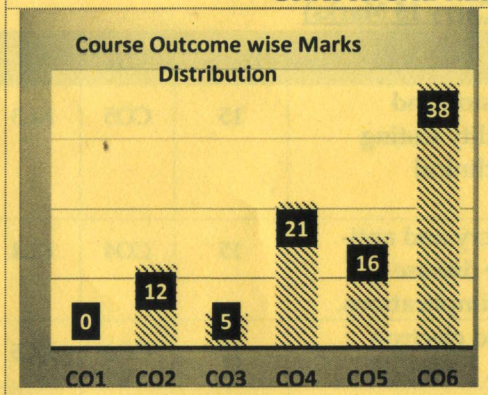
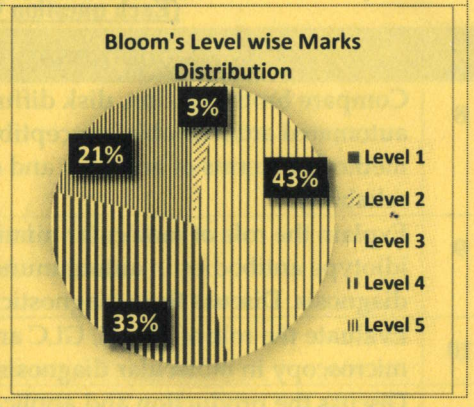
CO- Course Outcomes, **KL**- Knowledge Level, **PO** – Program Outcome

Course Outcomes	CO1	Understand Immunoassays, different enzyme available for immunoassays and immunohistochemical techniques
	CO2	Acquire knowledge about Application of enzyme immunoassays
	CO3	Understand the uses of monoclonal bodies in Immunoassays
	CO4	Explain application of PCR in clinical microbiology
	CO5	Understand different lab test in chemotherapy
	CO6	Comprehend the Rapid diagnostic approaches and standardization of antigen and specific antibodies

GRAPHICAL REPRESENTATION





ARKA JAIN University Jharkhand | NAAC GRADE A ACCREDITED UNIVERSITY

[30-04-2026]
END SEM EXAMINATION
School of Health & Allied Sciences

Program	**Bachelor of Science-Biotechnology**		
Subject Name	**Molecular Diagnostic**	**Session**	**Even, 2025-26**
Semester	**IV**	**Year**	**April, 2026**
Time: 3 Hour Max. Marks : 60	• Start writing from 2nd page onwards; **don't Write on the 1st Page Backside** • **Answer all Questions of Section A (Compulsory)** • **Answer Any Four out of Six of Section B** • **Answer Any Two out of Four of Section C** • **Possession of Mobile Phones** or any kind of **Written Material, Arguments with the Invigilator or Discussing with Co-Student** will comes under **Unfair Means** and will **Result** in the **Cancellation of the Papers**.		
Knowledge Level (KL)	**K1 :** Remembering	**K3 :** Applying	**K5 :** Evaluating
	K2 : Understanding	**K4 :** Analysing	**K6 :** Creating

Section A (Each question Carry 01 Marks from Q1-i to x) – 10 Marks

Q. N 1	QUESTIONS	Marks	COs	KL
i	The DNA fingerprinting pattern of child is a) Exactly similar to that of both the parents b) 100% similar to the father's DNA print c) 100% similar to the mother's DNA print d) 50% bands similar to father and rest similar to mother	01	CO5	KL3
ii	Nanotechnology improves the sensitivity of diagnostic tools primarily by a) Increasing the color change b) Reducing the cost of tests c) Enhancing signal-to-noise ratio d) Making reagents more stable	01	CO4	KL4
iii	Homogeneous immunoassay means a) Requires separation step b) No separation step required c) Only antibody used d) Only antigen used	01	CO2	KL2
iv	Best technique for antigen localization in tissues: a) ELISA b) Immunohistochemistry	01	CO6	KL3

	c) PCR d) RFLP			
v	Most suitable method for detecting mutation: a) SNP analysis b) Gram stain c) Culture d) ELISA	01	CO2	KL3
vi	Automated microbial diagnosis mainly improves: a) Manual error b) Speed c) Standardization d) All of these	01	CO4	KL2
vii	Western Blotting is the technique for the detection of a) Specify DNA in a sample b) Specify RNA in a sample c) Specify Protein in a sample d) Specify Glycolipid in a sample	01	CO5	KL1
viii	In RT-PCT test, when viral load is high, Ct-value will be a) High b) Low c) Irregular d) unknown	01	CO4	KL5
ix	Transgenic animals are produced by a) Mutation b) Gene insertion c) Deletion d) Translation	01	CO6	KL2
x	Cell sorting is performed using a) PCR b) Flow cytometry c) ELISA d) RFLP	01	CO6	KL4

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 5 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	A hospital laboratory reports false positive ELISA results during infectious disease screening. Analyse possible technical and immunological causes and propose corrective measures.	05	CO4	KL4
3	Critically analyse the factors affecting sensitivity and specificity of enzyme immunoassays.	05	CO2	KL4
4	Describe epitope design strategies and their applications in vaccine development and immunodiagnostic tests.	05	CO3	KL3
5	Compare immunofluorescence, radioimmunoassay and ELISA in terms of sensitivity, safety and clinical applicability.	05	CO2	KL3
6	Discuss the working principles and diagnostic applications of flow cytometry.	05	CO6	KL4
7	Evaluate the advantages and limitations of immunohistochemistry	05	CO1	KL5

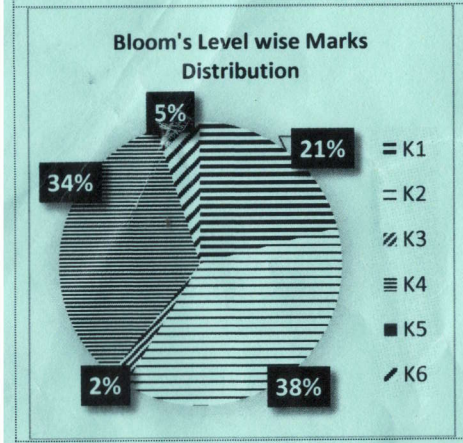
Section C (Answer any TWO out of FOUR) – 30 Marks
(Each question Carry 15 Marks)

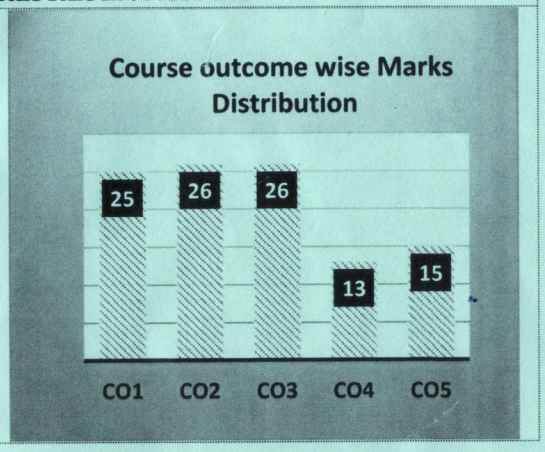
Q. No.	QUESTIONS	Marks	COs	KL
8	Compare broth dilution, disk diffusion and automated antimicrobial susceptibility testing methods in terms of accuracy and clinical reliability.	15	CO5	KL3
9	Explain the role of molecular mimicry and anti-idiotype antibodies in autoimmune disease diagnosis. Discuss their diagnostic implications.	15	CO4	KL4
10	Evaluate the role of HPLC, GLC and electron microscopy in molecular diagnosis.	15	CO6	KL5
11	Discuss the production and applications of transgenic animals in biomedical research and disease diagnosis.	15	CO6	KL3

CO- Course Outcomes, **KL**- Knowledge Level, **PO** – Program Outcome

Course Outcomes	CO1	Understand concept of resonance in various inorganic compounds
	CO2	Understand Intermolecular forces and their effect
	CO3	Acquire knowledge about Transition elements
	CO4	To be able to explain structural and stereoisomerism in complexes
	CO5	Understand Co-ordination compounds in biological systems

GRAPHICAL REPRESENTATION





ARKA JAIN University Jharkhand | NAAC GRADE A ACCREDITED UNIVERSITY

[11-05-2026]
END SEM EXAMINATION
School of Health & Allied Sciences

Program	**Bachelor of Science-Biotechnology**		
Subject Name	**Chemistry - 2**	**Session**	**Even, 2025-26**
Semester	**IV**	**Year**	**April, 2026**
Time: 3 Hour Max. Marks : 60	• Start writing from 2nd page onwards; **don't Write on the 1st Page Backside** • **Answer all Questions of Section A (Compulsory)** • **Answer Any Four out of Six of Section B** • **Answer Any Two out of Four of Section C** • **Possession of Mobile Phones** or any kind of **Written Material, Arguments with the Invigilator or Discussing with Co-Student** will comes under **Unfair Means**and will **Result** in the **Cancellation of the Papers**.		
Knowledge Level (KL)	**K1** : Remembering	**K3** : Applying	**K5** : Evaluating
	K2 : Understanding	**K4** : Analysing	**K6** : Creating

Section A (Each question Carry 01 Marks from Q1-i to x) – 10 Marks

Q. N 1	QUESTIONS	Marks	COs	KL
i	The most stable amongst the following O_2, O_2^+, O_2^-, O_2^{2+}, is _____.	01	CO2	K5
ii	The sulphur atom in SF_6 undergoes _____ hybridization and the molecule has _____ geometry.	01	CO4	K4
iii	Why hydrogen bond is form in HCl molecule?	01	CO2	K3
iv	What is meant by the term ligand? Name one bidentate ligand.	01	CO4	K2
v	What do you understand by coordination number?	01	CO4	K1
vi	Write IUPAC name of the [Co(en)3]Cl3.	01	CO4	K4
vii	Why He_2 molecule does not exist?	01	CO2	K3
viii	What are photochemical reactions?	01	CO3	K2
ix	What is meant by pH?	01	CO3	K1
x	Write one salient feature of Bent rule.	01	CO3	K2

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 5 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Predict the shape of the following molecules using VSEPR theory: (a) BF_3 and (b) H_2O.	05	CO1	K6
3	What do you understand by LCAO method? What are conditions necessary for combination of atomic orbitals?	05	CO2	K3
4	With the help of valence bond theory explain bonding in the following complexes: (i) $[NiCl_4]^{2-}$ (ii) $[CoF_6]^{3-}$	05	CO4	K4
5	Discuss hydrogen bonding. What are the consequences of hydrogen bonding?	05	CO3	K3
6	Write the difference between π and δ bond.	05	CO1	K5
7	Do coordination compounds show isomerism? Illustrate the following with the help of suitable examples (i) Ionization isomerism (ii) Hydrate isomerism (iii) Coordination isomerism	05	CO4	K4

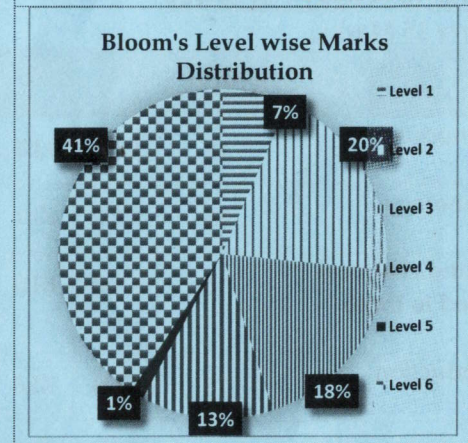
Section C (Answer any TWO out of FOUR) – 30 Marks
(Each question Carry 15 Marks)

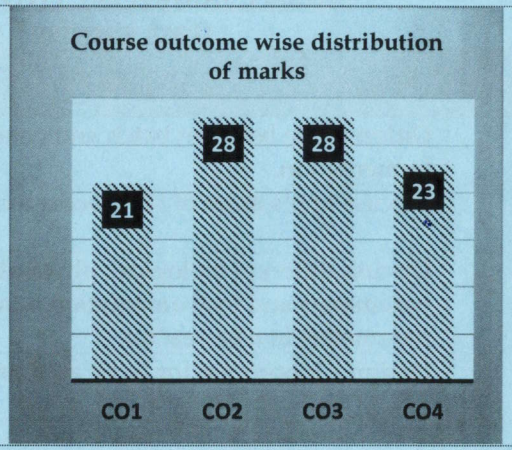
Q. No.	QUESTIONS	Marks	COs	KL
8	a. What are *sp*2 and *sp*3 hybridizations? Explain with examples. b. What are the shapes of PCl_5, NH_3, BCl_3.	15	CO1	K2
9	a. What do you understand by crystal field stabilization energy (CFSE)? Describe and compare the splitting of d orbitals under the influence of octahedral ligand fields. b. Explain the distribution of electrons in the presence of strong field and weak field ligands for a central atom having d4, d5, and d7 electrons, respectively.	15	CO5	K5
10	Explain the inductive effect, mesomeric effect and resonance effect with suitable example.	15	CO3	K3
11	Draw the energy level diagrams, calculate the bond order and predict the magnetic properties for N_2^-, CO, NO, O_2^+.	15	CO2	K5

CO- Course Outcomes, **KL**- Knowledge Level, **PO** – Program Outcome

Course Outcomes	CO1	Understand various types of bioprocess carried out in industry and various types of bioreactor.
	CO2	Understand the application and functioning of bioreactors system, computer aided Bioreactors.
	CO3	Understand upstream, downstream process for different bioprocess, and their control
	CO4	Acquire the basic understanding of various parameters for mass transfer.

GRAPHICAL REPRESENTATION





ARKA JAIN University
Jharkhand
NAAC GRADE A ACCREDITED UNIVERSITY

[08-05-2026]
END SEM EXAMINATION
School of Health and Allied Sciences

Program	**Bachelor of Science-Biotechnology**		
Subject Name	**Bioprocess Technology**	**Session**	**Even, 2025-26**
Semester	**IV**	**Year**	**April, 2026**
Time: 3 Hour Max. Marks : 60	• Start writing from 2nd page onwards; **don't Write on the 1st Page Backside** • **Answer all Questions of Section A (Compulsory)** • **Answer Any Four out of Six of Section B** • **Answer Any Two out of Four of Section C** • **Possession of Mobile Phones** or any kind of **Written Material, Arguments with the Invigilator or Discussing with Co-Student** will comes under **Unfair Means** and will **Result** in the **Cancellation of the Papers**.		
Knowledge Level (KL)	**K1 :** Remembering	**K3 :** Applying	**K5 :** Evaluating
	K2 : Understanding	**K4 :** Analysing	**K6 :** Creating

Section A (Each question Carry 01 Marks from Q1-i to x) – 10 Marks

Q. N 1	QUESTIONS	Marks	COs	KL
i	Scale-up of bioprocess involves: a) Reducing production b) Increasing process volume from lab to industry c) Decreasing cell growth d) Reducing equipment size	01	CO1	KL2
ii	Which type of bioreactor is best for shear-sensitive cells? a) Stirred tank reactor b) Airlift reactor c) Packed bed reactor d) Fluidized bed reactor	01	CO2	KL3
iii	What is the primary function of a bioreactor? a) Separation of products b) Growth of microorganisms under controlled conditions c) Storage of chemicals d) Filtration of media	01	CO2	KL2
iv	Which of the following is a downstream processing step? a) Fermentation	01	CO2	KL3

	b) Inoculum preparation c) Cell disruption d) Media formulation			
v	The lag phase in microbial growth represents a) Rapid growth b) Adaptation period c) Stationary phase d) Death phase	01	CO3	KL2
vi	Design a process to produce antibiotics efficiently; which phase is most important? a) Lag phase b) Log phase c) Stationary phase d) Death phase	01	CO3	KL6
vii	If oxygen transfer is insufficient, what modification is most appropriate? a) Decrease agitation b) Increase aeration rate c) Lower temperature d) Reduce pH	01	CO4	KL6
viii	Which factor would most likely reduce microbial growth rate? a) Optimal pH b) Adequate nutrients c) Extreme temperature d) Proper aeration	01	CO3	KL4
ix	Batch fermentation is characterized by a) Continuous addition of substrate b) No addition after start c) Continuous removal of product d) All of these	01	CO4	KL2
x	Which fermentation method is best for maximizing biomass production? a) Batch b) Continuous c) Solid-state d) None	01	CO4	KL5

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 5 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Discuss chronological development in Bioprocess technology.	05	CO1	KL1
3	Discuss components of fermentation process.	05	CO2	KL2
4	What are different factors which can affect kLa?	05	CO3	KL3
5	How can you prove that oxygen transfer rate is critical in a bioprocess?	05	CO4	KL6
6	Discuss in detail all parts and their function in Stirred tank bioreactor.	05	CO3	KL2
7	Differentiate between Packed bed Bioreactor and fluidised bed bioreactor.	05	CO2	KL4

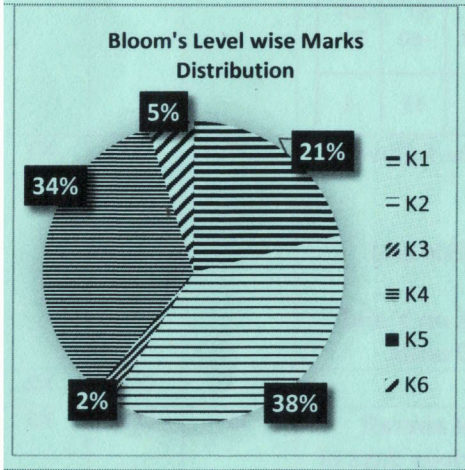
Section C (Answer any TWO out of FOUR) – 30 Marks
(Each question Carry 15 Marks)

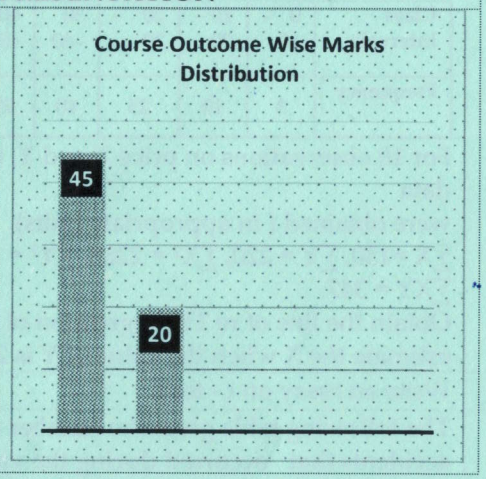
Q. No.	QUESTIONS	Marks	COs	KL
8	Differentiate between batch and continuous fermentation.	15	CO1	kL4
9	Discuss application of bioprocess technology.	15	CO2	KL1
10	Discuss different biological, physical and chemical parameters and instrumentation related to these parameters in a bioreactor.	15	CO3	KL3
11	Design a bioprocess for lactic acid production.	15	CO4	KL6

O- Course Outcomes, **KL**- Knowledge Level, **PO** – Program Outcome

Course Outcomes	CO1	Describe the roles biostatistics server in the discipline of public health.
	CO2	Apply basic statistical concepts commonly used in public health and health sciences.
	CO3	Demonstrate basic analytical techniques to generate results.
	CO4	Interpret results of commonly used statistical analysis in written summaries.

GRAPHICAL REPRESENTATION





ARKA JAIN University
Jharkhand

NAAC GRADE A
ACCREDITED UNIVERSITY

[06-05-2026]
END SEM EXAMINATION
School of Health & Allied Sciences

Program	**Bachelor of Science-Biotechnology**		
Subject Name	**Biostatistics**	**Session**	**Even, 2025-26**
Semester	**IV**	**Year**	**April, 2026**

Time: 3 Hour
Max. Marks : 60

- Start writing from 2nd page onwards; **don't Write on the 1st Page Backside**
- **Answer all Questions of Section A (Compulsory)**
- **Answer Any Four out of Six of Section B**
- **Answer Any Two out of Four of Section C**
- **Possession of Mobile Phones** or any kind of **Written Material, Arguments with the Invigilator or Discussing with Co-Student** will comes under **Unfair Means** and will **Result** in the **Cancellation of the Papers**.

Knowledge Level (KL)	**K1** : Remembering	**K3** : Applying	**K5** : Evaluating
	K2 : Understanding	**K4** : Analysing	**K6** : Creating

Section A (Each question Carry 01 Marks from Q1-i to x) – 10 Marks

Q. N 1	QUESTIONS	Marks	COs	KL
i	The median of first ten natural numbers is (a) 5 (b) 5.5 (c) 7 (d) none of these	01	CO2	K1
ii	Which of the following is not a measure location? (a) Mean (b) Mean Deviation about Mean (c) Mode (d) None of the above	01	CO2	K2
iii	Approximate relation between two variables of any bivariate data is established under (a) Regression analysis (b)Correlation analysis (c) both (a) and (b) (d) none of these	01	CO2	K1
iv	If A and B are two independent events such that P(A) = 0.5 and P(B) = 0.4, then P(A / B) equals to (a) 0 (b) 0.2 (c) 0.9 (d) None of these	01	CO3	K3

v	The mean and variance of which distribution are equal a) Binomial distribution (b) Normal distribution (c) Poisson distribution (d) none of these	01	CO3	K1
vi	The term probability mass function is used for the case when the random variable is (a) Discrete (b) Continuous (c) Both discrete and continuous (d) None of these	01	CO3	K1
vii	The sampling method in which the population is divided into homogeneous subgroups is called as (a) Systematic Sampling (b) Stratified Random Sampling (c) Simple Random Sampling (d) None Of These	01	CO2	K2
viii	Systematic sampling is a case of (a) probability sampling (b) purposive sampling (c) non-probability sampling(d) none of these	01	CO2	K2
ix	t – test is a case of (a) Chi-square test (b) Large sample test (c) Small sample test (d) None of these	01	CO3	K2
x	In two-way classification of analysis of variance, there are (a) Only one assignable factor an no other factor (b) One assignable factor and a chance factor (c) Two assignable factors and a chance factor (d) None of these	01	CO3	K2

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 5 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Describe the need of biostatistics in public health?	05	CO1	K2
3	Find median for the following data: **Value**: 22, 24, 25, 28, 30, 32, 35 **Frequency**: 4, 10, 22, 33, 22, 16, 3	05	CO3	K5
4	Write a note on Rank correlation.	05	CO2	K2
5	The correlation coefficient between two characters X and Y is 0.8. If the variance of X is 9 and standard deviation of Y is2, find the two regression coefficients.	05	CO3	K6
6	Explain stratified random sampling.	05	CO2	K2
7	Find the probability of getting a sum of at least two heads in tossing 3 coins simultaneously.	05	CO4	K4

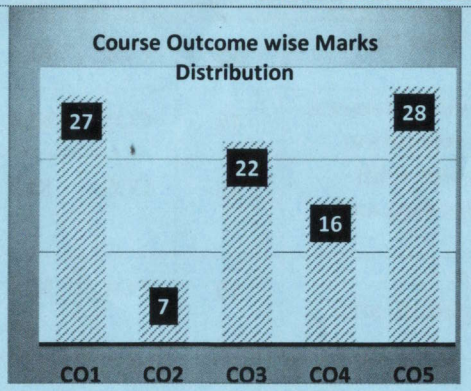
Section C (Answer any TWO out of FOUR) – 30 Marks
(Each question Carry 15 Marks)

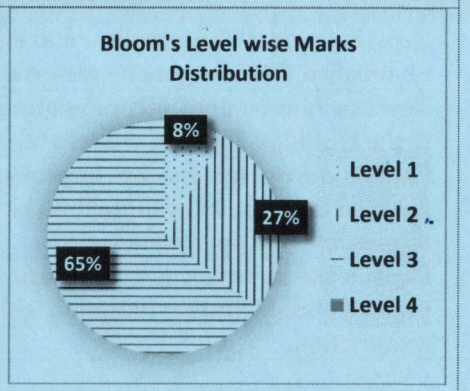
Q. No.	QUESTIONS	Marks	Cos	KL
8	Find standard deviation for the following data: **Class intervals**: 0 – 10, 10 – 20, 20 – 30, 30 –40, 40 –50, 50 –60, 60– 70 **Frequency**: 3, 10, 25, 40, 25, 13, 4	15	CO3	K5
9	For 10 observations on price X and Y, the following data were obtained (in appropriate units), $\sum X = 130$, $\sum Y = 220$, $\sum X^2 = 2288$, $\sum Y^2 = 5506$ and $\sum XY = 347$. Obtain the line of re The regression of X on Y and estimate the X when the value of Y is 20 units.	15	O3	K3
10	Write an essay on t - tests.	15	CO2	K2
11	The following table gives the number of aircraft accidents that occurred during the various days of the week. Find whether the accidents are uniformly distributed over the week? [The tabular value of $\chi^2_{0.05}$ for 6 degrees of freedom is 12.592 and for 7 degrees of freedom. it is 14.067]	15	CO4	K5

CO- Course Outcomes, **KL**- Knowledge Level, **PO** – Program Outcome

Course Outcomes	CO1	Understand the concept of DNA replication, transcription and translation
	CO2	Attain knowledge about DNA damage and various DNA repair mechanisms
	CO3	Understand the mechanism of recombination in DNA
	CO4	Able to elaborate the modern tools and techniques of molecular biology and isolation and identification of genes
	CO5	Able to understand the biology and application of antisense technologies and biology of cancer

GRAPHICAL REPRESENTATION





ARKA JAIN University Jharkhand — NAAC GRADE A ACCREDITED UNIVERSITY

[04-05-2026]
END SEM EXAMINATION
School of Health & Allied Sciences

Program	**Bachelor of Science-Biotechnology**		
Subject Name	**Molecular Biology**	**Session**	**Even, 2025-26**
Semester	**IV**	**Year**	**April, 2026**
Time: 3 Hour Max. Marks : **60**	• Start writing from 2nd page onwards; **don't Write on the 1st Page Backside** • **Answer all Questions of Section A (Compulsory)** • **Answer Any Four out of Six of Section B** • **Answer Any Two out of Four of Section C** • **Possession of Mobile Phones** or any kind of **Written Material, Arguments with the Invigilator or Discussing with Co-Student** will comes under **Unfair Means** and will **Result** in the **Cancellation of the Papers**.		
Knowledge Level (KL)	**K1 :** Remembering	**K3 :** Applying	**K5 :** Evaluating
	K2 : Understanding	**K4 :** Analysing	**K6 :** Creating

Section A (Each question Carry 01 Marks from Q1-i to x) – 10 Marks

Q. N 1	QUESTIONS	Marks	COs	KL
i	In the Meselson–Stahl experiment, intermediate density DNA after one generation indicates a) Conservative replication b) Semi-conservative replication c) Dispersive replication d) Random replication	01	CO1	K4
ii	If DNA polymerase loses proofreading ability, it will result in a) Faster replication b) Mutation c) Repair d) No synthesis	01	CO1	K3
iii	Which repair pathway specifically removes UV-induced thymine dimers in bacteria? a) BER b) NER c) Photoreactivation d) MMR	01	CO2	K4
iv	During base excision repair, the first enzyme acting is	01	CO2	K3

	a) DNA ligase b) DNA glycosylase c) Helicase d) Polymerase			
v	Rho-dependent termination requires a) ATP b) GTP c) NADH d) FAD	01	CO3	K4
vi	Mutation in -10 region (TATA box) of promoter affects a) Elongation b) Initiation c) Termination d) Translation	01	CO3	K3
vii	Alternative splicing increases a) DNA amount b) Protein diversity c) RNA degradation d) Mutation	01	CO5	KL2
viii	Wobble hypothesis explains a) Mutation b) Codon flexibility c) DNA repair d) Replication	01	CO5	KL2
ix	TFIID recognizes a) Enhancer b) TATA box c) Intron d) Exon	01	CO4	KL4
x	In lac operon, absence of lactose leads to a) Induction b) Repression c) Activation d) Mutation	01	CO5	K4

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 5 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Describe the mechanism of transcription initiation in eukaryotes.	05	CO1	KL4
3	Compare prokaryotic and eukaryotic translation.	05	CO5	KL4
4	Compare DNA replication in prokaryotes and eukaryotes	05	CO1	KL3
5	What is Promoter? Describe different promoter in eukaryote.	05	CO3	KL4
6	Explain photoreactivation DNA repair mechanism.	05	CO2	KL4
7	Describe the genetic code and its characteristics.	05	CO5	KL2

Section C (Answer any TWO out of FOUR) – 30 Marks
(Each question Carry 15 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
8	Explain in detail the experimental evidence that established DNA as genetic material	15	CO1	KL4
9	Describe homologous recombination with reference to the Holliday junction model and its resolution.	15	CO3	KL4
10	Explain the operon concept in prokaryotes with detailed description of inducible (lac operon) and repressible (trp operon) systems.	15	CO5	KL3
11	Explain the mechanism of translation in prokaryotes, including initiation, elongation, and termination.	15	CO4	KL3