Seat No. : _______________

AG-123

April-2025

B.Sc., Sem.-VI

CC-311 : Mathematics

(Convex Analysis and Probability Theory)

Time : 2:30 Hours] **[Max. Marks : 70**

Instructions : (1) **All** the questions are compulsory and carry equal marks.

(2) Notations are usual everywhere.

(3) The right hand side figures indicate marks of the question/sub-question.

1. (A) Define Convex set and prove that intersection of any two convex sets is a convex set. **9**

(B) If I is an interval and $f : I \rightarrow R$ is a strictly monotonic function such that f(I) is an interval then prove that the function f is one-one and continuous. **9**

OR

1. (A) Define Convex and Concave functions.

Also prove that the norm function $f : R^2 \rightarrow R$ defined as $f(x, y\} = \sqrt{x^2 + y^2}$ is a convex function on R^2. **9**

(B) If I is an interval and $f : I \rightarrow R$ is a strictly monotonic function such that f(I) is an interval then prove that the function f is one-one and continuous. **9**

2. (A) If I is an interval containing more than one point and $f : I \rightarrow R$ is a differential function then prove that f' is non-negative throughout I $\Leftrightarrow$ f is monotonically increasing on I. **9**

(B) State and prove the Bivariate Intermediate Value Theorem. **9**

OR

2. (A) (i) Define : **9**

Equally likely Elementary event, Classical and axiomatic definitions of probability.

(ii) Define Sample space with its types. Give one example for each of the three terms.

(B) Two balanced dice thrown once, simultaneously. **9**

Describe the sample space.

Find the probability of the following events :

(i) Even number on the first dice and odd on second dice.

(ii) Sum of points on both dice are 7.

(iii) Difference of numbers on two dice is divisible by 5.

3. (A) Define the following terms : **9**

Sample space, impossible and certain events, mutually exclusive and exhaustive events, equi-probable elementary events, empirical and classical probability.

(B) A random variable X follows Poisson distribution with parameter m, such that $P(X=2) = P(X=3)$, then find parameter m and also find $P(X=0)$, $P(X<2)$, $P(X>2)$. **9**

OR

3. (A) For a normal distribution, state its probability distribution function. Also, state mean, variance, mode and median of normal distribution. **9**

(B) A car hire firm has two cars, which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson with mean 1.5. Calculate the probability of events (i) neither car is used on a particular day, (ii) some demands are refused. **9**

4. Attempt any **Eight** of the following questions in short : **16**

(a) The function $f : R \to R$ defined by $f(x) = x^2$ is increasing on $(0, \infty)$. True or False ?

(b) Give examples each one of convex and non-convex sets of R^2.

(c) Define Convex linear combination and convex hull of a set.

(d) State the supporting hyperplane theorem.

(e) Define Convex and Concave functions on an interval I.

(f) If $A = \{(x, y) \in R^2 / x^2 + y^2 = 4\}$, then find the convex hull of A.

(g) Two coins are tossed, find the probability that exactly two heads appear.

(h) What are independent events ? If events A and B are independent, then are $\overline{A}$ and B independent ?

(i) If $P(A \cap B) = P(A)P(B)$, then events A and B are independent events.

(j) If $A = \phi$, then value of $P(A|B)$ more than 0.

(k) State Bayes' theorem on probability.

(l) For two mutually exclusive events A, B on a finite sample space S, $P(\overline{A}|B) = 1$. Do you agree ? If yes, justify.

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April-2025

B.Sc., Sem.-VI

CC-311 : Mathematics

(Operations Research)

Time : 2:30 Hours] **[Max. Marks : 70**

Instructions : (1) **All** the questions are compulsory.

(2) Notations and terminologies are standard.

(3) Figures to the right indicates the full marks.

1. (A) Explain Economic Order Quantity (EOQ) model with finite replenishment rate. **9**

(B) A company uses rivets at a rate of 5000 kg. per year, rivets costing ₹ 2 per kg. It costs ₹ 20 to place an order and the carrying cost of inventory is 10% per annum. How frequently should order for rivets be placed and how much ? **9**

OR

1. (A) Explain Order-Level, Lot-Size System model. Find minimum cost for this model and optimum shortage level. **9**

(B) The demand for an item in a company is 8000 units per year, and the company can produce the item at a rate of 3000 per month. The cost of one set-up is ₹ 500 and the holding cost of one unit per month is ₹ 0.15. The shortest cost of one unit is ₹ 20 per month. Determine the optimum manufacturing quantity and the number of shortages. Also determine the manufacturing time and the time between two set-ups. **9**

2. (A) Explain basic difference between PERT and CPM. **9**

(B) Consider the following data regarding the project : **9**

Activity	A	B	C	D	E	F	G	H	I
Immediate Predecessor	–	A	B	B	C	D	C	E, F	G, H
Duration	5	7	2	3	1	2	1	3	10

Find the critical path.

OR

2. (A) Construct the project network. Find total and free float for each non-critical activity. **9**

Act.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Imm. Pred	–	–	–	A	A	B	B	C	C	D	E	F	G	H	I	J, K, L	M, N, O
Duration	4	8	5	4	5	7	4	8	3	6	5	4	12	7	10	5	8

(B) Consider the following project. Draw a network diagram. **9**

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Predecessors	–	–	–	A	A	E	B	B	D, F	C	H, J	G, I, K

3. (A) Explain dominance principal. **9**

(B) Solve the following game graphically : **9**

Player B

Player A		B_1	B_2	B_3
	A_1	– 4	3	–1
	A_2	6	– 4	–2

OR

3. (A) Obtain the formula to find optimum strategies in 2×2 two-person zero sum game with mixed strategy. **9**

(B) Solve the following game : **9**

Player B

Player A

	B_1	B_2	B_3	B_4
A_1	–1	2	3	0
A_2	–4	–1	–1	0
A_3	–1	1	1	–4
A_4	4	–1	2	–7

4. Attempt any **eight** in short : **16**

(1) List the costs which are involved in inventory problem.

(2) Define : Lead time, Demand.

(3) What is the carrying cost in EOQ model with finite replacement rate if production rate = demand rate ?

(4) Given the following information, develop a network :

Activity	**Immediate Predecessor**
A	–
B	–
C	A
D	B

(5) Define : Project.

(6) Define : Two-person zero sum game.

(7) Define : Free Float.

(8) Solve the following game :

Player B

Player A		B_1	B_2	B_3	B_4
	A_1	8	–2	9	–3
	A_2	6	5	6	8
	A_3	–2	4	–9	5

(9) Define : A mixed strategy.

(10) List any two methods which are used to solve the games without saddle point.

(11) Define : Inventory.