biosafety guidelines for working on GMOs at the laboratories.

4+6=10

5. Write short notes on:
   (a) Euthanasia
   (b) Role of FSSAI

2.5+7.5=10

6. Explain 'raw data' and 'processed data' in experimental research with a suitable example. What is the significance of statistical analysis of experimental results? When writing a research project proposal to some central government funding agency in India, what are the major sections to be covered and discussed?

3+3+4=10

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M.Sc. Examination, 2022

Semester –IV

Biotechnology

Course: XVIII

(Laboratory IV - Genomics, Proteomics & Bioinformatics)

Time: 6 hrs **Full marks: 40**

1. Download the following gene sequence with accession number: HQ711937 from NCBI and answer the questions from A, B and C using this gene sequence.

A. i. Design a pair of primers to amplify this gene using any free primer designing software.

ii. Discuss all the necessary parameters.

iii. Mention the name of the software that you used. (2 + 2 +1 =5)

B. i. Mention the name of the gene and its type.

ii. Apply BLAST and identify the five best homologs of this gene. Write the name of the 5 best gene homologs.

iii.Do the multiple alignments of all of them including the given gene with default parameters.

(1 + 2 +2 = 5)

C. i. Translate the given gene sequence to corresponding protein sequence using any freely available bioinformatic software. Apply BLAST with the protein sequence & identify the best five protein homologs. Write the name of the 5 best homologous proteins.

ii. Is the 3D structure of this protein present in PDB? Mention how you can check it? If yes, mention the name of that protein. If not, find the closest structural homolog of this protein in PDB and mention its name.

(3+2=5)

2 a) Write the principle of RT-qPCR.

b). Discuss its application with special reference to Covid-19

c) Measure the expression of Actin gene from the given cDNA sample of *Phaseolus vulgaris*

(2+2 +6 = 10)

3. Submission of practical copy and Viva-Voce. (5 + 10 = 15)

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M.Sc. Examination, 2022
Semester - IV
Biotechnology
Course XIX
(Classical Papers & Seminar)

Time: 10 am onwards

Full Marks: 40

Questions are of value as indicated in the margin

1. Deliver an online PowerPoint presentation on the final classical paper that was assigned to you. Defend your presentation giving appropriate answers to the questions raised by the examiners. [Presentation: 10 mins; Discussion & defence: 5 mins.] 20 + 10 = 30

2. Submit seminar presentation reports. 10

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M.Sc. Examination, 2022
Semester - IV
Biotechnology
Course XX
Project Works and Presentation (Elective)

Time: 10 am onwards

Full Marks: 80

Questions are of value as indicated in the margin

1. Deliver a PowerPoint presentation on the project works you have carried out. Defend your presentation by giving appropriate answers to the questions raised by the examiners. [Presentation 15 mins. Discussion & Defence 5 mins.] 25 + 15 = 40

2. Submit a report on the project work you have carried out. 40