

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-IV (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2140606

Date: 30/05/2017

Subject Name: Numerical and Statistical Methods for Civil Engineering

Time: 10:30 AM to 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Statistical Tables are required.

MARKS

Q.1 Short Questions

14

- 1 In tossing 3 balanced coins, what is the probability of getting 2 heads?
- 2 Compute $P(A/B)$, if $P(A) = 0.6$, $P(B) = 0.7$ and $P(A \cap B) = 0.3$
- 3 What is the point of intersection of two regression lines: y on x and x on y?
- 4 Write the name of interpolation methods for unequally spaced arguments.
- 5 Write diagonally dominant condition for system of linear equations.
- 6 What is the convergent rate of Bisection method and Newton's Raphson method?
- 7 If the values of regression coefficients $b_{xy} = 0.8$ and $b_{yx} = 0.4$, then find the correlation coefficient r .
- 8 Is $f(x) = \frac{x}{6}$, $x = 0, 1, 2, 3, 4$ define probability distribution? Justify your answer.
- 9 Define: Positive correlation and Negative correlation.
- 10 Can we take initial interval (0,1) to solve $f(x) = x^3 + 2x + 1$ using Bisection method? Justify.
- 11 What is mathematical expectation if we stand to win \$8 if and only if a balanced coin comes up heads?
- 12 Rank correlation method is used for which type of data? And what is the range of rank correlation coefficient?
- 13 What is the degree of precision for 3 point Gauss Integration formula.
- 14 Write mean and variance of Poisson distribution.

Q.2 (a) Perform three iterations of the bisection method to obtain the approximate root of the equation $2 \sin x - x = 0$. Take (1,2) as initial interval. **03**

(b) Find the real root of the equation $3x = \cos x + 1$, taking $x_0 = 1$ by Newton Raphson method correct to four decimal places. **04**

(c) In environmental Geology computer simulation was employed to estimate how far a block from a collapsing rock wall bounce down a soil slope. Based on the depth, location and angle of block soil impact marks left on the slope of the actual rock fall, the following 10 rebound lengths(meters) were estimated. Compute mean, median, mode, standard deviation and variance of the rebounds. **07**

10.2	9.5	8.3	9.7	9.5	11.1	7.8	8.8	9.5	10
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OR

- (c) i) Write assumptions of Binomial Distribution. 07
ii) The following table gives the probabilities that a certain computer will malfunction 0,1,2,3,4,5 or 6 times on any one day:

No. of mal-functions $x :$	0	1	2	3	4	5	6
Prob. $f(x)$	0.17	0.29	0.27	0.16	0.07	0.03	0.01

Find the mean and standard deviation of this probability distribution.

- Q.3 (a)** In producing screws, let A mean “screw too slim” and B “screw too short”. Let $P(A) = 0.1$ and let the conditional probability that a slim screw is also too small be $P(B/A) = 0.2$. What is the probability that the screw that we pick randomly from the lot produced will be both too slim and too short? 03
- (b)** The breaking strength X[kg] of a certain type of plastic block is normally distributed with a mean of 1250 kg and a standard deviation of 55 kg. What is the maximum load such that we can expect no more than 5% of the block to break? 04
- (c)** Three boxes contain 10%, 20% and 30% of defective finger joints. A finger joint is selected at random which is defective. Determine the probability that it comes from
i) 1st box ii) 2nd box iii) 3rd box 07

OR

- Q.3 (a)** The following data represents the rank of 10 students in two subjects, Environmental Studies (ES) and Mechanics of Solids (MoS). Find the rank correlations. 03

ES	4	5	7	8	10	1	3	6	2	9
MoS	3	4	7	9	10	8	6	5	2	1

- (b)** Compute correlation coefficient between X and Y using the following data: 04

X	2	4	5	6	8	11
Y	18	12	10	8	7	5

- (c)** Let $y = (-3/2)x + 13$ and $x = (-1/6)y - (31/6)$ be the two regression lines. 07
i) Find the mean value and coefficient of correlation between x and y
ii) If the variance of y is 4, find the standard deviation of x .

- Q.4** 03

- (a)** Prove the relation: i) $\Delta = E - 1$ ii) $\Delta = \nabla E = \delta E^{\frac{1}{2}}$ 03
- (b)** Derive normal equations to fit a quadratic curve $y = a_0 + a_1x + a_2x^2$ using Least Squares method. 04
- (c)** Fit a straight line to the x and y values from the following table, and use the equation to determine the value of y when $x = 2.4$. 07

$x :$	1	2	3	4	5	6	7
$y :$	0.5	2.5	2.0	4.0	3.5	6.0	5.5

OR

Q.4 (a) A wind force distributed against the side of a skyscraper is measured as **03**

Height l, m	0	30	60	90	120
Force, $F(l), N / m$	0	350	1000	1500	2600

Use Simpson's $1/3^{rd}$ rule to compute the net force.

(b) The shear stress, n kips per square foot(ksf), of four specimens taken at various depth in a clay stratum are: **04**

Depath, m	2	3	5	7
Stress, ksf	0.1506	0.3001	0.4517	0.6259

Use Lagrange's interpolation formula to estimate the shear stress at a depth of 4 m.

(c) Compute the values of $f(x)$ at $x = 0.02$ and $x = 0.38$ using Newton's Forward difference and Newton's Backward difference interpolation formula respectively for the data given below. **07**

x	0.0	0.1	0.2	0.3	0.4
$f(x)$	1.0000	1.1052	1.2214	1.3499	1.4918

Q.5 (a) A river is 50 feet wide. The depth d in feet at a x feet from one bank is given by: **03**

x	0	10	20	30	40	50
d	0	4	7	9	12	15

Use Trapezoidal rule to find the area of cross-section of the river

$$A = \int_0^{50} d \, dx .$$

(b) Solve the following system of equations using Gauss elimination method. **04**

$$3x + 4y + 5z = 40; \quad 2x - 3y + 4z = 13; \quad x + y + z = 9$$

(c) Check diagonally dominant condition for the following system, and then solve the system using Gauss Seidel method. **07**

$$30x - 2y + 3z = 75; \quad 2x + 2y + 18z = 30; \quad x + 17y - 2z = 48$$

OR

Q.5 (a) Use Euler's method to find the approximate value of y at $x = 1.3$ **03**

taking $h=0.1$. Given $\frac{dy}{dx} = \frac{y-x}{\sqrt{xy}}$ and $y(1) = 2$.

(b) Solve $\frac{dy}{dx} = 1 + y^2, y(0) = 0$, using Taylor's series method and find the value of y for $x = 0.2$, taking $h=0.2$. **04**

(c) Solve the differential equation $\frac{dy}{dx} = x + y$, using the 4th order Runge-Kutta method, where $y(0) = 1$, from $x = 0$ to $x = 0.2$ taking step size 0.1. **07**
