COURSE CODE: 18P1WGE101   MAX. MARKS: 25
COURSE NAME: Research Methodology
COURSE CREDITS: 3   MAX. TIME: 1Hr 30 Mins

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Use of scientific calculator is allowed.

SECTION-A (STATISTICS PART)

(ATTEMPT ANY THREE QUESTIONS IN THIS SECTION)

Q.1 A new drug study was conducted by a drug company in Medical Town. In the study, 15 people were chosen at random to take Vitamin X for 2 months and then have their cholesterol levels checked. In addition, 15 different people were randomly chosen to take Vitamin Y for 2 months and then have their cholesterol levels checked. All 30 people had cholesterol levels between 8 and 10 before taking one of the vitamins. The drug company wanted to see which of the 2 vitamins had the greatest impact on lowering people's cholesterol. The following data was collected:

Vitamin X:	7.2	7.5	5.2	6.5	7.7	10.0	6.4	7.6	7.7	7.8	8.1	8.3	7.2	7.1	6.5
Vitamin Y:	4.8	4.4	4.5	5.1	6.5	8.0	3.1	4.6	5.2	6.1	5.5	4.2	4.5	5.9	5.2

Draw a box-and-whisker plot for both sets of data on the same number line. Use the double box-and-whisker plots to compare the 2 vitamins and provide a conclusion for the drug company.

[3]

Q.2 The first of the two samples has 100 items with mean 15 and standard deviation 3. If the whole group has 250 items with mean 15.6 and standard deviation 3.67, then find the standard deviation of the second group. [3]

Q.3 Fit a binomial distribution for the following data and also test the Chi-square goodness of fit at 5% level.

Value of X(x):	0	1	2	3	4	5	6	Total
Frequency (f):	5	15	25	35	25	15	5	125

[Given $\chi^2_{(3)} = 7.815, \chi^2_{(4)} = 9.488, \chi^2_{(5)} = 11.070, \chi^2_{(6)} = 12.592, \chi^2_{(7)} = 14.067$ at 5% Level]   [3]

Q.4 **(A)** A toy is rejected if the design is faulty or not. The probability that the design is faulty is 0.1 and that the toy is rejected if the design is faulty is 0.95 and otherwise 0.45. If a toy is rejected, what is the probability that it is due to faulty design?

(B) For the following probability density function (*pdf*):

$$f(x) = cx(1-x); 0 < x < 1$$

Find the value of c.   [2+1=3]

SECTION-B (MATHEMATICS PART)

Q.5 Answer the following questions: [6]

(i) Write the rotation matrix which will transform the vector [1, 0] to [1, -1].

(ii) For the following matrix A, if the eigenvalues are 4 and 8, then find the values of x and y:

$$A = \begin{bmatrix} 2 & 3 \\ x & y \end{bmatrix}$$

(iii) Find the value of b for which the system of linear equations has a non-trivial solution:

$$2x + y + 2z = 0$$
$$x + y + 3z = 0$$
$$4x + 3y + bz = 0.$$

[PTO]

(iv) For which value of μ, the rank of the following matrix is 3 ?

$$\begin{bmatrix} \mu & -1 & 0 & 0 \\ 0 & \mu & -1 & 0 \\ 0 & 0 & \mu & -1 \\ -6 & 11 & -6 & 1 \end{bmatrix}$$

Q.6. Investigate for what value of α, β the simultaneous equations [2]

$x + y + z = 6, x + 2y + 3z = 10, x + 2y + \alpha z = \beta$, have (i) no solution (ii) a unique solution.

Q.7. Four different jobs can be done on four different machines. The set up and take down time costs are assumed to be prohibitively high for changeovers. The matrix below gives the cost in rupees of producing jobs i on machine j :

	M_1	M_2	M_3	M_4
J_1	5	7	11	6
J_2	8	5	9	6
J_3	4	7	10	7
J_4	10	4	8	3

How should the jobs be assigned to the various machines so that the total cost is minimized? [4]

Q8. Solve the following linear programming problem:

$$Max.Z = 45x_1 + 80x_2$$

$s.t.$

$$5x_1 + 20x_2 \leq 400$$ [4]
$$10x_1 + 15x_2 \leq 450$$
$$x_1, x_2 \geq 0$$

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