**Time : 2 ½ Hours** **Total Marks : 60**

**N.B:**
(1) **All questions are compulsory.**
(2) Figures to the **right** indicate full marks.
(3) **Assume additional data if necessary** but state the same clearly.
(4) Symbols have their usual meanings and tables have their usual standard design unless stated otherwise.
(5) Use of **calculators** and statistical tables are **allowed**.

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| Q.1 | Attempt **any two** of the following | **(12)** |
| a) | Explain the role of a designer in the optimization process | **6** |
| b) | What are critical points? Explain its importance to find local minimizer. | **6** |
| c) | Golden section search uses the golden ratio to approximate Fibonacci search. Thus, explain Fibonacci and golden section search on a unimodal function. | **6** |
| d) | Give an example of a nontrivial function where quadratic fit search would identify the minimum correctly once the function values at three distinct points are available | **6** |
| Q.2 | Attempt **any two** of the following | **(12)** |
| a) | Prove that $d^{(k+1)}$ and $d^{(k)}$ are orthogonal using gradient decent | **6** |
| b) | State the first order methods. Thus explain Adagrad method | **6** |
| c) | Explain Secant Method in detail. | **6** |
| d) | When finding roots in one dimension, when would we use Newton's method instead of the bisection method? | **6** |
| Q.3 | Attempt **any two** of the following | **(12)** |
| a) | Explain how to calculate pairwise distance between point in sampling plan. | **6** |
| b) | What is the use of Quasi-Random Sequences? Thus state the quasi-Monte Carlo method's error convergence as compared to Monte Carlo integration. | **6** |
| c) | What is the use of Holdout method? Explain | **6** |
| d) | Explain the linear models in detail. | **6** |
| Q.4 | Attempt **any two** of the following | **(12)** |
| a) | What are different types of uncertainty explain any three. | **6** |
| b) | In the $f(z) \approx \hat{f}(z) = \sum_{i=1}^{k} \theta_i b_i(z)$ explain two inferences of the coefficients. Thus visualize the Orthogonal basis functions for uniform, exponential, and unit Gaussian distributions. | **6** |
| c) | What is dynamic programming? Explain | **6** |
| d) | Explain Ant Colony optimization as an optimal approach for solving Travelling salesman's problem | **6** |

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| Q.5 | Attempt **<u>any two</u>** of the following | **(12)** |
| a) | What is Unimodality? Explain. | **6** |
| b) | Explain the working of, RMSProp. And thus explain its advantages over Adagrad. | **6** |
| c) | Explain how Greedy local search and the exchange algorithm can be used to find a subset of points that maximally fill a space. | **6** |
| d) | When would we use a more descriptive model, for example, with polynomial features, versus a simpler model like linear regression | **6** |

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