25MAP104

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2025
(First Semester)

Branch – **MATHEMATICS**

OPTIMIZATION TECHNIQUES

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Which links all the nodes of the network ? a) Flow b) Path c) Tree d) Spanning Tree	K1	CO1
	2	How can we find the shortest routes between the source node and every other node in the network? a) Minimal spanning tree algorithm b) Maximal-flow algorithm c) Dijkstra's algorithm d) Floyd's algorithm	K2	CO1
2	3	When a state j, it is certain to return to itself in one transition that is $p_{ij} = 1$, then it is called as ____________. a) Periodic b) Recurrent c) Transient d)Absorbing	K1	CO2
	4	Describe that in a closed Markov chain, if all its states are recurrent and aperiodic, then is is said to be ____________. a) Absorbing b) Transient c) Communicate d) Ergodic	K2	CO2
3	5	Which method is suited for analytically tractable probability density functions such as the exponential and the uniform? a) Inverse method b) Convolution method c) Acceptance-rejection method d) Subinterval method	K1	CO3
	6	Compute value of y, if $m = 3, \lambda = 4$ events per hour and $R_1 = .0589, R_2 = .6733, R_3 = .4799$. a) .991 hr b) .992 hr c) .993 hr d) .994 hr	K2	CO3
4	7	When a stationary point X_0 is a minimum point, then the Hessian matrix H is _________. a) Indefinite b) Positive definite c) Negative definite d) Semi definite	K1	CO4
	8	Describe the method for identifying the stationary points of optimization problems with equality constraints : a) Newton-Raphson b) KKT Conditions c) Constrained gradient d) Lagrangean	K2	CO4
5	9	Write the name of the method for finding an interval of uncertainty known to include the optimum solution point? a)Direct search method b) Gradient method c) Inverse method d) Convolution method	K1	CO5
	10	In the following methods which one is used to generate successive points in the direction of the gradient of the function? a) Dichotomous b) Golden section c) Steepet ascent d) Inverse	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	A publisher has a contract with an author to publish a text book. The author submits a hard copy and a computer file of the manuscript. The (simplified) activities associated with the production of the text books are summarized in the following table : Activity — Predecessor(s) — Duration (weeks) A — – — 3 B — – — 2 C — – — 4 D — – — 3 E — A,B — 2 F — E — 4 G — F — 2 H — D — 1 I — G,H — 2 J — C,I — 4 Construct the project network.	K3	CO1
		(OR)		
	11.b.	Illustrate the Critical Path Method Computations for the project network.		
2	12.a.	Given transition matrix $P = \begin{pmatrix} .30 & .60 & .10 \\ .10 & .60 & .30 \\ .05 & .40 & .55 \end{pmatrix}$ with $a^0 =$ (1,0,0). Determine the absolute probabilities of the three states of the system after 1, 8 and 16 and investigating the resulting probabilities of the transition matrix P.	K3	CO2
		(OR)		
	12.b.	Define Markov chain process and its classification of the states.		
3	13.a.	Explain inverse method with exponential distribution.	K5	CO3
		(OR)		
	13.b.	Explain subinterval method with example.		
4	14.a.	By using Newton-Raphson method to estimate the stationary points of $g(x)$, if $g(x) = (3x-2)^2(2x-3)^2$.	K2	CO4
		(OR)		
	14.b.	By using constrained derivatives to estimate the constrained extreme points of the following problem: $Minimize\ f(X) = x_1^2 + x_2^2 + x_3^2$ Subject to $g_1(X) = x_1 + x_2 + 3x_3 - 2 = 0$ $g_2(X) = 5x_1 + 2x_2 + x_3 - 5 = 0$		
5	15.a.	By using dichotomous and golden section methods with $\Delta = 1$, to verify that the maximum value of $f(x)$ occurs at $x = 2$. If $Maximize\ f(x) = \begin{cases} 3x, & 0 \le x \le 2 \\ \frac{1}{3}(-x+20), & 2 \le x \le 3 \end{cases}$	K5	CO5
		(OR)		
	15.b.	Explain about Separable programming algorithm.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Construct the project network for the following table and determine the critical path. All the durations are in days. Activity / Predecessor(s) / Duration (days) A – 5 B – 6 C A 3 D A 8 E B,C 2 F B,C 11 G D 1 H E 12	K3	CO1
2	17	A product is processed on two sequential machines I and II. Inspection takes place after a product unit is completed on either machine. There is a 5% chance that the unit will be junked before inspection. After inspection, there is a 3% chance the unit will be junked and a 7% chance of being returned to the same machine for reworking. Else, a unit passing inspection on both machines is good. (a) For a part starting at machine I, determine the average number of visits to each state. (b) If a batch of 1000 units is started on machine I, determine the average number of completed good units. For the Markov chain, the production process has 6 states: start at $I(s1)$, inspect after $I(i1)$, start at $II(s2)$, inspect after $II(i2)$, junk after inspection I or $II(J)$, and good after $II(G)$. States J and G are absorbing states. The transition matrix is given as $P = \begin{pmatrix} 0 & .95 & 0 & 0 & .05 & 0 \\ .07 & 0 & .9 & 0 & .03 & 0 \\ 0 & 0 & 0 & .95 & .05 & 0 \\ 0 & 0 & .07 & 0 & .03 & .9 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}.$	K3	CO2
3	18	Estimate the area of the following circle by using Monte Carlo sampling : $(x-1)^2 + (y-2)^2 = 25$.	K5	CO3
4	19	Explain about inequality Constraints-Karush-Kuhn Tucker conditions for determining the stationary points.	K2	CO4
5	20	Solve the following problem by using KKT conditions to estimate the optimum solution. $Max\ z = 4x_1 + 6x_2 - 2x_1{}^2 - 2x_1x_2 - 2x_2{}^2$ Subject to $x_1 + 2x_2 \leq 2$ $x_1, x_2 \geq 0$.	K5	CO5

Z-Z-Z END