BIOTECHNOLOGY
PAPER 1
(THEORY)

S5000076

Maximum Marks: 70
Time Allotted: Three Hours
Reading Time: Additional Fifteen minutes

Instructions to Candidates

1. You are allowed an **additional fifteen minutes** for **only** reading the question paper.
2. You must **NOT** start writing during reading time.
3. This question paper has **8 printed pages**.
4. There are **twelve** questions in the paper. All questions are compulsory.
5. There are **three** sections in the paper: **A, B** and **C**.
6. **Section A** has **ten subparts** which are very short answer questions. Each question carries 1 mark.
7. While answering **Multiple Choice Questions** in Section A, you are required to **write ONLY one option** as the correct answer.
8. **Section B** has **seven questions** which are short answer questions. Each question carries 4 marks.
9. **Section C** has **four questions** which are long answer questions. Each question carries 7 marks.
10. **Internal choices** have been provided in **two questions** in **Section B** and in **one question** in **Section C**.
11. The intended marks for questions are given in brackets [ ].

Instruction to Supervising Examiner

1. Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

SECTION A – 14 MARKS

Question 1

(i) While preparing a cDNA library, a hairpin loop is formed. Which enzyme is used to remove the hairpin loop to make the DNA a double stranded structure? [1]

(ii) During DNA replication, Okazaki fragments are joined together with the help of DNA ligase by forming phosphodiester bonds. One phosphodiester bond joins 2 Okazaki fragments. If the lagging strand has 188 Okazaki fragments, how many phosphodiester bonds will be formed by DNA ligase? [1]

(iii) With reference to the directionality of RNA and coding strand of DNA during transcription in a prokaryotic cell, which of the following is the correct pair? [1]

S.No.	RNA	Coding strand of DNA
I.	5' - 3'	5' - 3'
II.	5' - 5'	3' - 3'
III.	5' - 3'	3' - 5'
IV.	3' - 5'	5' - 3'

(a) II

(b) I

(c) III

(d) IV

(iv) Given below are *four* mRNA sequences carrying *ten* codes, that were translated to synthesise protein. [1]

Observe the sequences and arrange them in ascending order according to the number of amino acids present in the polypeptide chain.

(a) AUG ACC CAC GAU AUG UGA CAC GAC GAG UAA

(b) AUG ACC CAC GAC ACG AAC CCC UCA UAG AUC

(c) ACA CAC AUG GAC ACG AAC CCC UCA AUC UAG

(d) AUG CAC AUG GAU CAC GAC GAG GAU UUU UAG

(v) Give a reason for each of the following:

(a) Haploid plantlet is subjected to Colchicine in cell culture. [1]

(b) Post transcriptional process occurs only in eukaryotes and not in prokaryotes. [1]

(vi) Observe the following DNA sequence that was acted upon by an exonuclease to obtain overhangs, and answer the questions that follow.

5' – ACGATCAGCATCGATCTG - 3'

3' – TGCTAGTCGTAGCTAGAC - 5'

(a) What are *overhangs*? [1]

(b) How many overhangs can be obtained during the above process? [1]

(vii) ***Figure 1*** below shows a setup of gene analysis technique. Observe it carefully and answer the questions that follow.

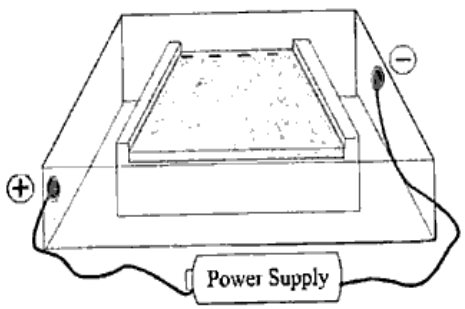

Figure 1

(a) Identify the technique shown in ***Figure 1***. [1]

(b) Write the working principle of this technique. [1]

(viii) Answer the following questions:

(a) Expand IBPGR. [1]

(b) What are the laboratory tools that assist in diagnosing diseases by identifying gene expression patterns, known as? [1]

(ix) Given below are two statements marked Assertion and Reason. Read the statements carefully and choose the correct option. [1]

Assertion: In plant tissue culture, somatic embryos can be induced from any plant cell.

Reason: Any usable plant cell can differentiate to form somatic embryo.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Both Assertion and Reason are false.

(x) Given below are two statements marked Assertion and Reason. Read the statements carefully and choose the correct option. [1]

Assertion: Microbes can be used to produce single cell protein.

Reason: Microbial biomass, on an average, contains 55% of protein and can be easily subjected to genetic manipulation.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Both Assertion and Reason are false.

SECTION B – 28 MARKS

Question 2

(i) ***Figure 2*** given below is the diagrammatic representation of a unit involved in Central Dogma. Observe the figure carefully and answer the questions that follow. [2]

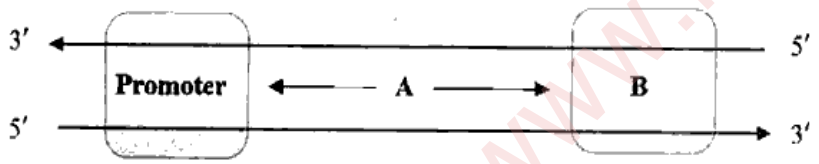

Figure 2

(a) Identify the parts labelled 'A' and 'B'.

(b) Mention the role of promoter and the part labelled 'B'.

(ii) High electric voltage pulses are used to introduce the desired DNA fragments into a suitable host cell such as *E. coli*. [2]

(a) Identify the technique referred to above. What is the role of electric current in this process?

(b) How was the technique referred to above used to produce Dolly sheep, the first animal clone?

Question 3 [4]

Answer the following questions.

(i) (a) Pests attack many crops and kill the plants. Incorporation of genes in plants helps develop resistance against pests and consequently yield pest resistant crops.

Enumerate the steps involved in the production of such pest resistant plants.

(b) In animal cell culture, the cells are disaggregated by using mechanical as well as chemical methods. Describe the chemical method to disaggregate the animal cells.

OR

(ii) (a) Some people suffer from high blood sugar level due to hyposecretion of a hormone. Earlier, they were treated by injecting this hormone. Since the hormone was derived from some animal sources, it caused allergies and other side effects. A pharmaceutical company Eily Lily developed a new and effective method to produce this hormone. Elaborate the steps involved in the production of this hormone.

(b) In certain plants, the embryo gets aborted at an early stage of development due to post-fertilisation barriers.

Describe the technique by which such barriers can be overcome.

Question 4 **[4]**

State *any two* differences between each of the following:

(i) Finite cell lines and Continuous cell lines

(ii) Dedifferentiation and Redifferentiation

Question 5 **[4]**

(i) Hershey and Chase performed an experiment to prove DNA as the genetic material. They radiolabelled two elements, one found in the capsid and other found in DNA of a bacteriophage.

(a) Which elements were radiolabelled by Hershey and Chase? Where are these elements found in bacteriophage?

(b) If protein would have been the genetic material, what observations would Hershey and Chase have made after centrifugation?

OR

(ii) A t-RNA plays an important role in translation as it brings the required amino acid to the site of protein synthesis. There are 20 amino acids and more than one t-RNA available in the cytoplasm for most of them.

(a) Explain how amino acid gets attached to the t-RNA.

(b) Why are more than one t-RNA available for most of the amino acids?

Question 6 **[4]**

(i) Imtiyaz is a biotechnologist, working to enhance the nutritional value of maize crops. He coated the desired gene over the surface of some metallic particles to successfully introduce the genes into the maize cells.

Explain the process used by Imtiyaz. Mention an advantage of the technique used by him.

(ii) Host cells can be made competent to accept foreign DNA directly by using certain chemicals and making subsequent variations in temperature.

(a) Mention the chemicals and the range of temperature variations used in the technique described above.

(b) Mention the other technique that uses only chemicals to transfer foreign DNA into the host cells.

Question 7 **[4]**

Nalini used the most suitable process to preserve the seeds of rare variety of rice at −196° C. She used certain chemicals to avoid any damage to the preserved seeds. Based on this information, answer the questions that follow.

(i) Which technique was used by Nalini?

(ii) How was the temperature brought to −196° C?

(iii) Mention the name of *any one* chemical which protects the cell from damage.

(iv) What other part(s) of this variety of rice can be preserved by using the above technique?

Question 8 **[4]**

A team of biotechnologists used the software tool BLAST to analyse genome of *Pisum* species. They isolated the DNA of this species and used restriction enzymes to obtain DNA fragments. The BLAST tool helped them to find out resemblance in DNA sequence with other related species. They found four different types of alignment sequences.

Discuss the *four* different types of alignment tools found by them.

SECTION C – 28 MARKS

Question 9

(i) What is *micropropagation*? Discuss the significance of micropropagation in plant tissue culture. **[4]**

(ii) What is *bioinformatics*? State *any two* uses of Bioinformatics. **[3]**

OR

(iii) The continuous culture uses either Chemostat system or Turbidostat system to obtain products like antibiotics. **[4]**

Mention *any four* differences between the Chemostat system and Turbidostat system.

(iv) Mention *any three* objectives of HGP. **[3]**

Question 10

(i) A bioreactor is used in microbial culture which provides ideal conditions for microbial growth. [4]

Mention *any four* parts of a bioreactor and state their uses.

(ii) Explain *switch on* and *switch off* processes of an inducible operon. [3]

Question 11

(i) ***Figure 3*** shows a nucleic acid involved in protein synthesis. Observe the figure carefully and answer the questions that follow. [4]

Figure 3

(a) Identify the nucleic acid shown in the ***Figure 3***.

(b) Why is the sequence of multiple A present at 3'- end?

(c) What are the roles of AUG and UGA in protein synthesis?

(d) What would happen to the nucleic acid at the 5' end if the cap is not present there?

(ii) ***Figure 4*** shows a technique used in biotechnology to find out the concentration of biomolecules. [3]

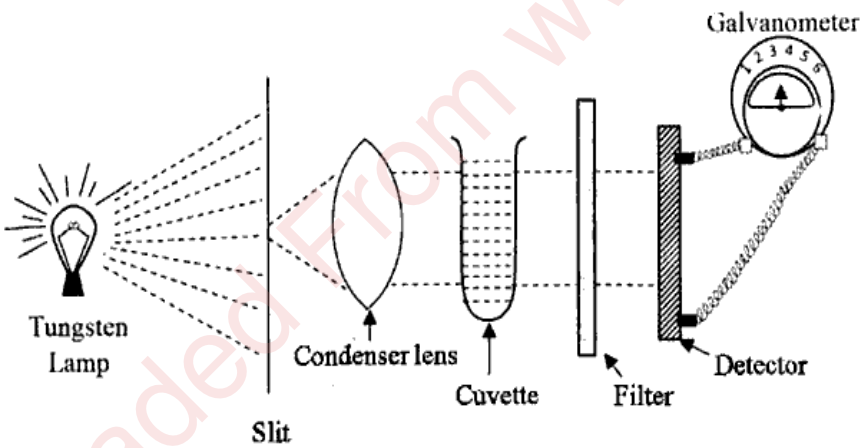

Figure 4

(a) Identify the technique shown in ***Figure 4***.

(b) State the principle of this technique.

(c) If the concentration of biomolecules is decreased in the cuvette, what change would be observed by the detector in the intensity of light?

Question 12

Steve is a research scholar who is working on a project to develop draught resistant plants. During his literature review, he learnt that a bacterium called *Agrobacterium tumefaciens* is used as a vector to create transgenic plants. *Agrobacterium tumefaciens* is a Gram-negative bacterium, also known as natural genetic engineer.

Steve used it as a vector to introduce the property of draught resistance in a wild variety of cotton and rice plants. He used certain techniques to identify and select the transformed cells for further development. He succeeded in transforming the cotton plant only.

(i) Why is *Agrobacterium tumefaciens* also known as a natural genetic engineer? **[1]**

(ii) Enumerate the steps involved in transformation of cotton plant. **[3]**

(iii) How did Steve identify and select the transformed cells? **[2]**

(iv) Why did he not succeed in transforming the rice plant? **[1]**