This question paper contains **7** printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **5584**

Unique Paper Code : **3182012402**

Name of the Paper : **Molecular Biology (DSC)**

Name of the Course : **B.Sc. (Hons.) Biomedical Science (NEP 2020)**

Semester : **IV**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

Give illustrations and examples wherever required.

(Subparts of the questions should be attempted together.)

1. (*a*) Provide *one* word for the following statements (any **6**) : 6×1=6

(*i*) Enzyme that relieves supercoiling tension ahead of the replication fork.

(*ii*) Replication model for mitochondrial DNA.

P.T.O.

(*iii*) Mutation type where a purine is replaced with a pyrimidine.

(*iv*) DNA repair process that fixes thymine dimers using light.

(*v*) Eukaryotic RNA polymerase responsible for mRNA synthesis.

(*vi*) Non-coding sequences removed from pre-mRNA.

(*vii*) Enzyme that removes RNA primers and replaces them with DNA in replication.

(*viii*) Protein complex that increases DNA polymerase processivity.

(*b*) Justify the following statements as true *or* false (any **6**) : 6×2=12

(*i*) DNA polymerase III is the main replicative polymerase in prokaryotes.

(*ii*) Transcription initiation does not require mediator complex.

(*iii*) The sliding clamp increases processivity by ensuring that DNA polymerase remains attached to the template strand.

(*iv*) Base excision repair removes damaged nucleotides one at a time.

(*v*) Eukaryotic transcription requires only RNA polymerase II.

(*vi*) Alternative splicing allows a single gene to code for multiple proteins.

(*vii*) All codons encode amino acids.

2. (*a*) Differentiate between the following (any 4) : 4×3=12

(*i*) Helicase and Topoisomerase

(*ii*) Direct Repair and Excision Repair

(*iii*) Intrinsic and Rho-Dependent Transcription Termination

(*iv*) Spliceosome-Mediated splicing and Self-splicing

(*v*) Tetracycline Vs. Chloramphenicol as Translation Inhibitors.

(*b*) Describe the sequential process of RNA primer removal during DNA replication. Explain the roles of RNase H, 5' exonuclease, DNA polymerase, and DNA ligase in ensuring the completion of the newly synthesized DNA strand. 6

3. (*a*) Explain the following concepts : 5×3=15

(*i*) Semi-conservative DNA replication and how it was experimentally proven.

(*ii*) Certain regions of DNA accumulate mutations more frequently than others.

(*iii*) Function of promoters and how they regulate transcription initiation.

(*iv*) Role of SR proteins in regulating splicing.

(*v*) Wobble hypothesis contribute to codon-anticodon pairing.

(*b*) A researcher discovers a strain of bacteria that does not require rho factor for transcription termination. What alternative mechanisms might be responsible ? 3

4. (*a*) Match the following statements : 8×1=8

Column A (Concept/Term)	**Column B (Function/Description)**
Primase	Directly reverses UV-induced damage
Okazaki Fragments	Synthesizes RNA primers
DNA Photolyase	Short DNA segments on the lagging strand
TATA Box	Transfers amino acids to the ribosome
Sigma Factor	Eukaryotic promoter sequence
Small nuclear ribonucleoproteins	Helps RNA polymerase bind to the promoter in bacteria
tRNA	Components of the spliceosome
Release Factors	Stops translation

(*b*) Sequence the events for the following processes : 2,2

(*i*) Elongation cycle of translation in order :

(1) Peptide bond formation occurs between amino acids.

(2) New tRNA enters the A site with an amino acid.

(3) Empty tRNA exits via the E site.

(4) Ribosome translocates, moving tRNA from A to P site.

(*ii*) Alternative splicing in order :

(1) Mature mRNAs with different coding sequences are produced.

(2) These mRNAs lead to different protein isoforms.

(3) Specific exons are included or excluded.

(4) Different splice sites are recognized by the spliceosome.

(*c*) If an inhibitor blocks the function of the sliding clamp loader, what would be the impact on DNA polymerase activity ? 6

5. (*a*) Draw a schematic representation to explain the following (any **5**) :

5×3=15

(*i*) Bacterial origin of replication and the role of DnaA in initiation.

(*ii*) Repair of thymine dimers through photoreactivation.

(*iii*) Various combinations of bacterial promoter elements.

(*iv*) Recruitment of RNA processing enzymes by the CTD tail of polymerase.

(*v*) RNA–RNA hybrids during the splicing reaction.

(*vi*) Composition of the prokaryotic and eukaryotic ribosomes.

(*b*) Identify the odd one out and explain your choice : 3

(*i*) DNA Polymerase III

(*ii*) Helicase

(*iii*) Topoisomerase

(*iv*) Sigma Factor.

6. Give significance/role of the following (any **9**) : 9×2=18

(*i*) Single-Stranded Binding Proteins

(*ii*) AP Endonuclease

(*iii*) TFIID

(*iv*) Branch Point Sequence

(*v*) Peptidyl Transferase

(*vi*) Shine-Dalgarno Sequence

(*vii*) Abortive Transcription

(*viii*) PCNA

(*ix*) Rifampicin

(*x*) tmRNA.