

Roll No.

Question Booklet Number

O. M. R. Serial No.

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M. Sc. (Microbiology) (Second Semester)

EXAMINATION, July, 2022

RECOMBINANT DNA TECHNOLOGY

Paper Code

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Questions Booklet
Series

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Time : 1:30 Hours]

[Maximum Marks : 100

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 60 questions. Examinee is required to answer any 50 questions in the OMR Answer-Sheet provided and not in the question booklet. If more than 50 questions are attempted by student, then the first attempted 50 questions will be considered for evaluation. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 60 प्रश्न हैं। परीक्षार्थी को किन्हीं 50 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। यदि छात्र द्वारा 50 से अधिक प्रश्नों को हल किया जाता है तो प्रारम्भिक हल किये हुए 50 उत्तरों को ही मूल्यांकन हेतु सम्मिलित किया जाएगा। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. In bacteria, the restriction endonucleases provide defense against foreign DNA, such as that borne by bacteriophages. But how bacteria are able to protect their own DNA ?
 - (A) By phosphorylation of bacterial DNA by restriction enzyme
 - (B) By methylation of foreign DNA by restriction enzyme
 - (C) By phosphorylation of foreign DNA by restriction enzyme
 - (D) By methylation of bacterial DNA by restriction enzyme

2. Which of the following is true regarding restriction enzymes ?
 - (A) Restriction enzymes are used to cut DNA molecule
 - (B) Restriction enzymes are used to construct restriction map
 - (C) Restriction enzymes are used in RFLP
 - (D) All of the above

3. DNA X and DNA Y were digested with restriction enzyme *HindIII* and analyzed by agarose gel electrophoresis. If DNA X gave three fragments and DNA Y gave four fragments, then which of the following are correct ?
 - P. DNA X has two restriction recognition sites and is circular.
 - Q. DNA Y has four restriction recognition sites and is circular.
 - R. DNA X has two restriction recognition sites and is linear.
 - S. DNA Y has two restriction recognition sites and is linear.
 - (A) Q and R
 - (B) P and S
 - (C) P and Q
 - (D) R and S

4. Three restriction endonucleases *HaeIII*, *KpnI*, and *NotI* recognize recognition site of 4bp, 6bp, and 8bp sequences, respectively. The relative frequency of occurrence of these recognition sites on a bacterial genome will be
 - (A) *HaeIII* > *KpnI* > *NotI*
 - (B) *HaeIII* > *NotI* > *KpnI*
 - (C) *NotI* > *KpnI* > *HaeIII*
 - (D) *KpnI* > *NotI* > *HaeIII*

5. Single stranded unpaired extension formed by restriction enzyme upon digestion is known as :
 - (A) Blunt ends
 - (B) Sticky ends
 - (C) Flush ends
 - (D) None of the above

6. Pairs of restriction enzymes that have slightly different recognition sequences, but upon cleavage of DNA, generate identical overhanging termini sequences, are called :
- Isoschizomers
 - Neoschizomers
 - Isocaudomers
 - None of the above
7. The T4 DNA ligase and *Escherichia coli* DNA ligase require cofactors, respectively.
- ATP and GTP
 - ATP and NAD^+
 - NAD^+ and FAD^+
 - GTP and FAD^+
8. Which is the enzyme used to remove phosphate group from the 5' end of the DNA ?
- Polynucleotide Kinase
 - Terminal Deoxynucleotidyl Transferase
 - Alkaline Phosphatase
 - Restriction Endonuclease
9. Which of the following statements is correct with respect to the function of exonucleases ?
- Exonucleases only act on single stranded DNA molecules
 - Exonucleases only act on double stranded DNA molecules
 - Exonucleases remove a single nucleotide base at a time from the end of a polynucleotide chain
 - Exonucleases remove nucleotide bases from the middle of a polynucleotide chain
10. Which of the following statements is incorrect with respect to the Linker DNA ?
- The linkers are short double stranded DNA segments which are formed of oligonucleotides
 - Linker DNA contains recognition sites for the action of one or more restriction enzymes
 - Linker DNA can be ligated to the blunt end of foreign DNA
 - Linker DNA has cohesive ends
11. The extra chromosomal, naturally occurring, self-replicating, double stranded circular DNA molecules are called :
- PPLO
 - Plasmids
 - MLO
 - Phages

12. Which of the following statements is incorrect ?
 - (A) A library encompassing an entire genome is called a genomic library.
 - (B) Genomic library contains both coding and non-coding DNA
 - (C) A cDNA library is made using mRNA instead of DNA as the starting material.
 - (D) A cDNA library contains both coding and non-coding DNA
13. Which of the following parts of vector helps in identifying transformed cells ?
 - (A) Multiple cloning sites
 - (B) Selectable marker
 - (C) Origin of replication
 - (D) All of the above
14. What does pBR stand for, in the pBR322 cloning vector ?
 - (A) Plasmid Boliver and Rodriguez
 - (B) Plasmid Baltimore and Rodriguez
 - (C) Plasmid bacterial recombination
 - (D) Plasmid bacterial replication
15. Plasmid incompatibility is :
 - (A) Inhibition of growth of the bacterial host cell by the plasmids
 - (B) Ability of two different plasmids to coexist in the same cell in the absence of selection pressure
 - (C) Inability of two different plasmids to coexist in the same cell in the absence of selection pressure
 - (D) None of the above
16. Which antibiotic resistance is present in pUC vectors ?
 - (A) Ampicillin
 - (B) Kanamycin
 - (C) Tetracycline
 - (D) Both ampicillin and tetracycline
17. Which of the statement is incorrect with respect to Alpha (α -) complementation ?
 - (A) One part of the *lacZ* gene (*lacZ'*) is present in the cloning vector
 - (B) Another part is present in the host itself
 - (C) The cloning vector is moved to host cell and transformants are selected on growth medium in the presence of IPTG, X-gal and antibiotic, blue colonies are observed
 - (D) The cloning vector containing insert, is moved to host cell and transformants are selected on growth medium in the presence of IPTG, X-gal and antibiotic, blue colonies are observed

18. The correct order of the three steps involved in PCR is :
- Annealing, extension, and denaturation
 - Extension, denaturation, and annealing
 - Denaturation, annealing, and extension
 - Denaturation, extension, and annealing
19. A cloning vector has two antibiotic resistance genes - for ampicillin and tetracycline. A foreign DNA is inserted into the tetracycline gene. Non-recombinants will survive on the growth medium containing :
- Ampicillin only
 - Tetracycline only
 - Both ampicillin and tetracycline
 - Neither ampicillin nor tetracycline
20. The process of introducing DNA molecules into the recipient host organism is known as :
- Translation
 - Transformation
 - Transduction
 - Transcription
21. Circularization of the injected linear phage DNA molecule to bacterial cell is facilitated by which of the following ?
- Polyhedral head
 - cos* sites
 - Phage tail
 - Capsid proteins
22. In the Lambda-replacement vector, what is the name of the fragment that is replaced for the cloning of the insert of interest ?
- Insertion fragment
 - Substitution fragment
 - Stuffer fragment
 - Displacement fragment
23. Find the range of size (Minimum-Maximum) of DNA that can be packaged into a λ phage is :
- 10 Kb-45 Kb
 - 38 Kb-52 Kb
 - 70 Kb-100 Kb
 - 29 Kb-49 Kb
24. Single stranded vectors are useful :
- For sequencing of cloned DNA
 - For oligonucleotide directed mutagenesis
 - For probe preparation
 - All of the above

25. You are given a Lambda replacement vector of 43 Kb. It contains a central stuffer fragment of 14 Kb. Find the maximum size of the DNA fragment that can be cloned in the given vector.
- (A) 14 Kb
(B) 43 Kb
(C) 23 Kb
(D) 29 Kb
26. Identify the correct order for the following cloning vectors in terms of cloning capacity :
- (A) Plasmid > Lambda Phage > Cosmid > BAC > YAC
(B) BAC > YAC > Plasmid > Lambda Phage > Cosmid
(C) YAC > BAC > Cosmid > Lambda Phage > Plasmid
(D) BAC > YAC > Lambda Phage > Plasmid > Cosmid
27. The 2-micron circle found in the yeast is a :
- (A) Phage
(B) Plasmid
(C) Gene product
(D) Centromere of YAC (Yeast Artificial Chromosome)
28. What is the function of the TRP1 gene located on the yeast replicating plasmid, YRp7 ?
- (A) Termination
(B) Tetracycline biosynthesis
(C) Tryptophan biosynthesis
(D) Tyrosine biosynthesis
29. Which of the following statements is incorrect with respect to yeast vectors ?
- (A) Yeast replicating plasmid (YRp) contain an autonomous replicating sequence (ARS)
(B) Yeast centromere plasmid (YCp) contain both an ARS and a yeast centromere
(C) Yeast episomal plasmids (YEPs) are shuttle vectors
(D) Yeast integrative plasmid (YIp) can replicate as a plasmid.
30. Cloning vectors that are used for recombinant protein production are called :
- (A) Advanced vectors
(B) Hybrid vectors
(C) Expression vectors
(D) All of the above

31. Which of the following statements is incorrect with respect to Lambda P_L (λP_L) promoter ?
- (A) $2 P_L$ promoter is a very strong promoter
 - (B) In the absence of cI repressor, there is a high level of expression from λP_L promoter.
 - (C) λP_L promoter is a very weak promoter.
 - (D) λP_L promoter is used in the expression vector.
32. Identify the problems of using prokaryotic host like *E. coli* for production of recombinant eukaryotic proteins using expression vector ?
- (A) Codon usage is different from eukaryotes
 - (B) Formation of insoluble aggregates called inclusion bodies due to incorrect folding
 - (C) Eukaryotic co-or posttranslational modifications not possible
 - (D) All of the above
33. The Ti (tumor inducing) plasmid is found in :
- (A) *Agrobacterium*
 - (B) Yeast as a 2-micron plasmid
 - (C) *Rhizobium*
 - (D) *Azotobacter*
34. The direct repeats flanking the T-DNA of *Agrobacterium tumefaciens* are known as :
- (A) Flanking sequences
 - (B) Border sequences
 - (C) Transfer sequences
 - (D) Inverted sequences
35. Identify the genes that encode for a two-component signal system that drive the expression of other *vir* genes of Ti plasmid via sensing plant-derived signals such as plant phenolics and monosaccharides :
- (A) *virD* and *virE*
 - (B) *vfrCI* and *vfrC2*
 - (C) *virA* and *virG*
 - (D) *virB* and *virD*

36. Which of the following statements is incorrect with respect to T-DNA binary vector system ?
- (A) The *vir* genes and the disarmed T-DNA containing the transgene are located on separate plasmids.
 - (B) The *vir* functions are supplied *in trans*, causing transfer of the recombinant T-DNA to the plant genome.
 - (C) Mini-Ti plasmid and helper Ti plasmid forms T-DNA binary vector system.
 - (D) Gene of interest (transgene) is cloned in the helper Ti plasmid
37. Identify the DNA virus that have been developed as vector for the gene transfer to the plant cell :
- (A) Tobacco mosaic virus
 - (B) Cauliflower mosaic virus
 - (C) Brome mosaic virus
 - (D) Potato virus X
38. Gene transfer across the protoplast membrane is promoted by :
- (A) Phenol
 - (B) Benzoic acid
 - (C) Polyethylene glycol
 - (D) Naphthalene
39. The first human protein produced through recombinant DNA technology is :
- (A) Insulin
 - (B) Interferon
 - (C) Somatostatin
 - (D) Erythropoietin
40. Some of the steps involved in gene cloning and expression are given below :
- (i) Insertion of isolated gene to the vector
 - (ii) Introduction of recombinant vector to the host
 - (iii) Isolation of desired gene
 - (iv) Expression of recombinant gene in the host
 - (v) Extraction of recombinant gene product (recombinant protein)
- The correct sequence of steps involved is
- (A) (iii), (i), (iv), (ii), (v)
 - (B) (ii), (i), (iii), (iv), (v)
 - (C) (iii), (i), (ii), (iv), (v)
 - (D) (i), (ii), (iii), (iv), (v)
41. A transgenic plant “Golden Rice” contains foreign genes that produce :
- (A) Niacin
 - (B) Biotin
 - (C) Beta-carotene (β -carotene)
 - (D) Yellow fluorescent protein

42. The gene which was used to produce insect resistant transgenic cotton plant was taken from :
- Bacillus clausii*
 - Agrobacterium tumefaciens*
 - Bacillus subtilis*
 - Bacillus thuringiensis*
43. Generation of recombinant DNA involves :
- Cleaving and rejoining DNA segments with ligase alone
 - Cleaving DNA segments with ligase and rejoining them with restriction endonuclease
 - Cleaving and rejoining DNA segments with restriction endonuclease alone
 - Cleaving DNA segments with restriction endonuclease and rejoining them with ligase
44. Which problem does SV40 as a cloning vector face which is similar to that faced by lambda and caulimovirus ?
- Narrow host range
 - Packaging constraint
 - Digestion limitation
 - Post translational modifications
45. Embryonic stem cells are :
- Totipotent stem cells
 - Pluripotent stem cells
 - Multipotent stem cells
 - Omnipotent stem cells
46. Which of the following statements is correct concerning methods of production of transgenic mice ?
- Retrovirus-mediated gene transfer method is used to create transgenic mice
 - Pronuclear Microinjection is used to create transgenic mice
 - Embryonic stem cell-mediated gene transfer is used to create transgenic mice
 - All of the above
47. Identify the name of first ever transgenic primate :
- Rosie
 - ANDi
 - Tracy
 - ANRi
48. Dolly is the name of the :
- First cloned sheep
 - First cloned monkey
 - First test-tube baby
 - First human fossil

49. Northern blotting is performed for :
- (A) Determining the size of DNA
 - (B) Sequencing of DNA
 - (C) Quantification of RNA
 - (D) Sequencing of RNA
50. The inheritance pattern of RAPD markers is :
- (A) Dominant
 - (B) Recessive
 - (C) Co-dominant
 - (D) Random
51. Western blotting is the technique for the detection of :
- (A) Specific protein in the sample
 - (B) Specific DNA in the sample
 - (C) Specific RNA in the sample
 - (D) Specific glycolipid in the sample
52. The dideoxy method is also known as :
- (A) Maxam and Gilbert method
 - (B) Sanger sequencing
 - (C) Pyrosequencing
 - (D) Autosequencing
53. Nick translation is done by :
- (A) Kinase
 - (B) DNA polymerase III
 - (C) DNA ligase
 - (D) DNA polymerase I
54. The Southern blotting technique depends on :
- (A) Similarities between the sequences of probe DNA and experimental DNA
 - (B) Similarities between the sequences of probe RNA and experimental RNA
 - (C) Similarities between the sequences of probe protein and experimental protein
 - (D) The molecular mass of proteins
55. What is a shuttle vector ?
- (A) A vector having multiple selectable markers
 - (B) A vector that can be propagated between two different organisms
 - (C) A vector having multiple cloning sites
 - (D) A vector that can be transformed by multiple ways
56. Identify the label used for the generation of non-radioactive hybridization probes :
- (A) Fluorescein
 - (B) Biotin
 - (C) Digoxigenin
 - (D) All of the above

57. Nucleic acids are readily labeled with tags that facilitate detection or purification. Which of the following components are required for the 3'-end labeling of DNA with radioactive phosphorous ?
- (A) Terminal deoxynucleotidyl transferase and (gamma) γ - ^{32}P dNTP
 - (B) Polynucleotide kinase and (gamma) γ - ^{32}P dNTP
 - (C) Terminal deoxynucleotidyl transferase and (alpha) α - ^{32}P dNTP
 - (D) Polynucleotide kinase and (alpha) α - ^{32}P dNTP
58. A dye called "SYBR Green" is used in :
- (A) Nested PCR
 - (B) Inverse PCR
 - (C) Anchored PCR
 - (D) Real-Time PCR
59. Expression vectors have been engineered so that the protein being expressed is fused to another protein, called a *tag*, which can be used to facilitate protein purification. Which of the following statements is correct with respect to protein *tag* ?
- (A) Recombinant proteins that have Glutathione S-transferase (GST) tags are purified using amylose columns.
 - (B) MBP (Maltose binding protein)-tagged fusion proteins are purified via immobilized metal ion affinity chromatography.
 - (C) His-tagged fusion proteins can easily be purified by Ni-NTA affinity resin.
 - (D) Glutathione sepharose resins are often used for purification of MBP (Maltose binding protein) -tagged fusion proteins.
60. Arrange the various steps of DNA fingerprinting technique in the correct order :
- (i) Separation of DNA fragments by electrophoresis
 - (ii) Digestion of DNA by restriction endonucleases
 - (iii) Hybridization using labeled probe
 - (iv) Isolation of DNA
 - (v) Detection of hybridized DNA fragments by autoradiography
 - (vi) Transferring the separated DNA fragments to nitrocellulose membrane
- (A) (i) \rightarrow (ii) \rightarrow (iii) \rightarrow (iv) \rightarrow (v) \rightarrow (vi)
 - (B) (iv) \rightarrow (ii) \rightarrow (i) \rightarrow (vi) \rightarrow (iii) \rightarrow (v)
 - (C) (iii) \rightarrow (v) \rightarrow (iv) \rightarrow (ii) \rightarrow (i) \rightarrow (vi)
 - (D) (iv) \rightarrow (i) \rightarrow (ii) \rightarrow (vi) \rightarrow (iii) \rightarrow (v)

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the most correct/appropriate answer and mark the same in the OMR Answer-Sheet as per the direction :

Example :

Question :

Q. 1 (A) ☒ (B) (C) (D)

Q. 2 (A) (B) ☒ (C) (D)

Q. 3 (A) ☒ (B) (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. : On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से एक सबसे सही अथवा सबसे उपयुक्त उत्तर छोटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 (A) ☒ (B) (C) (D)

प्रश्न 2 (A) (B) ☒ (C) (D)

प्रश्न 3 (A) ☒ (B) (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।