Roll No: | | | | | | | | | | | | | |

BTECH
(SEM VII) THEORY EXAMINATION 2024-25
ARTIFICIAL INTELLIGENCE

TIME: 3 HRS **M.MARKS: 100**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. **Attempt *all* questions in brief.** **2 x 10 = 20**

Q no.	Question	CO	Level
a.	List examples of convex optimization problems.	1	K1
b.	State the Karush-Kuhn-Tucker (KKT) conditions.	1	K1
c.	State the basic steps of the mirror descent algorithm.	2	K1
d.	Define proximal gradient methods.	2	K1
e.	What are monotone operators?	3	K2
f.	Illustrate the intuition behind Douglas–Rachford splitting.	3	K2
g.	What is Langevin dynamics?	4	K1
h.	State the purpose of averaging methods in stochastic optimization.	4	K2
i.	Differentiate supervised and unsupervised learning.	5	K1
j.	What do you mean by feature extraction in machine learning.	5	K1

SECTION B

2. **Attempt any *three* of the following:** **10 x 3 = 20**

Q no.	Question	CO	Level
a.	Illustrate how duality is applied in optimization problems with a simple example.	1	K2
b.	Explain the connection between ODE interpretations and optimization algorithms.	2	K2
c.	Use the Augmented Lagrangian method to solve a constrained optimization problem with quadratic constraints.	3	K3
d.	How does Polyak–Juditsky averaging smooth the optimization trajectory?	4	K2
e.	Discuss various application domains of machine learning.	5	K2

SECTION C

3. **Attempt any *one* part of the following:** **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Apply the KKT conditions to solve a simple quadratic programming problem.	1	K3
b.	Derive the dual problem for a given primal linear programming problem.	1	K3

4. **Attempt any *one* part of the following:** **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Apply the Frank–Wolfe method to solve a simple linear programming problem.	2	K1
b.	Use gradient descent to minimize the quadratic function $f(x)=x^2+4x+4$	2	K1

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5.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Compare and contrast the Augmented Lagrangian method with the standard Lagrangian approach.	3	K4
b.	Analyze the convergence properties of ADMM for non-smooth problems.	3	K4

6.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Apply Polyak–Juditsky averaging to improve the convergence of an iterative algorithm.	4	K3
b.	Implement SVRG to optimize a logistic regression problem.	4	K3

7.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Explain use case on Bayesian classifier.	5	K4
b.	Create a real-world optimization scenario to demonstrate the use of PCA.	5	K4