Biotechnology

3 Hours

+Total Marks: 100

1. Attempt all questions.
2. All questions carry equal marks.
3. Draw neat labelled diagrams wherever necessary.
4. Use of log tables and non-programmable calculators is allowed.

Q.1 a. Select the correct alternative: (Any Six) 06

1. To express a novel gene in a plant system, _____ is the genetic element that is NOT required in gene construct.
   A) Promote
   B) Gene of interest
   C) Marker gene
   D) pUC 18 DNA segment
2. _____plasmid of Agrobacterium tumefaciens is responsible for causing crown gall disease.
   A) To plasmid
   B) Tr plasmid
   C) Ti plasmid
   D) Ts plasmid
3. Name the specific part of the tumor-inducing plasmid inserted into the nuclear genome of the plant.
   A) Origin of replication
   B) T-DNA region
   C) Vir gene
   D) Opine catabolism region
4. Name the protein product responsible for creating a transient bridge or a cell membrane connection for T-DNA transfer.
   A) Vir E B) Vir B C) Vir H D) Vir C
5. Name the gas used for particle propulsion in biolistic transformation.
   A) Argon B) Neon C) Hydrogen D) Helium
6. Name the enzyme/s which are NOT used to isolate a protoplast from a plant cell.
   A) Pectinase B) Cellulase C) Hemicellulase D) Chitinase
7. Which part of lipids forms the wall of transient aqueous pores after electroporation?
   A) Hydrophobic tail B) Hydrophobic head
   C) Hydrophilic tail D) Hydrophilic head
8. Liposomes are
   A) Naturally present structure made up of lipids and protein
   B) Artificial structure made up of lipids used to deliver the DNA into cells
   C) Arrangement of multilamellar and unilamellar vacuoles
   D) Required electric impulse for DNA transformation

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9. From the following given options select the disadvantage of the electroporation method for plant transformation.
A) Irregular intensity pulses causing cell damage
B) Suitable for both monocots and dicots only
C) Specific transport
D) Needs an ideal buffer system

Q.1 b. Answer the following questions: (Any Two) **14**

1. Describe the mechanism of transfer of T-DNA in plant
2. With suitable examples explain the need for seed quality protein improvement. How it can be achieved using transgenic technology?
3. Illustrate the use of a 'cointegrate vector system' using diagrammatic representation.

Q.2 a. Select the correct alternative: (Any Six) **06**

1. In transgenic fish, AFP genes from the ocean pout codes for_____protein.
a) molten protein
b) freeze protein
c) antifreeze protein
d) crystal protein
2. The transgene which is microinjected in the fertilized egg of mice is often in a linear form and free of_____vector DNA.
a) prokaryotic
b) eukaryotic
c) intermediate
d) repeated
3. _____is scorable reporter genes.
a) TK genes b) DHFR gene
c) CAD gene. d) Luciferase gene
4. In the lentiviral transfer vector, WPRE _____the transduction of host cells.
a) enhance b) lower c) drop-down d) slow
5. Retroviruses have ____ genomes that are used as templates for reverse transcriptase to synthesize a DNA copy.
a) DNA
b) RNA
c) dsDNA
d) cDNA

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6. After treatment with G418 and ganciclovir, only cells that have undergone homologous recombination with specific integration will _____.
   a) killed
   b) survive
   c) not survive
   d) not live
7. In the bacteriophage P1 genome, A lox P site consists of two 13-base-pair _____ that are separated from each other by an 8-bp spacer sequence.
   a) side repeats
   b) inverted repeats
   c) simple repeats
   d) central repeats
8. Transgenic _____fish is used as biosensors of environmental pollutants.
   a) Medaka
   b) Scoliodon
   c) Rohu
   d) Salmon
9. _____ is the last phase in the process of fusing two haploid eukaryotic cells together.
   a) Karyogamy
   b) Plasmogamy
   c) Xenogamy
   d) Cytogamy

Q.2 b. Give an account on the following questions: (Any Two) **14**

1. Explain the cloning of livestock by nuclear transfer method.
2. Discuss the embryonic stem cell methodology for the production of transgenic mice.
3. Discuss any one vector used for animal cells.

Q.3 a. Select the correct alternative: (Any Six) **06**

1. A cloning vector containing regulatory sequences is called
   a. shuttle vector
   b. expression vector
   c. cosmid
   d. M13 phage
2. When M 13 infects the host cell, the host cell
   a. is lysed
   b. continues growth at the same rate
   c. growth is arrested after a few generations
   d. growth is slowed down and viral particles are released

3. The enzyme that can convert staggered ends to blunt ends
   a. DNA pol I
   b. S1 nclease
   c. both
   d. neither

4. The transgene in pET vector is introduced in the
   a. Host genome
   b. pET vector
   c. Helper plasmid
   d. Any of them

5. To check the presence of gene product of an expression vector, we can perform
   a. Western blotting
   b. Northern blotting
   c. Southern blotting
   d. Eastern blotting

6. Problem of repetitive DNA being a part of the probe and creating a problem while identifying the overlapping fragment can be overcome in
   a. Chromosome walking
   b. Chromosome jumping
   c. Both
   d. Neither

7. Synthetic oligonucleotide probes are called
   a. heterologous probes
   b. guessmers
   c. DNA probes
   d. homologous probes

8. In Southern blotting, the specificity of the test lies in selection of
   a. source DNA
   b. radioisotope
   c. appropriate probe
   d. all three

9. Introducing the transgene in the MCS of the SUP 4 gene results in
   a. alpha complementation
   b. beta complementation
   c. suppressor mutation
   d. insertional inactivation

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Q.3 b. Discuss the following: (Any Two) **14**

1. Southern Blotting with a diagram.
2. Describe a method to prepare a cDNA library.
3. pUC as a cloning vector.

Q.4 a. Select the correct alternative: (Any Six) **06**

1. Why are ddNTPs used in DNA sequencing?
   A. because ddNTPs are fluorescent
   B. because ddNTPs are efficiently incorporated into DNA
   C. because ddNTPs cannot be incorporated into DNA-by-DNA polymerases
   D. because ddNTPs prevent further DNA synthesis once incorporated into the DNA
2. What is the fundamental principle underlying Sanger's method for DNA sequencing?
   A. Using chemicals for base-specific cleavage
   B. Using dNTPs for chain termination
   C. Using ddNTPs for chain termination
   D. Using 32P for chain termination
3. In RNAi-mediated gene silencing, what complex forms when siRNA binds to the target gene?
   A. RNA Associated Silencing Complex
   B. RNA Mediated Silencing Complex
   C. RNA Induced Silencing Complex
   D. RNA-DNA Silencing Complex
4. What is the term for synthetic short strands of double-stranded DNA with one blunt end and one staggered end?
   A. linkers
   B. tails
   C. adaptors
   D. probes
5. What is Cas9?
   A. Nuclease
   B. Polymerase
   C. Primer
   D. Probe
6. What is the term for the manipulation of a gene using engineered nucleases composed of sequence-specific DNA-binding domains fused to a Restriction endonuclease?
   A. DNA Sequencing
   B. RNAi
   C. Gene editing
   D. Gene shifting

7. What enzyme creates double-strand breaks at the target site for genome editing?
   A. ZFNs
   B. TALENs
   C. CRISPR Cas9
   D. all three
8. In the context of CRISPR, where are the repeated sequences located?
   A. Bacterial DNA
   B. Viral DNA
   C. Fungal DNA
   D. Plasmid DNA
9. In which DNA sequencing method does premature chain termination not occur?
   A. Automated sequencing
   B. Sanger's sequencing method
   C. Maxam-Gilbert method
   D. None of these

Q.4 b. Give an account of the following questions: (Any Two) **14**

1. What are the principles and applications of pyrosequencing in DNA sequencing?
2. How do microRNAs (miRNAs) participate in regulating gene expression in eukaryotes?
3. What is TALEN, and how is it used in the context of gene editing?

Q.5 Write Short notes on the following: (Any Four) **20**

a. Vir gene

b. Applications of transgenic mice

c. Non-radioactive labelling of DNA.

d. Shuttle vector.

e. Human genome mapping: Significance in health

f. Role of ZNF in genome editing?
