KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Tech.
Year : II

Course : BIOT 206
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 07 FEB 2025

SECTION "A"
[20Q. × 1 = 20 marks]

Encircle the most appropriate answer.

1. How was the fact that mRNA is synthesized in nucleus and exported to the cytoplasm established?
   a. Time lapse microscope photograph of tritium labeled cytidine was taken
   b. Centrifugation of cytoplasmic and nuclear extracts were collected
   c. Pulse chase experiment of labeled uracil was carried out
   d. Time lapse centrifugation of nuclear extract followed by cytoplasmic extracted was carried out

2. Thomas Hunt Morgan (September 25, 1866 – December 4, 1945) was an American evolutionary biologist, geneticist, embryologist, and science author who won the Nobel Prize in Physiology or Medicine in 1933 for discoveries elucidating the role that the chromosome plays in heredity. Which one of the following is his contribution
   a. He discovered that distance between genes can be mapped
   b. He discovered the double helical structure of DNA
   c. He discovered that in most organisms DNA is the genetic material
   d. He engineered genome of Drosophila melanogaster to form red eyes

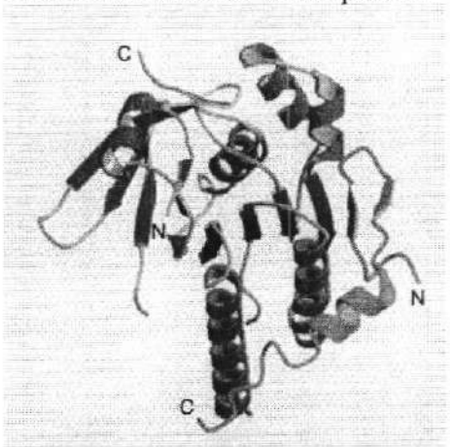
3. Consider four steps in homologous recombination:
   A. Pairing of homologous DNA
   B. Processing of DNA breaks and generation of single stranded DNA
   C. Resolution of holiday junction
   D. Strand invasion

   Which of the following correctly describes the order of events?
   a. D to B to A to C
   b. C to B to A to D
   c. B to D to A to C
   d. A to B to D to C

4. An archaea was brought from moon. It had a very different physiology and biochemistry. Its DNA was isolated and subjected to mica experiment. After running the gel bands were observed that were 10, 11, 21, 20 and 22 base pairs long. The band at 21 base pairs was especially strong. What is the periodicity of the newly isolated DNA from the novel archaea?
   a. 10 base pairs
   b. 11 base pairs
   c. 10.5 base pairs
   d. 20 and 22 base pairs

5. Which of the following statements is **TRUE**?
   a. DNA can never be naturally left handed helical.
   b. Single stranded DNA (which can also be called denatured DNA) is hyperchromatic.
   c. There is not much difference between B and A forms of DNA.
   d. Syn and anti forms of base-sugar-phosphate arrangement is found in all DNA types

6. This is a structure of which protein



   a. BRCA2 protein, which is a tumor suppressor
   b. RecBCD, which is a nuclease and helicase
   c. BRCA1, which is also a tumor suppressor
   d. RecA, which forms a strand invasion protein

7. Programs have been developed to predict the secondary structure of RNA. Given your knowledge of RNA structures, which of the following structures will be most difficult to predict?
   a. Bulge, which is an unpaired nucleotide in normal pairing
   b. Internal loop, which are short stretches that are not able to pair
   c. Hairpin, which consists of some paired nucleotides forming stem
   d. Pseudoloop, where the hairpin forms not contiguous pairing

8. Which of the following is **NOT** a common application of EMSA?
   a. Finding the order of nucleotides in DNA
   b. Identifying protein-DNA interactions in the regulatory region of the gene
   c. Assessing DNA protein binding affinity
   d. Studying transcription factor binding to DNA

9. Taq polymerase is used in PCR reaction because:
   a. It has low thermal stability and is not stable at low temperature
   b. It has high fidelity, meaning it is very accurate
   c. It has high speed, meaning the polymerization is very fast
   d. It has high thermal stability, meaning it is stable at high temperatures

10. What is a commonality between whole genome tiling arrays, microarrays and Southern blot hybridization
   a. In all these techniques the level of mRNA is measured
   b. All the three are hybridization techniques
   c. In all these techniques mutant strain can be distinguished from non mutant strain
   d. In all these techniques DNA is hybridized to another piece of DNA

11. A circular DNA of 4.7 Mb length is cut with a restriction enzyme whose precise recognition sequence is not known. The digest shows 75 fragments in pulsed field electrophoresis. What is the most likely conclusion from this data?
    a. The enzyme is a 4 base cutter
    b. The enzyme is a blunt cutter
    c. This was a partial digest
    d. The enzyme is a 8 base cutter

12. Which of the following is true about the human genome:
    a. There are more exonic genes than microsatellites
    b. Intron are usually longer than exons
    c. More than 2 percent of the genome consisting of genes coding exons
    d. Transposons account for about 20 percent of the genome

13. Nucleosome chaperones
    a. Add phosphoryl, methyl and acetyl group to histone tails
    b. Help assemble histones after replication of DNA
    c. Help slide and exchange nucleosomes
    d. Help DNA form 30 nm fiber around histones

14. What about histone tails is **NOT** correct?
    a. They are cleaved from nucleosomes upon digestion with proteases
    b. They are sites of post translational modification
    c. They contain histone fold domain
    d. They are required to form 30 nm fiber

15. In E. coli DNA replication takes 40 minutes while cell division occurs every twenty minutes. Which of the following is true in E.coli?
    a. There are multiple origins of replication, which initiate during replication.
    b. There is a second initiation from the origin of replication before the first replication has completed
    c. When you look at an E coli cell in phase the DNA looks like two ring attached next to each other
    d. One round of replication completes before initiating another round of replication.

16. According to Trombone model
    a. Sliding clamp coordinates 3 DNA polymerases
    b. Two DNA polymerases work on lagging strand, one works on leading strand
    c. Helicase interacts with ligase to recruit it
    d. Helicase loader coordinates 3 DNA polymerases

17. Autonomous replicating sequences
    a. Are origins of replication identified in plasmids
    b. Are origins of replication identified in chromosome in vivo
    c. Are initiator proteins identified in plasmids
    d. Are initiator proteins identified in chromosomes in vivo

18. According to telomere hypothesis:
    a. Hayflick's countdown clock is molecularly probably dependent of telomere
    b. Younger people have shorter telomere than older people
    c. Cancer cells have very little telomerase activity
    d. Normal cells have a lot of telomerase activity

19. Direct reversal of DNA damage does not include:
    a. Photo reversal of pyrimidine dimer
    b. Removal of methyl group from methyl guanine
    c. Activity of photolyase enzyme
    d. Removal of uracil from genome

20. How is ubiquitination involved in translesional synthesis?
    a. Translesional polymerase is ubiquitinated
    b. DNA where damage occurs is ubiquitinated
    c. Regular DNA polymerase is ubiquitinated and released
    d. Sliding clamp is ubiquitinated which recruits translesional polymerase

KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Level : B.Tech.
Year : II
Time : 2 hrs. 30 mins.

07 FEB 2025

Course : BIOT 206
Semester : II
F.M. : 55

Indicate by checking (√) of each question you have answered in the cover page of main answer book.

SECTION "B"
[5Q. × 3 = 15 marks]

Attempt *ANY FIVE* questions.

1. Major groove contains more chemical information than minor groove. Explain [3]

2. How is programmed double stranded break formed during meiosis? [3]

3. Describe the RNA switch in Murine Leukemia Virus. [3]

4. What is gel filtration chromatography? [3]

5. Describe the differences between zigzag and solenoid model. [3]

6. What is the structure and function of sliding clamp loader? [3]

7. How do UV ray and gamma ray damage DNA? [3]

SECTION "C"
[5Q. × 5 = 25 marks]

Attempt ANY *FIVE* questions.

8. Describe mating type switching. [5]

9. What are plectonomic and toroidal writhes? What is positive and negative supercoiling? Explain. [2.5+2.5]

10. What is SELEX and 3C assay? [5]

11. A new protist (single cell eukaryote) species was discovered in the Himalayas. Describe its possible genomic structure. [5]

12. Describe histone-remodeling complexes. [5]

13. Mechanistically describe the difference between helicase loading and activation. [5]

14. Describe the mechanism of base excision repair. [5]

P.T.O.

SECTION "D"

[2Q. × 7.5 = 15 marks]

Attempt *ANY TWO* questions.

15. What would the outcomes of Messelsen and Stahl experiment if DNA replication were dispersive? What did the crystallographic image of DNA solved by Rosalind Franklin look like? How was it demonstrated that mRNA acts as a messenger from nucleus to cytoplasm? [2.5+2.5+2.5]

16. CRISPR Cas9 is a new genetic editing tool. It uses a nuclease Cas9 to cleave DNA using guide RNA. Explain how this could potentially happen with a figure. A gene needs to be replaced with an antibiotic resistance marker in E. coli. Explain how homologous recombination could aid the process. After the replacement is made, how is the mutant confirmed? [2.5+2.5+2.5]

17. What is end replication problem? What is the function of DNA primase? What are the roles of finger, palm and thumb domains of the DNA polymerase? [2.5+2.5+2.5]