Roll. No. .....

O.M.R. Serial No. | | | | | | | | |

Question Booklet Number

M.Sc. (SEM.-IV) (NEP) (SUPPLE.)EXAMINATION, 2024-25

BOTANY

(Advanced Genetics, Molecular Biology)

Paper Code							
B	0	4	1	0	0	1	T

Question Booklet Series

A

Time : 1 : 30 Hours **Max. Marks : 75**

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. 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.
4. Four alternative answers are mentioned for each question as - A, B, C & D in the booklet. The candidate has to choose the correct / answer and mark the same in the OMR Answer-Sheet as per the direction :

(Remaining instructions on last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। 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, उसे तुरन्त बदल लें।
4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर- A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR उत्तर-पत्रक में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

(शेष निर्देश अन्तिम पृष्ठ पर)

1. Which of the following correctly represents the hierarchical organization of genetic material from smallest to largest?

(A) Nucleotide → Chromosome → DNA → Histone → Chromatin

(B) Nucleotide → DNA → Nucleosome → Chromatin → Chromosome

(C) DNA → Nucleotide → Nucleosome → Chromatin → Chromosome

(D) Nucleotide → Nucleosome → DNA → Chromatin → Chromosome

2. In eukaryotic chromatin, DNA is wrapped around which protein core to form a nucleosome?

(A) Actin

(B) Tubulin

(C) Histone

(D) Keratin

3. How many base pairs of DNA are wrapped around a histone octamer in a nucleosome core particle?

(A) 100 bp

(B) 146 bp

(C) 200 bp

(D) 300 bp

4. The histone octamer of a nucleosome is composed of:

(A) H1, H2A, H2B, H3, H4

(B) H2A, H2B, H3, H4 (two copies each)

(C) H1, H2A, H2B, H3 (two copies each)

(D) H1, H3, H4, H2B

5. Which level of DNA packaging is described as "beads on a string"?

(A) Nucleosome

(B) Solenoid

(C) 30 nm fibre

(D) Chromatid

6. The 30 nm chromatin fiber is primarily stabilized by:

(A) DNA methylation

(B) Histone H1

(C) RNA polymerase

(D) Topoisomerase

7. Euchromatin is characterized by:

(A) Highly condensed and transcriptionally inactive

(B) Less condensed and transcriptionally active

(C) Completely uncoiled and inactive

(D) Found only in prokaryotes

8. Which modification is generally associated with gene activation?

(A) DNA methylation

(B) Histone acetylation

(C) Histone deacetylation

(D) Chromatin condensation

9. In Plant, chloroplast DNA is organized as:

(A) Linear double-stranded DNA

(B) Circular double-stranded DNA

(C) Circular single-stranded DNA

(D) Linear single-stranded DNA

10. The complete set of DNA in a cell, including nuclear and extranuclear DNA, is called:

(A) Chromatin

(B) Genome

(C) Transcriptome

(D) Proteome

11. The chemical bond linking nucleotides in a DNA strand is:

(A) Hydrogen bond

(B) Glycosidic bond

(C) Phosphodiester bond

(D) Peptide bond

12. Which of the following is NOT part of a nucleosome core particle?

(A) H2A

(B) H3

(C) H1

(D) H4

13. Which structural form of DNA is the most common under physiological conditions in cells?

(A) A-DNA

(B) B-DNA

(C) Z-DNA

(D) C-DNA

14. Which enzyme relieves torsional strain during DNA packaging?

(A) DNA polymerase

(B) DNA ligase

(C) Topoisomerase

(D) Helicase

15. DNA supercoiling is essential because it:

(A) Increases mutation rate

(B) Helps compact DNA into the cell

(C) Stops transcription completely

(D) Prevents replication

16. Which of the following best defines epigenetics?
    (A) Study of DNA sequence changes over time
    (B) Study of heritable changes in gene expression without change in DNA sequence
    (C) Study of mutations caused by environmental factors
    (D) Study of genetic recombination events

17. DNA methylation usually occurs at which nucleotide sequence in mammals?
    (A) CpG dinucleotides
    (B) AT-rich sequences
    (C) Non-coding RNAs
    (D) Telomeric repeats

18. Epigenetics plays a crucial role in:
    (A) Cell differentiation
    (B) Genomic imprinting
    (C) X-chromosome inactivation
    (D) All of the above

19. In the scope of epigenetics, "epigenome" refers to:
    (A) Total DNA sequence of an organism
    (B) Complete set of epigenetic modifications in a cell
    (C) All expressed mRNAs in a cell
    (D) Set of chromosomal rearrangements

20. Which enzyme catalyzes DNA methylation?
    (A) DNA polymerase
    (B) DNA methyltransferase (DNMT)
    (C) RNA polymerase II
    (D) Histone acetyltransferase (HAT)

21. Environmental factors can influence epigenetic changes. Which is NOT an example?
    (A) Diet
    (B) Stress
    (C) Temperature
    (D) Point mutations

22. Chromatin remodeling refers to:
    (A) Permanent changes in DNA sequence
    (B) ATP-dependent alteration of chromatin structure to regulate DNA accessibility
    (C) Histone mutation events
    (D) Only methylation of DNA

23. The primary purpose of chromatin remodelling is to:
    (A) Facilitate transcription, replication, and DNA repair
    (B) Change the genetic code
    (C) Create permanent mutations
    (D) Destroy histone proteins

24. The energy for chromatin remodelling is derived from:
    (A) ATP hydrolysis
    (B) GTP hydrolysis
    (C) Proton gradients
    (D) Oxidative phosphorylation directly

25. A key difference between histone modification and chromatin remodelling is that :
    (A) Histone modification changes DNA sequence; chromatin remodelling does not
    (B) Chromatin remodelling moves or ejects nucleosomes, histone modification alters histone tails chemically
    (C) Both are permanent changes in genome structure
    (D) Histone modification requires ATP, remodelling does not

26. Histone modifications primarily occur on:
    (A) Histone N-terminal tails
    (B) DNA backbone
    (C) Ribosomal proteins
    (D) tRNA molecules

27. Which is NOT a common type of histone modification?
    (A) Acetylation
    (B) Methylation
    (C) Phosphorylation
    (D) Replication

28. Which enzyme catalyzes the addition of acetyl groups to histone lysine residues?
    (A) Histone methyltransferase (HMT)
    (B) Histone acetyltransferase (HAT)
    (C) Histone deacetylase (HDAC)
    (D) DNA methyltransferase (DNMT)

29. Removal of acetyl groups from histones is carried out by:
    (A) Histone acetyltransferases
    (B) Histone deacetylases (HDACs)
    (C) Histone kinases
    (D) Ubiquitin ligases

30. Which amino acid residues are most commonly methylated in histones?
    (A) Lysine and arginine
    (B) Serine and threonine
    (C) Proline and alanine
    (D) Cysteine and methionine

31. Which technique is most commonly used to Study DNA.protein interactions in vitro?
    (A) ChIP-seq
    (B) EMSA (Electrophoretic Mobility Shift Assay)
    (C) DNase footprinting
    (D) Western blot

32. In EMSA (Electrophoretic Mobility Shift Assay), the mobility of DNA in a gel is:

(A) Increased when bound to protein

(B) Decreased when bound to protein

(C) Unchanged regardless of protein binding

(D) Completely blocked by protein binding

33. Which method is used to identify the exact binding site of a transcription factor on DNA?

(A) Northern blotting

(B) DNase I footprinting

(C) EMSA

(D) Western blotting

34. ChIP (Chromatin Immunoprecipitation) is used to study:

(A) DNA replication origins

(B) Protein.DNA interactions in vivo

(C) RNA stability

(D) Protein.protein interactions

35. In DNase I footprinting, the principle is based on:

(A) Enzyme modifying DNA bases

(B) Protection of DNA region bound by protein from nuclease cleavage

(C) Incorporation of labeled nucleotides

(D) Separation of proteins by SDS-PAGE

36. Which method allows detection of chromatin accessibility across the genome?

(A) DNase-seq

(B) ChIP-seq

(C) EMSA

(D) Western blot

37. Which among the following is not a method for DNA.protein interaction study?

(A) EMSA

(B) DNase footprinting

(C) ChIP

(D) Southern blotting

38. In ChIP experiment, the protein.DNA complexes are first:

(A) Digested with RNase

(B) Cross-linked using formaldehyde

(C) Amplified by PCR

(D) Separated by SDS-PAGE

39. In DNase I footprinting, the "footprint" appears as:

(A) Enhanced cleavage at protein-binding site

(B) No bands at protein-binding site

(C) Stronger fluorescence at binding site

(D) Shift in DNA mobility

40. Which of the following is a limitation of EMSA?

(A) Cannot determine binding site sequence

(B) Cannot detect DNA.protein interaction

(C) Requires sequencing

(D) Only works in vivo

41. Which of the following is a limitation of DNase I footprinting?

(A) Cannot be used with purified proteins

(B) Cannot identify precise DNA binding sites

(C) Requires prior knowledge of binding sequence

(D) Cannot be used with short oligonucleotides

42. The main principle of ChIP-seq is:

(A) Separation of RNA by size

(B) Sequencing cDNA

(C) Immunoprecipitation of protein-bound DNA, followed by sequencing

(D) Measuring RNA degradation rates

43. In EMSA, what is the typical label used to visualize DNA fragments?

(A) Fluorescent or radioactive tags

(B) Antibody probes

(C) Ribosomal RNA

(D) GFP reporter

44. Which method relies on enzymatic digestion patterns to determine protein binding regions?

(A) EMSA

(B) DNase I footprinting

(C) ChIP-seq

(D) Northern blot

45. Southern blotting is primarily used for:

(A) RNA detection

(B) Protein detection

(C) DNA detection

(D) Carbohydrate detection

46. The inventor of the Southern blotting technique is:

(A) Frederick Sanger

(B) Edwin Southern

(C) Maxam and Gilbert

(D) Kary Mullis

47. In Southern blotting, the DNA is first:

(A) Transcribed into RNA

(B) Separated by SDS-PAGE

(C) Digested with restriction enzymes and electrophoresed

(D) Sequenced directly

48. Sanger fs di-deoxy sequencing method depends on:

(A) Incorporation of fluorescent dyes

(B) Chain termination by dideoxynucleotides (ddNTPs)

(C) RNA sequencing

(D) Radioactive protein labeling

49. Which of the following is NOT required in Sanger sequencing?

(A) DNA polymerase

(B) Template DNA

(C) Restriction enzymes

(D) dNTPs + ddNTPs

50. In pyrosequencing, the DNA synthesis is monitored by:

(A) Incorporation of radioactive isotopes

(B) Detection of pyrophosphate release converted into light

(C) Gel electrophoresis

(D) Southern blot

51. Which enzyme is essential in pyrosequencing to produce light?

(A) Luciferase

(B) Restriction endonuclease

(C) RNA polymerase

(D) Reverse transcriptase

52. Nanopore sequencing works on the principle of:

(A) Chain termination

(B) Sequencing by synthesis

(C) Detection of changes in ionic current as DNA passes through a nanopore

(D) Hybridization with fluorescent probes

53. Which DNA sequencing method allows real-time long read sequencing?

(A) Sanger sequencing

(B) Pyrosequencing

(C) Nanopore sequencing

(D) Maxam.Gilbert sequencing

54. Which of the following is an advantage of nanopore sequencing over Sanger sequencing?
(A) Lower accuracy
(B) Long read lengths in real time
(C) Requires gel electrophoresis
(D) Only detects RNA

55. Pyrosequencing detects:
(A) Chain termination fragments
(B) DNA fragments hybridized with probes
(C) Release of inorganic pyrophosphate (PPi)
(D) Restriction enzyme digestion

56. Which of the following blots is used for RNA analysis?
(A) Southern blot
(B) Northern blot
(C) Western blot
(D) Eastern blot

57. Which sequencing method is also known as the chain termination method?
(A) Maxam.Gilbert sequencing
(B) Nanopore sequencing
(C) Sanger sequencing
(D) Pyrosequencing

58. The Southern blotting method combines:
(A) DNA hybridization + electrophoresis
(B) RNA sequencing + PCR
(C) Protein electrophoresis + antibody detection
(D) Chain termination sequencing

59. In pyrosequencing, ATP sulfurylase converts PPi into:
(A) Light directly
(B) ATP
(C) AMP
(D) GMP

60. The main goal of functional genomics is to:
(A) Sequence the genome
(B) Study the functions of genes and their products
(C) Map chromosomes
(D) Study DNA replication

61. Quantitative real-time PCR (qPCR) measures:
(A) Protein expression levels
(B) DNA sequence polymorphisms
(C) Gene expression levels in real time
(D) DNA.protein interactions

62. Which dye is commonly used in qPCR for detection?
(A) Coomassie Blue
(B) SYBR Green
(C) Ethidium bromide
(D) Silver stain

63. DNA microarrays are primarily used to:
(A) Detect DNA methylation only
(B) Study protein folding
(C) Measure expression of thousands of genes simultaneously
(D) Sequence entire genomes

64. Which technique relies on hybridization of nucleic acids on a solid surface?
(A) qPCR
(B) Microarray
(C) CRISPR
(D) RNAi

65. RNA interference (RNAi) functions by:
(A) Enhancing transcription
(B) Blocking mRNA translation or degrading mRNA
(C) Increasing DNA replication
(D) Stimulating protein folding

66. Which enzyme complex mediates RNA interference?
(A) DNA polymerase
(B) Dicer and RISC
(C) RNA polymerase II
(D) Cas9

67. siRNA and shRNA are tools for:
(A) Gene amplification
(B) Gene silencing
(C) Gene editing
(D) Genome sequencing

68. Mutagenesis is used in functional genomics to:
(A) Study protein folding
(B) Introduce mutations to study gene function
(C) Sequence DNA
(D) Detect polymorphisms

69. Which of the following is a site-directed mutagenesis method?
(A) Random UV exposure
(B) Error-prone PCR
(C) Oligonucleotide-directed mutagenesis
(D) EMS chemical mutagenesis

70. Which of the following is a genome editing tool based on engineered DNAbinding domains?
(A) RNAi
(B) TALENs
(C) Microarrays
(D) qPCR

71. Which of the following is an application of metagenomics?
(A) Studying gene expression in single cells
(B) Analyzing microbial communities without culturing
(C) Sequencing individual human genes only
(D) Editing genomes

72. Metagenomics mainly relies on sequencing of:
(A) Ribosomal RNA genes (e.g., 16S rRNA)
(B) Histone proteins
(C) Transfer RNA
(D) Antibodies

73. Which method allows gene knockdown without altering DNA?
(A) CRISPR-Cas9
(B) TALENs
(C) RNA interference
(D) Site-directed mutagenesis

74. Which of the following is NOT a genome editing technique?

(A) CRISPR

(B) TALENs

(C) ZFNs

(D) qPCR

75. Functional genomics integrates:

(A) Sequencing and protein modelling

(B) Transcriptomics, proteomics, and metabolomics

(C) Only DNA replication studies

(D) Only mutagenesis studies

76. TaqMan probes in qPCR are:

(A) Non-specific dyes

(B) Fluorescent probes that increase specificity

(C) RNA interference molecules

(D) Cas9 guide RNAs

77. Pulldown assay is mainly used for:

(A) Detection of DNA-protein interactions

(B) Detection of protein-protein interactions in vitro

(C) Determining transcription start site

(D) Protein folding studies

78. In a pulldown assay, the "bait protein" is usually attached to:

(A) Agarose beads or resin

(B) DNA fragment

(C) RNA probe

(D) Fluorescent dye

79. Yeast Two-Hybrid (Y2H) system is based on the reconstitution of:

(A) Transcriptional activator

(B) RNA polymerase activity

(C) DNA helicase activity

(D) Protein phosphorylation

80. In Y2H assay, the "bait" protein is fused to:

(A) DNA-binding domain

(B) Activation domain

(C) GFP-tag

(D) Histidine tag

81. FRET (Forster Resonance Energy Transfer) is based on:

(A) Light absorption by heme group

(B) Energy transfer between two fluorescent molecules

(C) Electron transfer between proteins

(D) Protein phosphorylation

82. In FRET, which condition must be fulfilled for energy transfer?

(A) Donor and acceptor proteins should be at least 10 nm apart

(B) Donor and acceptor proteins must be within 1.10 nm distance

(C) Donor must be radioactive

(D) Acceptor must be attached to agarose beads

83. FRET is most useful for studying:

(A) In vitro protein folding

(B) Real-time protein-protein interactions in living cells

(C) Protein sequencing

(D) DNA methylation

84. Which of the following is NOT a commonly used reporter gene in Y2H?

(A) HIS3

(B) lacZ

(C) GFP

(D) actin

85. The GAL4 system used in Y2H comes from which organism?

(A) E. coli

(B) Saccharomyces cerevisiae

(C) Drosophila melanogaster

(D) Arabidopsis thaliana

86. FRET efficiency depends strongly on:

(A) Protein phosphorylation rate

(B) Distance and orientation of fluorophores

(C) Size of proteins involved

(D) Presence of antibodies

87. Which fluorophore pair is commonly used in FRET experiments?

(A) GFP.RFP

(B) His.GST

(C) DNA.RNA

(D) Biotin.Streptavidin

88. Which downstream method is typically used to detect proteins after pulldown assay?

(A) SDS-PAGE + Western blot

(B) PCR

(C) DNA sequencing

(D) Northern blot

89. In Northern blot analysis, the separation of RNA molecules is done by:

(A) Agarose gel electrophoresis under denaturing conditions

(B) Polyacrylamide gel electrophoresis of proteins

(C) Chromatography on cellulose

(D) Western blotting

90. Which of the following techniques involves hybridization of labeled probe to RNA in solution, protected from nuclease digestion?

(A) Northern blotting

(B) Nuclease protection assay

(C) Nuclear run-off transcription assay

(D) 5' RACE

91. The nuclease protection assay is more sensitive than Northern blotting because:

(A) It detects proteins directly

(B) Hybridized RNA fragments are protected from enzymatic degradation

(C) It uses antibodies

(D) RNA is amplified before detection

92. Which RNA analysis technique measures active transcription rates rather than mRNA stability?
(A) Northern blot
(B) Nuclease protection assay
(C) Nuclear run-off assay
(D) 5 Œ RACE

93. 5 Œ RACE (Rapid Amplification of cDNA Ends) is used to:
(A) Determine the transcription start site of mRNA
(B) Measure the half-life of mRNA
(C) Quantify mRNA levels
(D) Detect ribosomal RNA contamination

94. In 5 Œ RACE, the initial step involves:
(A) Digestion of RNA with RNase H
(B) Reverse transcription of RNA into cDNA
(C) Translation of RNA into protein
(D) Southern blotting

95. Which of the following is a non-PCR method to study RNA expression?
(A) 5 Œ RACE
(B) Northern blot
(C) RT-qPCR
(D) RNA-seq

96. In nuclease protection assay, the enzyme most commonly used to digest unhybridized RNA is:
(A) RNase A
(B) DNase I
(C) Proteinase K
(D) Restriction endonuclease

97. The nuclear run-off assay requires:
(A) Isolated intact nuclei
(B) RNA polymerase purified from bacteria
(C) Intact polysomes
(D) Complementary DNA probes attached to agarose beads

98. A researcher wants to measure both the amount and the approximate size of an mRNA. Which method is most appropriate?
(A) Nuclear run-off assay
(B) Nuclease protection assay
(C) Northern blot
(D) 5' RACE

99. Which of the following techniques uses labeled RNA probes rather than labeled DNA probes?
(A) Northern blot
(B) Southern blot
(C) Nuclease protection assay
(D) Nuclear run-off assay

100. Which of the following steps is not involved in Northern blotting?
(A) RNA extraction
(B) Gel electrophoresis of RNA
(C) Transfer to membrane
(D) Enzymatic amplification of RNA

Rough Work

Example :

Question :

Q.1 Ⓐ ● Ⓒ Ⓓ

Q.2 Ⓐ Ⓑ ● Ⓓ

Q.3 Ⓐ ● Ⓒ Ⓓ

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 & 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.

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ● Ⓒ Ⓓ

प्रश्न 2 Ⓐ Ⓑ ● Ⓓ

प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ०एम०आर० 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. ओ०एम०आर० 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 में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैल्कुलेटर, 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।

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