D 121282 **(Pages : 2)** **Name.................................**

Reg. No...............................

FOURTH SEMESTER M.Sc. (CBCSS) (REGULAR/SUPPLEMENTARY) DEGREE EXAMINATION, APRIL 2025

Mathematics

MTH4C16—OPTIMIZATION TECHNIQUES IN OPERATIONS RESEARCH

(2019 Admission onwards)

Time : Three Hours Maximum Weightage : 30

Part A

Answer **all** *the questions.*
Each questions carries a weightage of 1.

1. What are the conditions that are to be satisfied by a network ?
2. Define compression limit of an activity.
3. In how many ways can 5 jobs be performed on 4 machines ?
4. What is Bellman's optimality principle ?
5. Test the definiteness of the function $f(\mathrm{X}) = x_1^2 + x_2^2 + x_3^2 - 2x_1x_2$.
6. Show that a convex functon is unimodal.
7. Find the lower bound for $f(x) = x^{-4} + 4x^3 + 4x,\ x > 0$.
8. What is the general form of an unconstrained posynomial minimizatoin problem ?

(8 × 1 = 8 weightage)

Part B

Answer any **two** *questions from each module.*
Each question carries a weightage of 2.

Module I

9. Construct a network where the activities satisfy the requirements : (i) A and B are the first activities of the project to start simultaneously ; (ii) A and B precede C ; (iii) B precedes D and E ; (iv) A and B precede F ; (v) F and D precede G and H ; (vi) C and G precede I ; (vii) E, H and I are the terminal activities. The duration of activities A, B, C, D, E, F, G, H, and I are 2, 3, 5, 2, 7, 4, 6, 11 and 3 respectively.
10. Describe the Stepping step method in project management.
11. Write the algorithm for the sequencing problem of n jobs and m machines.

Module II

12. Distinguish between Backward dynamic programming and Forward dynamic programming.

Turn over

13. Find the stationary points and classify them for $f(X) = 2 + 2x_1 + 3x_2 - x_1^2 - x_2^2$.
14. Describe the eigenvalue test for finding the definiteness of a quadratic form.

Module III

15. Describe the Dichotomous search method.
16. What are the limitations of Fibonacci search method ?
17. Define degree of difficulty of a geometric programming problem. How does it explain the existence of solution of a problem ?

(6 × 2 = 12 weightage)

Part C

Answer any **two** *questions.*
Each question carries a weightage of 5.

18. Consider the project for which details are mentioned below :

Activity		*Normal duration*	*Normal cost*	*Crash duration*	*Crash cost*
(i, j)	...	T_n	C_n	T_c	C_c
(1, 2)	...	15	600	12	1200
(1, 3)	...	8	700	5	1600
(2, 5)	...	12	750	6	1500
(3, 4)	...	15	650	12	1400
(3, 5)	...	18	700	13	1450
(4, 5)	...	8	500	5	950

Find by FF limt method the minimum cost schedule, if the project is to be completed in 28 days.

19. (a) Let $f(X)$ be a convex function defined over a convex set S in $\mathbb{R}^n$, the n-dimensional Euclidean space. Then prove that the local minimum is the global minimum of $f(X)$ over S.

(b) Prove that a set $S = \{X : g_i(X) \leq 0, X \geq 0\}$ of feasible solutions of the general convex non-linear programming problem is a convex set.

20. (a) Define separable function and give an example for a separable function.

(b) Write the dual of the problem :

$$\text{Minimise } f(X) = -4x_1 - 2x_2 + x_1^2 + x_2^2$$
$$\begin{aligned} \text{subject to } \quad 2x_1 - x_2 &\leq 7 \\ -x_1 + x_2 &\leq -2 \\ x_1, x_2 &\geq 0. \end{aligned}$$

21. (a) Explain the Gravel box design problem.

(b) Find the maximum of $f(x) = x(1.5 - x)$ in the interval [0, 1] to within 10 % of the exact value. Take $\delta = 0.001$.

(2 × 5 = 10 weightage)

D 121282-A **(Pages : 4)** **Name....................................**

Reg. No.................................

FOURTH SEMESTER M.Sc. (CBCSS) (REGULAR/SUPPLEMENTARY) DEGREE EXAMINATION, APRIL 2025

Mathematics

MTH4C16—OPTIMIZATION TECHNIQUES IN OPERATIONS RESEARCH

(2019 Admission onwards)

(Multiple Choice Questions for SDE Candidates)

[Improvement Candidates need not appear for MCQ part]

Time : 20 Minutes	**Total No. of Questions : 20**	**Maximum : 5 Weightage**

INSTRUCTIONS TO THE CANDIDATE

1. This Question Paper carries Multiple Choice Questions from 1 to 20.
2. The candidate should check that the question paper supplied to him/her contains all the 20 questions in serial order.
3. Each question is provided with choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and enter it in the main answer-book.
4. The MCQ question paper will be supplied after the completion of the descriptive examination.

MTH4C16—OPTIMIZATION TECHNIQUES IN OPERATIONS RESEARCH

(Multiple Choice Questions for SDE Candidates)

1. The time required by each job on each machine is called ——— time.

   (A) Elapsed. (B) Idle.

   (C) Processing. (D) Average.

2. CPM means ———.

   (A) Critical Path Method. (B) Cost Project Minimization.

   (C) Cost Project Maximsation. (D) Critical Project Management.

3. The graphical representation of project operations :

   (A) Critical path. (B) Activities.

   (C) Techniques. (D) Network.

4. The slope of crashing an activity is given by :

   (A) $\frac{C_c + C_n}{T_n + T_c}$. (B) $\frac{C_c - C_n}{T_n}$.

   (C) $\frac{C_c - C_n}{T_n - T_c}$. (D) $\frac{C_c}{T_n - T_c}$.

5. In the network of the project for which the activities E precedes G and H means :

   (A) $E \to G \to H$. (B) $H \to G \to E$.

   (C) $E \to G, E \to H$. (D) $G \to E, H \to E$.

6. An optimal policy has the property that whatever the initial state and initial decision are the remaining decisions must constitute an optimal policy with regard to the state resulting from the preceding decision, is called :

   (A) Forward recursion. (B) Backward recursion.

   (C) Dynamic method. (D) Bellman's optimality.

7. A quadratic form X^TAX is said to be positive definite if :

   (A) $X^TAX > 0 \; \forall X \neq 0$.

   (B) $X^TAX \geq 0 \; \forall X \neq 0$ atleast one $X \neq 0, X^TAX = 0$.

   (C) $X^TAX < 0 \; \forall X \neq 0$.

   (D) $X^TAX \leq 0 \; \forall X \neq 0$ atleast one $X \neq 0, X^TAX = 0$.

8. If $f(X) = x_1^2 - (x_2 - x_3)^2$ then f is :

   (A) Positive definite. (B) Negative definite.

   (C) Positive semi definite. (D) Indefinite.

9. The Assembly line scheduling and longest common subsequence problems are an example of :

   (A) Greedy algorithm. (B) Branch and bound method.

   (C) Geometric method. (D) Dynamic algorithm.

10. For the matrix $\begin{bmatrix} -3 & -5 & 3 \\ -5 & 2 & 2 \\ 3 & 2 & -3 \end{bmatrix}$ we have D_2 is :

    (A) 32. (B) – 31.

    (C) 16. (D) – 10.

11. A necessary conditions for $f(X) \in C^2$ to have stationary points is that :

    (A) $\nabla f(x) = 0$. (B) $\nabla f(x) \neq 0$.

    (C) $\nabla f(x) > 0$. (D) $\nabla f(x) < 0$.

12. For a quadratic $X^T AX$ if A is indefinite then the point X* is called :

    (A) Node. (B) Maximum.

    (C) Saddle point. (D) Minimum.

13. Let $f(X) = X^T AX$. Then $f(X)$ is convex in R^n if $X^T AX$ is :

    (A) Convex. (B) Concave.

    (C) Positive semi definite. (D) Negative sem definite.

14. A feasible solution of convex non-linear programming problem is a ————.

    (A) Open set. (B) Convex set.

    (C) Closed set. (D) Empty set.

15. Let $f(X)$ and G(X) be convex differentiable functions, and let X* be an optimal solution of primal, then (X^*, λ^*) is :

    (A) An optimal solution of a dual. (B) An optimal solution of a primal.

    (C) Solution of both dual and primal. (D) None of these.

Turn over

16. In this method two experiments are placed as close as possible to the centre of the interval of uncertainty :

    (A) Newton-Raphson method.
    (B) Steepest decent method.
    (C) Fibonacci search method.
    (D) Dichotomous search method.

17. Two vectors s_1 and s_2 in Rn are said to be conjugate vectors with respect to H if :

    (A) $s_1^{T} H s_2 > 0$.
    (B) $s_1^{T} H s_2 = 0$.
    (C) $s_1^{T} H s_2 < 0$.
    (D) $s_1^{T} H s_2 \neq 0$.

18. The technique used for solving problems involving posynomials is called :

    (A) Dynamic programming.
    (B) Goal programming.
    (C) Geometric programming.
    (D) Linear programming.

19. The geometric programming is cannot be applied in :

    (A) Posynomal optimization.
    (B) Linear optimization.
    (C) Oil tank design problem.
    (D) Gravel box design problem.

20. The direct cost of project increases and indirect cost decreases if the duration of the project is :

    (A) No change.
    (B) Increased.
    (C) Medium change.
    (D) Reduced.