**BT 205**
**Time: 9.00-11.00**
**Dated: 20-09-2024**
**Total Marks: 30**

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1. a) Write stepwise equation for DNA curving using k, t and N* [p= pitch, k= curvature, t= twist, N*= bp steps in complete one turn]
   b) Write stepwise equation for DNA curving using P, k and t [p= pitch, k= curvature, t= twist, N*= bp steps in complete one turn]
2. Assume that Histone Octamers form a cylinder of diameter 12 nm with a height of 6 nm, where human genome has 35 million nucleosomes
   a) What **volume** of nucleus (having 8-micron diameter) is occupied by Histone octamers?
   b) What **fraction** (in percent) of the nuclear volume do the DNA and Histone Octamers occupy?
3. Assume that 30 nm chromatin fiber contains about 30 nucleosomes (1 nucleosome= 200 bp) per 75 nm of DNA.
   a) Calculate the degree of compaction of DNA associated with the level of chromatin structure.
   b) What fractions (in percent) of 15000-fold condensation does this DNA packing represent?
4. Show the steps of Meselson and Stahl's experiment. If Meselson and Stahl's experiment is continued for 4 generations in *E. coli*, then what would be the ratio of $^{15}N/^{15}N$:$^{15}N/^{14}N$:$^{14}N/^{14}N$ in the end?
5. Excess of $^{3}H$ labeled DNA replicated in a medium with $^{32}P$dCTP. Incubation was continued for the cell cycles and then DNA was extracted by CSCl gradient. Show the graph(s) **radioactivity vs time** for i) one cycle ii) two cycle of replication.
6. A 200 nucleotide segment is responsive for replication of a gene X of a cell. It is found that this segment is moved different places in genome and those new sites are also amplified in cells.
   a) Sketch the amplified DNA cluster.
   b) Calculate the fold of DNA amplification after 6 round of replications.
   c) What is the role of 200 nucleotide amplification control element of the gene X cluster?
7. Explain with diagram why Okazaki fragments are formed during DNA replication?
8. What are the steps in base excision repair? Show the diagram.

**(Marks: 3 x 8= 24)**

9. a) What are the major activities of Klenow enzyme?
   b) Write the final structure when the partial DNA (shown below) is placed in a mixture containing four dNTPs, buffer and Klenow enzyme? [Bold letters indicate the complementary bases]

3′OH-ATGCGAATTAGCGACATCGATCGCGCATCGCTA-p 5′
5′ p-ATCGGTACGACGCTTAAC-OH-3′ GTAGCTAG 5′ p-TTAGC-OH-3′

**(Marks 2+4: 6)**