Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: M.Tech**

Sub_Code: 24PC1001

1st Semester Regular/Back Examination: 2025-26

SUBJECT: Data Science

BRANCH(S): CSEAIML, CSEDS, Data Sciences

Time: 3 Hours

Max Marks: 100

Q.Code: U519

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.

The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is supervised learning?
b) Define ridge regression.
c) What is bias in a predictive model?
d) Define variance.
e) What is in-sample prediction error?
f) Define the Bayesian Information Criterion (BIC).
g) What is meant by the optimism of training error rate?
h) Define random forest.
i) What is k-means clustering?
j) What is a support vector?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Define Confusion Matrix. Draw and explain a confusion matrix.
b) Difference Between Simple and Multiple Linear Regression.
c) What Is the role of the Intercept in linear regression?
d) What is the difference between forward selection and backward elimination in feature selection for linear regression?
e) What is collaborative filtering? Explain.
f) What is Kernel PCA and how does it differ from PCA?
g) What is matrix factorization in collaborative filtering?
h) Derive the EM algorithm for Gaussian Mixture Models.
i) Describe k-means clustering algorithm.
j) Explain unsupervised learning with examples.
k) What spectral clustering? Explain.
l) Explain SVM for binary classification.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Consider the time series data given below: **(16)**

Xi	8	3	2	10	11	3	6	5	6	8
Yi	4	12	1	12	9	4	9	6	1	14

Use the least squares method to determine the equation of line of best fit for the data. Then plot the line.

Q4 Explain with suitable example how Ridge Regression and Lasso Regression help for regularization of models. **(16)**

Q5 Discuss in brief about KNN Classification with suitable diagram. **(16)**

Q6 What is k-fold cross-validation? Explain its steps. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: M.Tech**
Sub_Code: 24PC1002

1st Semester Regular Examination: 2025-26
SUBJECT: Advanced Data Structure and Algorithm
BRANCH(S): CSEAIML, CSEDS, Data Sciences
Time: 3 Hours
Max Marks: 100
Q.Code: U706

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is Divide-and-Conquer paradigm?
b) What is Strassen's matrix multiplication?
c) Define randomized algorithm.
d) What is open addressing in hashing?
e) State one property of Red-Black Tree.
f) What is amortized analysis?
g) Define modular arithmetic.
h) What is parallel algorithm?
i) What do you mean by online algorithm?
j) Define NP-complete problem.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain Strassen's algorithm for matrix multiplication and its time complexity.
b) Describe probabilistic analysis with reference to the hiring problem.
c) Explain randomized quicksort and analyze its expected running time.
d) Discuss hash functions and collision resolution using open addressing.
e) Explain insertion and deletion operations in Red-Black Trees.
f) What are augmented data structures? Explain interval trees.
g) Explain rod cutting problem using dynamic programming approach.
h) Describe aggregate and accounting methods of amortized analysis.
i) Explain the Chinese Remainder Theorem with an example.
j) Discuss the working principle of RSA public-key cryptosystem.
k) Explain parallel merge sort algorithm and its performance.
l) Explain online caching problem.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3	Explain Divide-and-Conquer and Randomized Algorithms. Discuss Strassen's matrix multiplication and randomized quicksort with detailed analysis.	**(16)**
Q4	Describe Hash Tables and Balanced Search Trees. Explain Red-Black Tree properties, rotations, insertion, and deletion algorithms in detail.	**(16)**
Q5	Explain Dynamic Programming and Amortized Analysis. Discuss optimal binary search trees and the potential method with suitable examples.	**(16)**
Q6	Explain Parallel and Online Algorithms. Discuss parallel matrix multiplication, online caching, and NP-completeness with reducibility and proof outline.	**(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: M.Tech**
Sub_Code: 24PC1003

1st Semester Regular/Back Examination: 2025-26
SUBJECT: SCIENTIFIC COMPUTING
BRANCH(S): CSEDS, Data Sciences
Time: 3 Hours
Max Marks: 100
Q.Code: U607
Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Define round-off error.
b) What is machine epsilon?
c) Write the matrix form of a system of linear equations.
d) Define the forward difference operator.
e) What is a nonlinear equation?
f) Define order of convergence.
g) What is an eigenvector?
h) Define the eigenvalue of a matrix.
i) Write the formula for Simpson's 1/3 rule.
j) What is an initial value problem?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain the floating-point representation of real numbers with an example.
b) Solve the system of linear equations below using the Gauss elimination method.
$2x + y + z = 10$
$3x + 2y + 3z = 18$
$x + 3y + 2z = 13$
c) Explain the LU decomposition method with an example.
d) Compare direct methods and iterative methods for solving linear systems.
e) Explain Newton's forward interpolation formula.
f) Explain convergence and divergence of iterative methods.
g) Why does the Newton–Raphson method fail for multiple roots? Illustrate.
h) Explain the power method for finding the dominant eigenvalue.
i) Derive the Trapezoidal rule for numerical integration.
j) Compare numerical integration methods based on accuracy, stability, and computational efficiency for real-time applications.

k) Solve an IVP using the Runge–Kutta method of second order.

l) Discuss local and global truncation errors.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Describe the Jacobi iterative method and state its convergence condition. A poorly scaled system gives inaccurate results on a computer. Explain why and suggest remedies. **(16)**

Q4 Compare different root-finding methods for speed, accuracy, and computational cost using a suitable example. **(16)**

Q5 Derive least squares formulas and fit a curve to given data. Explain the limitations of curve fitting. **(16)**

Q6 Explain and apply the Runge–Kutta fourth-order method to solve an initial value problem. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: M.Tech
Sub_Code: 24PC1004

1st Semester Regular/Back Examination: 2025-26
SUBJECT: OPTIMIZATION TECHNIQUES
BRANCH(S): CSEDS, Data Sciences
Time: 3 Hours
Max Marks: 100
Q.Code: U552

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Determine whether or not W is a subspace of $\mathbb{R}^3$ where W consists of all vectors $(x, y, z) \in \mathbb{R}^3$ such that,$x + 2y + 3z = 1$.
b) When a system of linear equations has a unique solution?
c) Define sample space with an example.
d) When does the Simplex method indicate that the linear programming problem has an alternative optimal solution?
e) Write two limitations of Linear Programming Problems (LPPs).
f) What is the Duality Gap in linear Programming?
g) Explain how the Generalized Reduced Gradient method is applied to an unconstrained nonlinear programming problem.
h) What is the difference between constrained and unconstraint optimization problems?
i) What is a general nonlinear programming problem?
j) State the First Order Necessary Condition (FONC) for unconstrained optimization.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) For a given function $f(x, y) = x^2 + 2y^2$, find the gradient ∇f and Hessian matrix H.
b) Find the eigenvalues and eigenvectors of the matrix $A = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$. Is A positive definite?
c) Show that all the vectors in $\mathbb{R}^3$ satisfying $2x_1 + 3x_2 - x_3 = 0$, $x_1 - 4x_2 + x_3 = 0$ is a subspace of $\mathbb{R}^3$.
d) Explain Karmarkar's Algorithm briefly. compare the complexity of this algorithm with the Simplex Method.
e) Write the dual of the Primal LPP. Maximize $Z = 5x_1 + 12x_2 + 4x_3$ Subject to $x_1 + 2x_2 + x_3 \leq 10, 2x_1 - x_2 + 3x_3 \leq 8, x_1, x_2, x_3 \geq 0$.
f) Solve the LPP. Maximize $Z = 4x_1 + 3x_2$ Subject to $2x_1 + x_2 \leq 10, x_1 + x_2 \leq 8,\ x_1, x_2 \geq 0$.

g) Discuss the convergence of conjugate direction method.

h) Use the Golden Section search to find the value of x that minimizes $f(x) = x^4 - 14\,x^3 + 0x^2 - 70x$ in the range [0, 2]

i) Minimize $f(x) = 2{x_1}^2 + {x_2}^2$ using the Steepest Descent method. Start from $X_0 = (1, 1)$ and perform one iteration.

j) Explain the basic behind Projection methods in constrained optimization.

k) Use Lagrange Multipliers to find the extreme values of $f(x, y) = xy$ subject to constraint $x^2 + y^2 = 8$.

l) Check whether the point $(1, 1)$ satisfies the KKT conditions for minimizing $f(x) = (x_1 - 2)^2 + (x_2 - 2)^2$ subject to $x_1 + x_2 \leq 2$.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Consider the function $f: \mathbb{R}^2 \to \mathbb{R}$ defined by $f(x_1, x_2) = \frac{3}{2}(x_1^2 + x_2^2) + (1 + a)x_1x_2 - (x_1 + x_2) + b$, where a and b are real parameters. Write the function f in the usual multivariable quadratic form. **(8 x 2)**

b) Show that all eigenvalues of a symmetric matrix are real.

Q4 **a)** Solve the LPP: $Max\ z = 107x_1 + x_2 + 2x_3$ subject to $14x_1 + x_2 - 6x_3 + 3x_4 \leq 7,\ 16x_1 + x_2\ 6x_3 \leq 5, 3x_1 - x_2 - x_3 \leq 0, x_1, x_2, x_3, x_4 \geq 0$. **(8 x 2)**

b) State and prove Weak Duality Lemma.

Q5 **a)** Minimize $f(x) = x_1 - x_2 + 2{x_1}^2 + 2x_1x_2 + {x_2}^2$ using Newton 's Method. Start from $x_0 = (0, 0)$ and find the optimum point. **(8 x 2)**

b) Draw a comparison between Quasi-Newton Methods and the standard Newton Method. What are the Advantages of Quasi -Newton method?

Q6 **a)** Solve the nonlinear programming problem: $Optimize\ z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$ subject to $x_1 + x_2 + x_3 = 15,\ 2x_1 - x_2 + 2x_3 = 20$. **(8 x 2)**

b) Consider the problem: Maximize $f(x_1, x_2) = (x_1 - 3)^2 + (x_2 - 3)^2$ Subject to $x_1 + x_2 \leq 4, x_1, x_2 \geq 0$. Write down the KKT conditions and find the optimal solution.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: M.Tech**
Sub_Code: 24PE1004

1st Semester Regular Examination: 2025-26
SUBJECT: Cloud Computing
BRANCH(S): CSEDS
Time: 3 Hours
Max Marks: 100
Q.Code: U657

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate on-demand self-service from measured service with one real-world cloud example.
b) Why is location-independent resource pooling considering a key enabler of cloud scalability?
c) How did high-performance computing (HPC) influence cloud architecture design?
d) State one major security limitation of cloud computing related to the protection of sensitive information.
e) List the key differences between SaaS and PaaS from a developer's perspective.
f) What is the primary purpose of the IaaS model in cloud computing?
g) Define hypervisor.
h) What is the vendor lock-in problem? How to mitigate it?
i) What is the role of a simulator like CloudSim in cloud research?
j) State the advantages of VMware virtualization.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain the essential characteristics of cloud computing and justify why rapid elasticity is critical for modern applications.
b) Compare traditional IT service providers and cloud service providers with respect to resource provisioning and cost models.
c) Discuss how essential characteristics of cloud computing influence resource discovery, scheduling, and offloading in large-scale systems.
d) Explain the architectural influences of utility computing and enterprise grid computing on cloud platforms.
e) Discuss the benefits and limitations of cloud computing with respect to application development and security responsibility.
f) List the different cloud usage scenarios and discuss how scalability, vendor dependency, and simplicity affect enterprise adoption.

g) Explain the layers in cloud architecture and their functional roles.

h) Discuss the features and benefits of SaaS, PaaS, and IaaS with suitable examples.

i) Explain the service-level agreements (SLAs) in cloud computing and their role in ensuring quality of service.

j) Explain the energy-aware simulation objectives of GreenCloud and its relevance in green computing research.

k) Explain the architecture of GridSim with a suitable diagram.

l) Describe the steps involved in creating and cloning a virtual machine using VMware Workstation.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 State the origins and roots of cloud computing, explaining how virtualization, distributed systems, and internet technologies contributed to its evolution. Analyze how cloud components collectively support data-intensive workloads. **(16)**

Q4 State the security benefits and risks of third-party cloud environments. How do government policies and regulatory issues impact cloud adoption across regions? **(16)**

Q5 Compare and contrast public, private, community, and hybrid cloud deployment models. Justify the suitability of each model for different organizational use cases. **(16)**

Q6 Explain the working platform of CloudSim in detail and discuss how it can be used to model scheduling and resource allocation policies in cloud environments. **(16)**