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1411E1186

Candidate's Seat No :_____

M.Sc. Sem.-3 Examination

502

A. M. S.

Time : 2-30 Hours] November-2025 [Max. Marks : 70

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 **(a)** Write an algorithm of unrestricted search method with fixed step size. Also, Discuss its graphical representation. **(07)**

(b) Write an algorithm of Golden Section Search Technique. **(07)**
State (any two) difference between Golden Section search method and Fibonacci search method.

OR

(a) Explain Exhaustive Search technique for minimization problems by using its graphical representation. **(07)**

(b) Using Fibonacci search method, find the minimum for the function **(07)**
$f(x) = x(x - 1.5)$ in the interval $[0,1]$ within the interval of uncertainty 0.25 of the initial interval of uncertainty.

Q.2 **(a)** Explain in brief Interior and Exterior penalty functions. Explain an algorithm of Exterior penalty function method. **(07)**

(b) Write an algorithm of Steepest Descent (Cauchy) Method. **(07)**
Determine the minimum of the given function
$f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ using steepest descent method with initial guess $x_0 = \begin{bmatrix}0\\0\end{bmatrix}$

OR

(a) State Conjugate Gradient method (Fletcher-Reeves) and its algorithm. **(07)**
Using Conjugate Gradient Method, determine the minimum of the given function $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ with initial guess $x_0 = \begin{bmatrix}0\\0\end{bmatrix}$.

(b) Write an algorithm of Newton's method. **(07)**
Determine the minimum of the given function
$f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ using Newton's method with initial guess $x_0 = \begin{bmatrix}0\\0\end{bmatrix}$.

Q.3 **(a)** Explain Genetic Algorithm with flow chart and its operators. Also, discuss its basic terminology: population, chromosomes, gene, allele, genotype and phenotype. **(07)**

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(b) Find the minimum of the function $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ by using Univariate method. (Use $\epsilon = 0.01$)) **(07)**

OR

(a) Find the minimum of the function $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_2x_1 + x_2^2$ by using Hooke-Jeeves method, starting from the point $X_1 = (0,0)^T$. Take $\Delta x_1 = \Delta x_2 = 0.8$ (Perform only one iteration) **(07)**

(b) State Nelder-Mead's Search method (Simplex Search Method). Explain its operators (Reflection, Expansion, Contraction and Shrink) with graphical representation. **(07)**

Q.4 **(a)** State Master method for solving recurrences. Using Master's method find the worst time complexity of the recurrence $T(n) = T\left(\frac{n}{2}\right) + c$ **(07)**

(b) Define Growth of Functions. Define the Asymptotic Notations: Big-oh (O), Big-Omega (ω), Big-Theta (θ) with its graphical representation. **(07)**

OR

(a) Define NP-Complete and NP-Hard problems. Explain with diagram the concept of P, NP, NP-Complete and NP-Hard. **(07)**

(b) What is Clique? Prove that Clique decision problem is NP-complete. **(07)**

Q.5 Attempt any **SEVEN** out of **TWELVE:** **(14)**

(1) State Unimodal function. State its types.

(2) What is the worst-case complexity (time) of Selection sort and Merge-sort?

(3) Draw a flowchart of the optimal design procedure.

(4) State Exploratory and Pattern move used in Hooke-Jeeves Search Method.

(5) State (only) Vertex Covering Problem?

(6) What is the time complexity of the following code:

```
def func(n):
    for i in range (n):
        for j in range (n):
            print (i, j)
```

A. $O(n)$
B. $O(n \log n)$
C. $O(n^2)$
D. $O(n^3)$

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(7) State in brief: Parabolic penalty function and Infinite Barrier penalty function.

(8) Explain in brief: Crossover and Mutation operator in Genetic Algorithm.

(9) Which of the following sorting algorithms is based on Divide and Conquer algorithmic approach?

A. Bubble sort
B. Selection Sort
C. Insertion sort
D. Quick sort

(10) State (only) Cook's Theorem.

(11) What is the worst-case time complexity of Strassen method?

A. $O(n^3)$
B. $O(n \log n)$
C. $O(n^{\ln 7})$
D. $O(\log n)$

(12) Which of the following asymptotic notations holds the property of Reflexivity, Symmetry and Transitivity?

A. Big Oh notations
B. Big Theta notations
C. Big Omega notations
D. Small Oh notations

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