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UNIT- IV

10 / 15 Marks

Q.1. Explain Catabolism of Purine Nucleotide.

ANSWER: Introduction:

- Purine nucleotides (AMP, GMP, IMP) are continuously synthesized and degraded in the body.
- Degradation is essential to :
  - Recycle nitrogen bases.
  - Maintain uric acid balance.
  - Provide intermediates for other pathways.
- In humans, the end product of purine catabolism is uric acid, which is excreted in urine.

1. Overview of Purine Catabolism

- The pathway involves the degradation of nucleic acids (DNA/RNA) → nucleotides → nucleosides → free bases → uric acid.
- The major intermediates are adenosine, inosine, hypoxanthine, xanthine and uric acid.

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2. Major Steps of Purine Catabolism

Step 1 : Degradation of Nucleic Acids.

- DNA and RNA are degraded by endonucleases and exonucleases to yield mononucleotides (AMP, GMP).

Enzymes involved :

- Deoxyribonuclease (DNase) → acts on DNA.
- Ribonuclease (RNase) → acts on RNA.

▫ Reactions :

DNA / RNA → Oligonucleotides → Mononucleotides (AMP, GMP).

Step 2 : Conversion of Nucleotides to Nucleosides.

- 5- Nucleotidases remove the phosphate group.

Reactions :

- AMP → Adenosine + Pi
- GMP → Guanosine + Pi

Enzyme : Nucleotidase

3.-Step : Conversion of Nucleosides to free Purine Bases

Substrate	Enzyme	Product
• Adenosine	• Adenosine deaminase (ADA)	Inosine
• Guanosine	• Purine nucleoside phosphorylase (PNP)	Guanine
• Inosine	• Purine nucleoside phosphorylase (PNP)	Hypoxanthine

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- Adenosine first loses an amino group (NH_2) to form inosine.
- Inosine is cleaved to produce hypoxanthine, while guanosine gives guanine.

- **Step 4: Conversion of Bases to Xanthine.**

Base	Enzyme	Product
Hypoxanthine	Xanthine oxidase	Xanthine
Guanine	Guanine deaminase	Xanthine

- Thus, both adenine and guanine derivatives converge at xanthine, which is the common intermediate.

- **Step 5: Formation of Uric Acid**

- Reaction: Xanthine + O_2 + H_2O → Uric acid + H_2O_2.
- Enzyme: Xanthine oxidase (contains molybdenum and iron).
- Site: Mainly in the liver and small intestine.
- Uric acid is only slightly soluble in water.
- It is carried in plasma and excreted by the kidneys through urine.

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- End Product of Purine Catabolism : Uric acid in Human and higher primates.

Fate of Uric Acid

- Uric acid circulates in plasma (3-7mg/dL).
- Excreted mainly via urine; a small amount via sweat.
- It acts as a powerful antioxidant in plasma.
- When serum uric acid levels rise, crystals of sodium urate may deposit in joints causing gout.

Regulation of Purine Catabolism

- Controlled mainly by availability of substrates (AMP, GMP) and enzyme activities like ADA and xanthine oxidase.
- High uric acid inhibits xanthine oxidase activity to prevent overproduction.

Clinical Significance of Purine Catabolism

a) Gout

- A metabolic disorder characterized by excess urine acid (hyperuricemia) and deposition of urate crystals in joints.
- Treatment : • Allopurinol (xanthine oxidase inhibitor) reduces uric acid production.
- Colchicine relieves inflammation.

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b) Severe Combined Immunodeficiency (SCID)

- Caused by Adenosine deaminase (ADA) deficiency.
- Accumulation of deoxyadenosine and dATP inhibits DNA synthesis in lymphocytes → immunodeficiency.
- Treatment : Bone marrow transplant or gene therapy.

- **Conclusion**

- Purine catabolism is essential for maintaining nucleotide balance and preventing toxic accumulation.
- The final product, uric acid, though useful as an antioxidant, becomes harmful in excess.
- Understanding this pathway helps in the diagnosis and treatment of gout, SCID and related metabolic disorders.
- Enzymes like xanthine oxidase, ADA and HGPRT (Hypoxanthine-Guanine Phosphoribosyl transferase) play crucial roles & are targets of pharmacological therapy.

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Q.2 Explain the Biosynthesis of Purine and Pyrimidine Nucleotides

ANSWER: Introduction

- Nucleotides are the structural units of nucleic acids (DNA & RNA).
- They consist of a nitrogenous base (purine or pyrimidine) a pentose sugar (ribose or deoxyribose) and a phosphate group.
- Nucleotide biosynthesis is essential for cell growth, repair and genetic information transfer.
- There are two major types:
  - Purine nucleotides - Adenine and Guanine.
  - Pyrimidine nucleotides - Cytosine, Thymine & Uracil.
- Nucleotides are synthesized in two ways:

1. De novo synthesis - from small precursor molecules
2. Salvage pathway - reuse of bases from degraded nucleic acids.

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A. BIOSYNTHESIS OF PURINE NUCLEOTIDES

- The pathway begins with Ribose-5-phosphate an intermediate of the Pentose Phosphate Pathway.
- This is converted into 5-Phosphoribosyl-1-Pyrophosphate (PRPP) by the enzyme Phosphoribosyl Pyrophosphate Synthetase (PRPP synthetase).
- Reaction

  Ribose-5-Phosphate + ATP → 5-Phosphoribosyl-1-Phosphate (PRPP) + AMP.

■ Steps in De Novo Purine Nucleotide Synthesis

- The entire pathway involves a series of ten enzymatic reactions.
- Each step gradually builds the purine ring on the ribose moiety of PRPP 5-phosphoribosyl-1-phosphate.

Step 1 : Formation of 5-Phosphoribosylamine

- Enzyme : Amidophosphoribosyl Transferase.
- Reaction : 5-Phosphoribosyl-1-Pyrophosphate (PRPP) + Glutamine ⟶ 5-phosphoribosylamine + Glutamate + Pyrophosphate.

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- Step 2 : Addition of Glycine
- Enzyme : Glycinamide Ribonucleotide Synthetase (GAR synthetase).
- Glycine contributes three atoms (C_4, C_5, N_7) to form Glycinamide Ribonucleotide (GAR).

- Step 3 : Formylation of GAR
- Enzyme : GAR Transformylase
- Donor : N^{10}- Formyl - Tetrahydrofolate (N^{10}- formyl - THF)
- Product : Formylglycinamide Ribonucleotide (FGAR).

- Step 4 : Addition of Nitrogen from Glutamine.
- Enzyme : FGAM Synthase [Formylglycinamidine Synthase]
- Formylglycinamide Ribonucleotide (FGAR) + ATP.
  (FGAM synthetase) ↓
  Formylglycinamidine Ribonucleotide.
  (FGAM

- Step 5 : Cyclization to form AIR (5-Aminoimidazole Ribonucleotide).
- Enzyme : AIR (5-Aminoimidazole Ribonucleotide Synthetase).
- Product : 5-Aminoimidazole Ribonucleotide (AIR).

- Step 6 : Carboxylation of AIR.
- Enzyme : AIR Carboxylase.
- AIR + CO_2 ⟶ 5- Carboxyaminoimidazole Ribonucleotide (CAIR)

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- **Step 7 : Addition of Aspartate**

Enzyme : 5-Aminoimidazole-4-succinocarboxamide Ribonucleotide Synthetase (SAICAR Synthetase).

- Product : 5-Aminoimidazole-4-succinocarboxamide Ribonucleotide (SAICAR).

- **Step 8 : Removal of Fumarate**

Enzyme : Adenylosuccinase

- Reaction : SAICAR ⟶ 5-Aminoimidazole-4-Carboxamide Ribonucleotide CAICAR) + Fumarate.

- **Step 9 : Addition of Formyl Group.**

Enzyme : 5-Aminoimidazole-4-carboxamide Ribonucleotide Transformylase (AICAR transformylase).

- AICAR + N^{10}-Formyl-Tetrahydrofolate (N^{10}-Formly-THF) ⟶ 5-Formamidoimidazole-4-carboxamide Ribonucleotide (FAICAR).

- **Step 10 : Cyclization to form IMP**

- Enzyme : IMP Cyclohydrolase

- Reaction : FAICAR ⟶ Inosine Monophosphate (IMP), which contains purine base hypoxanthine.

Regulation of Purine Biosynthesis

1. Feedback Inhibition : The enzyme Amidophosphoribosyl Transferase is inhibited by end products AMP, GMP & IMP.

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2. Balancing mechanism :

- AMP synthesis requires Guanosine Triphosphate (GTP) as an energy source.
- GMP synthesis requires Adenosine Triphosphate (ATP) as an energy source.
- This cross-regulation maintains balance between AMP and GMP levels.

B. BIOSYNTHESIS OF PYRIMIDINE NUCLEOTIDE

- Introduction
- Pyrimidine nucleotides are essential components of DNA and RNA.
- Pyrimidine bases include Cytosine (C), Thymine (T) and Uracil (U).
- Unlike purine biosynthesis (where the purine ring is built on the sugar 5-Phosphoribosyl-1-Pyrophosphate (PRPP), in pyrimidine biosynthesis, the pyrimidine ring is first formed independently and then attached to Ribose-5-Phosphate through PRPP.
- The first formed nucleotide in the pyrimidine pathway is Uridine Monophosphate (UMP).

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Stepwise Reactions of De Novo Pyrimidine Biosynthesis

- **Step 1: Formation of Carbamoyl Phosphate**

Enzyme: Carbamoyl Phosphate Synthetase II (CPSII)

Reaction: Glutamine + Carbon dioxide (CO_2) + 2 Adenosine Triphosphate (ATP) ⟶ Carbamoyl Phosphate + Glutamate + 2 Adenosine Diphosphate (ADP) + Pi.

- **Step 2: Formation of Carbamoyl Aspartate.**
- Enzyme: Aspartate Transcarbamoylase (ATCase).
- Reaction: Carbamoyl Phosphate + Aspartate ⟶ Carbamoyl Aspartate + Pi.
- This step joins the carbamoyl group with the amino acid Aspartate to begin forming pyrimidine ring.
- **Step3: Cyclization to Dihydroorotate**
- Enzyme: Dihydroorotase
- Reaction: Carbamoyl Aspartate ⟶ Dihydroorotate + H_2O
- The enzyme closes the ring to form the dihydropyrimidine structure.

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- **Step 4 : Oxidation to Orotate**
- Enzyme : Dihydroorotate Dehydrogenase
- Reaction : Dihydroorotate + Nicotinamide Adenine Dinucleotide (NAD^+) ⟶ orotate + Nicotinamide Adenine Dinucleotide Reduced ($NADH + H^+$)

- **Step 5 : Formation of Orotidine Monophosphate (OMP)**
- Enzyme : Orotate Phosphoribosyltransferase
- Reaction : Orotate + 5- Phosphoribosyl- 1 - Pyrophosphate (PRPP) ⟶ Orotidine Monophosphate (OMP) + Pyrophosphate (PP_i)

- **Step 6 : Decarboxylation to form Uridine Monophosphate (UMP)**
- Enzyme : Orotidine - 5' - Monophosphate Decarboxylase
- Reaction : orotidine Monophosphate (OMP) ⟶ Uridine Monophosphate (UMP) + CO_2

- This reaction completes formation of first pyrimidine nucleotide Uridine Monophosphate (UMP).

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Regulation of Pyrimidine Biosynthesis

1. Carbamoyl Phosphate Synthase II (CPS II):

- Inhibited by: Uridine Triphosphate (UTP)
- Activated by: ATP and 5-Phosphoribosyl-1-Pyrophosphate (PRPP).

2. Balancing Purine and Pyrimidine Levels:

- When ATP levels are high, Pyrimidine synthesis is stimulated to maintain equilibrium between purine and pyrimidine nucleotides for DNA & RNA Synthesis.

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Conclusion

- The biosynthesis of purine and pyrimidine nucleotides is vital for the formation of nucleic acids, energy molecules and coenzymes.
- Both pathways are tightly regulated and clinically significant, as their disturbances lead to metabolic disorders like gout, Lesch-Nyhan syndrome and orotic aciduria.

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5 / 7 Marks Questions

Q.1 Write down the structure & Functions of DNA & RNA.

⇨ **ANSWER** : Introduction

- DNA and RNA are nucleic acids that store and transfer genetic information essential for cell growth, development and protein synthesis.

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- Structure of DNA

A] Chemical Components

- Sugar : Deoxyribose
- Nitrogen Bases : Adenine (A), Guanine (G), Cytosine(C), Thymine (T).
- Phosphate group forms backbone.
- Base Pairing : A-T (2 hydrogen bonds)
  G-C (3 hydrogen bonds).

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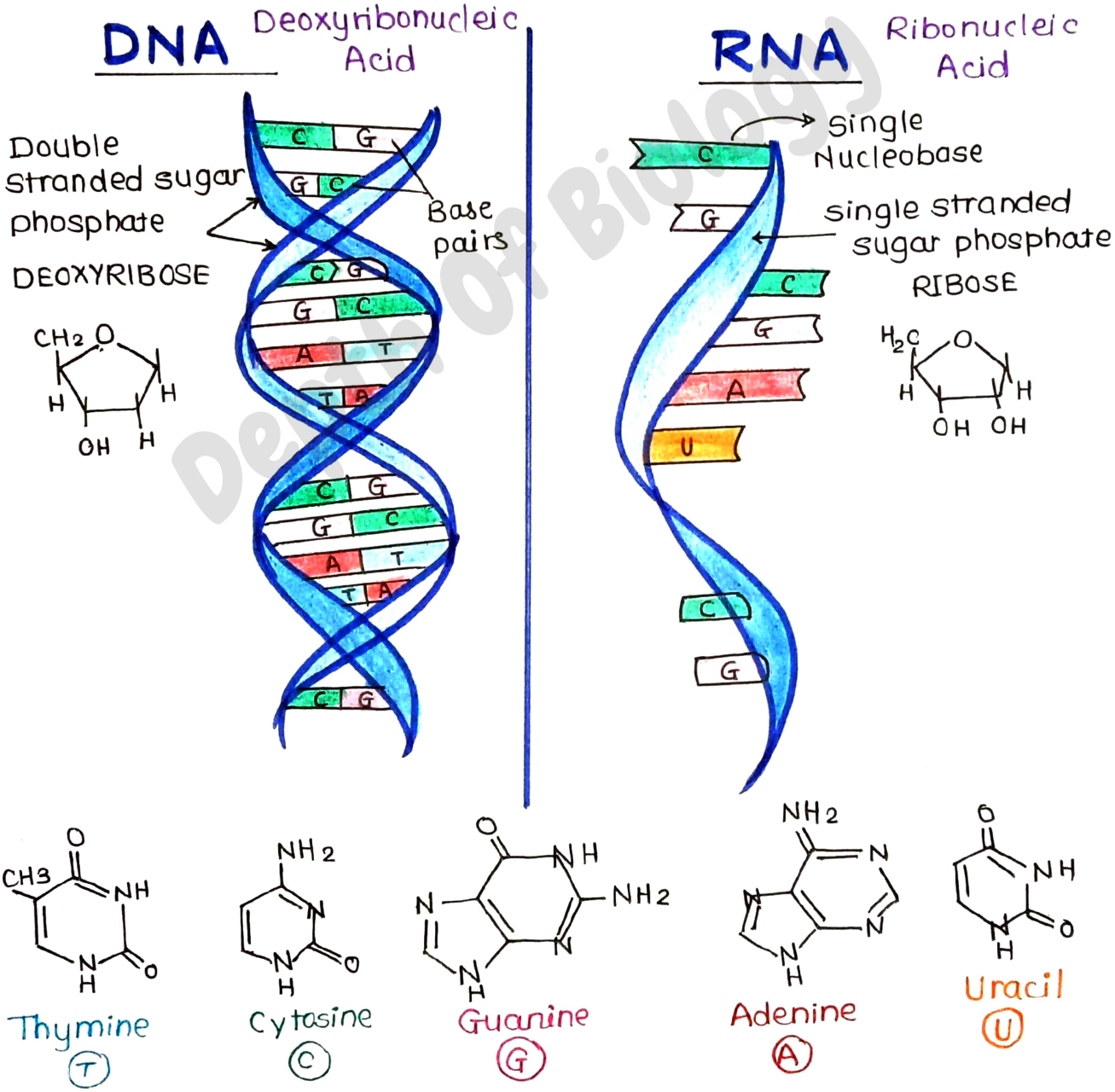
B] Double Helix Model (Watson & Crick, 1953):

- Two antiparallel strands coiled into a right-handed helix.
- One complete turn has 10 Base pairs (34Å length).
- Backbone ⟶ sugar-phosphate ; Bases ⟶ inside forming hydrogen bonds.



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Structure of RNA

A] Components:

- Sugar: Ribose
- Bases: Adenine, Guanine, Cytosine, Uracil [Instead of Thymine].
- Usually single-stranded

B] Types of RNA

Type	Full form	function
mRNA	Messenger RNA	Carriers genetic code from DNA to ribosome.
tRNA	Transfer RNA	Brings amino acids to ribosome.
rRNA	Ribosomal RNA	Forms ribosome structure and catalyzes protein synthesis.

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Conclusion:

- DNA is the genetic material and RNA is the functional molecule that helps in expressing genetic information through protein synthesis.

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Q.2. Define DNA Replication (Semi-Conservative Model.

ANSWER : Introduction

- DNA replication is the biological process of producing two identical copies of DNA from one original DNA molecule.
- It ensures that genetic information is accurately passed from parent to daughter cells during cell division.

- Definition

- DNA replication is defined as the process by which a double-stranded DNA molecule duplicates itself in a semi-conservative manner, where each daughter DNA contains one parental (old) and one newly synthesized (new) strand.

- Experimental Proof (Meselson-Stahl Experiment, 1958).

- Conducted using Escherichia Coli (E.coli) grown in Nitrogen-15 (^{15}N) heavy isotope medium.
- After replication in Nitrogen-14 (^{14}N) medium, the DNA density was intermediate, proving semi-conservative nature.

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- Each new DNA molecule has one old and one new strand.

- **Steps in DNA Replication**

- **Step 1 : Initiation**
- Occurs at a specific region called the Origin of Replication (ORI site)
- Helicase enzyme unwinds the double helix.
- Single-strand binding proteins (SSBPs) stablize the unwond strands.
- Topoisomerase enzyme prevents supercoiling ahead of fork.

- **Step 2 : Primer Formation**
- Primase enzyme synthesizes a short RNA primer complementary to the DNA template.
- Primer provides a free 3'-OH (3 prime hydroxyl) end for DNA synthesis.

- **Step 3 : Elongation**
- DNA Polymerase III extends the primer by adding deoxyribonucleotides. (A, T, G, C).

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- New DNA strand grows in 5' ⟶ 3' direction.
- One strand (leading strand) is synthesized continuously and the other (lagging strand) is synthesized discontinuously in small fragments called Okazaki fragments.

- **Step 4 : Primer Removal and Gap filling.**
- DNA Polymerase I removes RNA primers and replaces them with DNA nucleotides.
- **Step 5 : Ligation**
- DNA ligase enzyme joins Okazaki fragements to form a continuous strand on the lagging side.

- **Conclusion :**
- DNA replication is an accurate and enzyme-controlled process that maintains genetic stability across generations.

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Q.3. Define Transcription / RNA Synthesis

⇨ **ANSWER** : Introduction

- Transcription is the biological process of synthesizing RNA (Ribonucleic Acid) using DNA (Deoxyribonucleic Acid) as a template. It is the first step of gene expression, where genetic information from DNA is copied into messenger RNA (mRNA).

- Definition

- Transcription is defined as the process in which a specific segment of DNA serves as a template to form a complementary RNA strand by the action of the enzyme RNA Polymerase.

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- Site and Direction

- Occurs in the nucleus of eukaryotic cells (in cytoplasm for prokaryotes).

- RNA synthesis proceeds in the 5'→3' direction (five prime to three prime direction).

- Only one strand of DNA acts as a template (template strand) the other is the coding (sense) strand.

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- **Types of RNA Produced**

1. Messenger RNA (mRNA):
   - Carries genetic code from DNA to ribosome.

2. Transfer RNA (tRNA):
   - Transports amino acids for protein synthesis.

3. Ribosomal RNA (rRNA):
   - Combines with proteins to form ribosomes.

- **Enzymes Involved**

- The key enzyme is RNA Polymerase, which synthesizes RNA using ribonucleoside triphosphates (ATP, GTP, CTP, UTP).
- In prokaryotes, there is a single RNA Polymerase.
- In eukaryotes, there are three types:
  - RNA Polymerase I: Synthesizes rRNA
  - RNA Polymerase II: Synthesizes mRNA
  - RNA Polymerase III: Synthesizes tRNA.

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- **Steps in Transcription**

- **Step 1 : Initiation**

- RNA Polymerase binds to a specific DNA sequence called the promoter region (e.g. TATA Box).

- DNA strands unwind locally to expose the template strand.

- **Step 2 : Elongation**

- Ribonucleotides (GTP, ATP, CTP, UTP) are added complementary to the DNA template:

- A → U , T → A , C → G , G → C

- The RNA chain elongations in 5' → 3' direction.

- **Step 3 : Termination**

- When RNA Polymerase reaches a terminator sequence, the newly formed RNA is released.

- The DNA helix formed.

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- **Post-Transcriptional Modifications (in Eukaryotes only).**

- After transcription, the primary RNA transcript (hnRNA - heterogeneous nuclear RNA) undergoes modifications :

1. **Capping**: Addition of a methylated guanine cap at the 5' end.

2. **Tailing**: Addition of poly-adenine (Poly-A) tail at the 3' end.

3. **Splicing**: Removal of non-coding sequences (introns) and joining of coding sequences (exons).

- **Conclusion**

- Transcription is the first and most important step in gene expression, converting the genetic message from DNA into RNA for protein formation.

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Q.4. Explain Protein Synthesis

ANSWER : Introduction

- Protein synthesis, also called translation, is the process by which genetic information present in messenger RNA (mRNA) is converted into a specific sequence of amino acids, resulting in the formation of a functional protein molecule.

- It takes place on the ribosomes in the cytoplasm.

1. **Definition** : Protein synthesis is defined as the translation of the nucleotide sequence of mRNA into a polypeptide chain of amino acids with the help of ribosomes, tRNA & rRNA.

- Site and Components Required.

Component	Function
mRNA	Carries genetic code from DNA to ribosome.
tRNA	Brings specific amino acids to the ribosome
rRNA	Forms structure of ribosome & catalyzes peptide bond formation.
Amino acids	Building blocks of proteins.
Enzymes	Catalyze various steps (eg. Aminoacyl-tRNA synthetase).
Energy (ATP & GTP)	Required for activation & binding steps.

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Steps of Protein Synthesis

Step 1 : Activation of Amino acids

- Each amino acid reacts with ATP in presence of the enzyme Aminoacyl-tRNA synthetase to form an Aminoacyl-AMP complex.
- Then, the amino acid is transferred to its specific tRNA forming Aminoacyl-tRNA (charged tRNA).

Reaction

Amino acid + tRNA + ATP ⟶ Aminoacyl-tRNA + AMP + PPi.

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Step 2 : Initiation

- The small ribosomal subunit attaches to the 5'end of the mRNA at the start codon AUG (Adenine-Uracil-Guanine).
- The initiator tRNA carrying Methionine (Met) binds to this codon.
- The large ribosomal subunit then joins to form the complete initiation complex.

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- Step 3 : Elongation

- The next Aminoacyl-tRNA binds to the next codon in the A site (Aminoacyl site) of the ribosome.
- The enzyme Peptidyl Transferase (present in large rRNA) forms a peptide bond between first and second amino acids.
- The ribosome then moves (translocates) along mRNA to next codon.

- Step 4 : Termination

- When the ribosome reaches a stop codon (UAA, UAG or UGA) no tRNA binds.
- Release factors bind instead and the completed polypeptide chain is released from the ribosome.
- The ribosomal subunits separate and are reused.

- Step 5 : Post-Translational Modifications

- After release, the new polypeptide undergoes modifications like :

  - Folding into proper shape

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- Cleavage or removal of signal peptides.
- Addition of prosthetic groups or carbohydrates.

- These changes help the protein become fully functional.

- **Conclusion**

- Protein synthesis is an energy-dependent, enzyme-controlled process that accurately converts genetic information into functional proteins essential for life processes.

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Q.5. Define Genetic Code

⇨ **ANSWER**: Introduction

- The genetic code is the set of rules by which the sequence of nucleotides in messenger RNA (mRNA) determines the sequence of amino acids in a protein.

- It is a universal language of life, used by all living organisms to translate genetic information into functional proteins.

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- **Definition**

- The genetic code is defined as the relationship between the sequence of nitrogen bases in mRNA and the sequence of amino acids in a polypeptide chain.

- **Basic unit of Genetic Code - Codon**

- A codon is a sequence of three nucleotides (triplet) on mRNA that specifies a particular amino acid.
- Example:
  - AUG (Adenine - Uracil - Guanine) → Methionine (Start codon).
  - UAA, UAG, UGA → Stop codons (Termination signals)

Characteristics / Properties of Genetic Code.

1. Triplet Code

- Each amino acid is coded by a triplet of nucleotides (3 bases).
- Example : AUG codes for Methionine.

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2. Degenerate Code

- Most amino acids are coded by more than one codon.
- Example: Leucine has 6 codons, Serine has 6 codons.

3. Non-Overlapping Code

- Each base is read only once in forming a codon; codons do not overlap.

4. Comma-Less Code

- There are no gaps or punctuation between codons; reading continues without interruption.

5. Universal Code

- The same codons specify the same amino acids in almost all living organisms.
- Example: AUG → Methionine in both humans and bacteria.

6. Specific and Unambigous

- One codon always codes for only one amino acid; it is not ambiguous.
- Example: UUU always codes for Phenylalanine.

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7. Start Codon and Stop Codons

- **Start Codon** : AUG (Codes for Methionine ⟶ signals initiation of translation).

- **Stop Codons** : UAA, UAG, UGA (signal termination of protein synthesis).

8. Non-Ambiguous and Non-redundant Nature.

- Though multiple codons may code for the same amino acid (degeneracy), a codon never codes for more than one amino acid.

9. Colinearity

- The sequence of codons in mRNA corresponds directly and linearily to the sequence of amino acids in the proteins.

- **Conclusion**: The genetic code is a universal, triplet and degenerate system that governs the accurate translation of genetic information from mRNA into proteins, ensuring life's continuity and function.

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2/3 or MCQ

Q.1. Define Hyperuricemia.

⇨ **ANSWER** : **Definition** :

- Hyperuricemia is a metabolic disorder characterized by an abnormally high level of uric acid in the blood - generally above 7 mg/dL in males and above 6 mg/dL in females.

- **Clinical Significance** :
- Leads to deposition of sodium urate crystals in joints and tissues.
- Causes inflammation, pain and swelling.
- Major risk factor for gout disease and kidney stone.

- **Conclusion**
- Hyperuricemia is an important biochemical indicator of impaired purine metabolism and can lead to serious joint and renal complications if untreated.

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Q.2. Gout Disease

ANSWER: Definition

- Gout is a metabolic disorder resulting from deposition of uric acid crystals (sodium urate) in joints and tissues due to chronic hyperuricemia.

- **Pathophysiology**:
- Excess uric acid forms sharp needle-like crystals in joints (especially great toe).
- These crystals cause inflammation and severe pain known as a gouty attack.

- Symptoms:

1. Intense pain and redness in joints (especially big toe).
2. Swelling and stiffness.
3. Fever in severe attacks.

- **Conclusion**
- Gout is a painful joint disorder due to defective purine metabolism, which can be managed effectively by diet and uric acid-lowering drugs.

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Q.3. DNA and its functions

ANSWER: Definition

- DNA (Deoxyribonucleic Acid) is a double-stranded helical molecule that carries the genetic information required for growth, development and reproduction.

- **Functions of DNA**:

1. Genetic Material :
   - Stores hereditary information and transfers it to offspring.
2. Replication :
   - Can duplicate itself before cell division, ensuring genetic continuity.
3. Template of RNA :
   - serves as a template during transcription to form RNA.
4. Control of Cell Functions :
   - Directs synthesis of proteins that regulate all biological activities.
5. Mutations and Evolution :
   - Alterations in DNA sequences cause variations and drive evolution.

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Q.4. RNA and its Functions

⇨ **ANSWER**: Definitions

- RNA (Ribonucleic Acid) is a single-stranded nucleic acid that plays a vital role in protein synthesis and gene expression.

- **Types & Functions**

1. Messenger RNA (mRNA): Carries genetic code from DNA to ribosome for protein synthesis.
2. Transfer RNA (tRNA): Brings specific amino acids to the ribosome.
3. Ribosomal RNA (rRNA): Forms structural and catalytic part of ribosomes.
4. Small Nuclear RNA (snRNA): Helps in RNA processing and splicing.

Depth Of Biology

Q.5 Define Protein Synthesis & Its Inhibitors

- ⇨ **ANSWER**: Definition:

- Protein Synthesis (Translation) is the biological process in which amino acids are assembled into a polypeptide chain according to the sequence of codons in mRNA.

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- **Inhibitors of Protein Synthesis:**

Drug / Toxin	Site of Action	Mechanism
Chloramphen-icol	50S ribosomal subunit	Inhibits peptidyl transferase.
Tetracycline	30S ribosomal subunit.	Blocks attachment of aminoacyl tRNA.
Streptomycin	30S ribosomal subunit.	Causes misreading of mRNA.
Erythromycin	50S ribosomal subunit	Prevents translocation step.
Cycloheximide (in eukaryotes)	80S ribosome	Inhibits elongation.

Depth Of Biology