ARYA INSTITUTE OF ENGINEERING & TECHNOLOGY
GUESS PAPERS
(B.Tech. III Semester 2025- 2026)

AEM 3CS2-01

Unit 1:

Short Answers: (2 Marks Each)

Q. 1 Define distribution functions for continuous random variables.
Q. 2 Define Moment Generating function of Poisson distribution.
Q. 3 Define Karl Pearson's coefficients of Skewness and Kurtosis.
Q. 4 Write statement of chebyschev's inequality.
Q. 5 Describe the relation between moment about mean and moment about origin.
Q. 6 Explain marginal probability distribution of X and Y for continuous random variables?

Descriptive Answers: (5 to 20 Marks)

Q. 1 A continuous random variable X has the following distribution function:-

$$F(X) = \begin{cases} 0 & if \quad x \le 1 \\ k\,(x-1)^4 & if \quad 1 < x \le 3 \\ 1 & if \quad x > 3 \end{cases}$$

Find (i) k (ii) pdf f (x).

Q. 2 Calculate the first four moments about mean for the following distribution and also calculate $\beta_1, and\ \beta_2$.

X	0	1	2	3	4	5	6	7	8
Y	1	8	28	56	70	56	28	8	1

Q. 3 Three groups of children consist of 3 girls and 1 boy , 2 girls and 2 boys and 1girl and 3 boys respectively. One child is selected at random from each group. Show that the chance that the three selected consist of 1 girl and 2 boys is 13/23.

Q. 4 The first four moments about the value 5 of a variable are 2, 20, 40 and 50. Find (i) moments about mean, Variance, $\beta_1 and\ \beta_2.$ also give the nature of distribution.

Q. 5 The join probability mass function of (X, Y) is given by p(x,y) =k(2x+3y), x=0, 1, 2; y=1, 2, 3.

Find: - (i) k (ii) Marginal probability distribution of X. (iii) Conditional distribution of Y given X = 2.

(iv) The probability distribution of (X+Y).

Q. 6 The first four moments about the value 4 of a variable are - 1.5, 17, - 30 and 108. Find (i) moments about mean, variance, $\beta_1 and\ \beta_2.$ also give the nature of distribution.

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Unit 2:

Short Answers:(2 Marks Each)

Q. 1 following set of observations

x	1	2	3	4	5
y	2	5	3	8	7

Find the standard error of estimate of $y on x$.

Q. 2 Explain the method of least square for fitting of a second degree parabola.
Q. 3 Find mean and standard deviation of the exponential distribution.
Q. 4 Define mathematical Expectation for discrete & continuous random variables.
Q. 5 Prove that the normal probability distribution is one.
Q. 6 Define Uniform probability distribution.

Descriptive Answers: (5 to 20 Marks)

Q. 1 In a partially destroyed Laboratory record of an analysis of correction data, the following results only are legible:

Variance of x=9. Regression equation, 8x-10y+66=0; 40x-18y=214.

Find (i) variance of y. (ii) the coefficient of correlation between x and y.

Q. 2 Find the angle between the two lines of regression, interpret the case when r ±1, 0.
Q. 3 Three judges gave the following marks for ten competitors, determine which pair of judges have nearly same approach ..

X	1	6	5	10	3	2	4	9	7	8
Y	6	4	9	8	1	2	3	10	5	7
Z	3	5	8	4	7	10	2	1	6	9

Q. 4 In a normal distribution 31% of the item are under 45 and 8% are over 64. Find the parameters distribution?

Q. 5 Find the rth moment of the rectangular distribution, about the point x=a, whose pdf is f (x) = $\frac{1}{b-a}$ for a≤ x ≤ b.

Q. 6 A sample of 100 dry battery cells tested to find the length of life produced the following results. μ (mean) =12 hrs. And standard deviation 3 hrs. Assuming the data to be normally distributed. What percentage of battery cells is expected to have life. (i) More than 15 hrs. (ii) Less than 6 hrs. (iii) Between 10 and 14 hrs.

Unit 3:

Short Answers: (2 Marks Each)

Descriptive Answers: (5 to 20 Marks)

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Q. 1 Write short note on Historical development in optimization techniques.

Q. 2 write the statement and classification of optimization problem.

Q. 3 write the short note on Engineering application of optimization.

Q. 4 A firm manufactures headache pills in two sizes A and B. Size A contains two grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine, Size B contain 1 grain of aspirin, 8 grain of bicarbonate and 6 grain of codeine It has been found by user that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate effects. Explain it in mathematical formulation.

Q. 5 An animal food company must produced 200 kg of mixture containing ingredients A and B daily. Ingredient A costs Rs 3.00 per kg and B costs Rs 8.00 per kg. No more than 80 kg of A can be used and at least 60 kg of B must be used. Formulate the problem.

Q. 6 A firm produces 3 products A,B and C with profits per unit Rs 3, Rs 2 and Rs 4 respectively. The firm has two machines D and E. the required processing time in minutes for each machine on each, product is given below:

	A	**B**	**C**
D	**3**	**2**	**4**
E	**2**	**1**	**3**

Machine D and E have 1800 and 2400 machine minutes respectively. The firm must manufacture 100 A's, 200 B's and 50 C's but not more than 150 A's. Set up an LPP to maximize the profit.

Unit 4:

Short Answers: (2 Marks Each)

Q. 1 Optimize $Z = x_1^2 + x_2^2 + x_3^2$

Subject to $4x_1 + x_2^2 + 2x_3 = 14.$

Q. 2 find the dual of the following LPP

Min $z = 5x_1 + 2x_2$

St $3x_1 + x_2 = 4$

$2x_1 + x_2 \geq 3$

$x_1 + 2x_2 \leq 3$

and $x_1, x_2 \geq 0$.

Q. 3 Obtain the extreme points (if any) of

$f(x) = x_1^2 + x_2^2 + 2x_1^2 + 4x_2^2 + 6.$

Q. 4 Find the maximum and minimum values of the function

$f(x) = 12x^5 - 45x^4 + 40x^3 + 5$

Q. 5 Find the maximum and minimum values of the function:

$f(x_1x_2) = 8x_1x_2 + 3x_2^2$

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Descriptive Answers: (5 to 20 Marks)

Q. 1 Use Kuhn-Tucker conditions to

Minimize $f(x) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2 + 20x_1 + 10x_2)$

s.t. (i)$x_1 \geq 40$, (ii)$= x_1 + x_2 \geq 80$, (iii) $x_1 + x_2 + x_3 \geq 120$.

Q. 2 Minimize $f(x) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2)$

s.t. g_1(x)$= x_1 - x_2 = 0$, g_1(x)$= x_1 + x_2 + x_3 - 1 = 0$.

By Lagrange's multiplier method.

Q. 3 Solve the following problem

Min $f(x) = x_1^2 + x_2^2 + x_3^2$

s.t. $x_1 + x_2 + x_3 \geq 5, x_2x_3 - 2 \geq 0, \quad x_1 \geq 0, x_2 \geq 0, x_3 \geq 2$.

Determine whether K-T conditions are satisfied at the following points

$X_1 = \left(\frac{3}{2}, \frac{3}{2}, 2\right), \qquad X_2 = \left(\frac{4}{3}, \frac{2}{3}, 3\right)$

Q. 4 Minimize $f(x) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2)$

s.t. g_1(x)$= x_1 - x_2 = 0$, g_1(x)$= x_1 + x_2 + x_3 - 1 = 0$.

By Lagrange's multiplier method.

Q. 5 Optimize Z $= x_1^2 + x_2^2 + x_3^2$

Subject to $4x_1 + x_2^2 + 2x_3 = 14$.

Unit 5:

Short Answers:(2 Marks Each)

Q.1 Define the following terms:

1) Basic variable
2) Basic solution
3) Slack variable
4) Artificial variable, and
5) Feasible solution

Q.2 Write primal and dual correspondence in LPP.
Q.3 Differentiate between transportation and Assignment methods.
Q.4 Write the significance of duality theory in linear programming.

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Q.5 Solve the minimal assignment problem whose effectiveness matrix is given below:

Jobs / Persons	1	2	3	4
A	2	3	4	5
B	4	5	6	7
C	7	8	9	8
D	3	5	8	4

Q. 6 A firm manufactures headache pills in two sizes A and B. Size A contains two grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine, Size B contain 1 grain of aspirin, 8 grain of bicarbonate and 6 grain of codeine It has been found by user that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate effects. Use simplex method to determine the least number of pills a patient should have to get immediate relief.

Descriptive Answers: (5 to 20 Marks)

Q. 1 Find optimum solution of the following transportation problem.

D / O	D_1	D_2	D_3	Supply
O1	5	1	7	10
O2	6	4	6	80
O3	3	2	5	15
Demand	75	20	50	

Q. 2 A company is spending Rs 1000 on transportation of its units to four warehouses from three factories. What can be the maximum saving by optimal scheduling. Solve the following transportation problem:

Factory ↓	← Warehouses→ W-1	W-2	W-3	W-4	W-5
F-1	19	30	50	10	7
F-2	70	30	40	60	9
F-3	40	8	70	20	18
Demand	5	8	7	14	

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Q. 3 Use VAM method to Solve the following transportation problem.

	D_1	D_2	D_3	available
O_1	2	7	4	5
O_2	3	3	1	8
O_3	5	4	7	7
O_4	1	6	2	14
demand	7	9	18	

Q. 4 Solve the following LPP by two phase method.

Min $z = 5x_1 + 2x_2$

St $3x_1 + x_2 = 4$

$2x_1 + x_2 \geq 3$

$x_1 + 2x_2 \leq 3$

and $x_1, x_2 \geq 0$.

Q. 5 Use duality to solve the following LPP.

Min $z = 3x_1 + x_2$

St $x_1 + x_2 \geq 1$

$2x_1 + 3x_2 \geq 2$. and $x_1, x_2 \geq 0$.

Q. 6 A campany has 5 jobs to be done, the following matrix shows the return in Rs. Of assigning ith (i=1, 2… ,5). Assign the five jobs to the five machines so as to maximize the total return.

Machines	Jobe-1	Jobe-2	Jobe-3	Jobe-4	Jobe-5
A	5	11	10	12	4
B	2	4	6	3	5
C	3	12	5	14	6
D	6	14	4	11	7
E	7	9	8	12	5