Master of Biomedical Engineering and M.Tech FTBE Examination, 2017

(1st Year, 1st Semester)

Biomathematics and Biostatistics

Time: Three hours | Full Marks: 50

Use Separate Answer Scripts for each Part

Part-I

Answer **any five** questions

Q-1) Apply Runge-Kutta fourth order method to find the value of y for x = 1 in steps of 0.5 given that y = 1 when x = 0 and that 10 Marks

$$\frac{dy}{dx} = \frac{y - x}{y + x}$$

Q-2) Solve: - 10 Marks

$$\frac{\partial^2 z}{\partial x^2} - 4\frac{\partial^2 z}{\partial x \partial y} + 4\frac{\partial^2 z}{\partial y^2} = e^{2x+y}$$

Q-3) Find a polynomial which attains the following tabular values 10 Marks

x	1	2	- 4
y	3	-5	4

Q-4) Using the table below, calculate the values of $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 1.5 10 Marks

x	0	1	2	3	4
y	6.9897	7.4036	7.7815	8.1291	8.4510

PTO

Q-5) Evaluate 10 Marks

$$I = \int_{0.1}^{0.2} \sqrt{(1 - x^2)}\, dx$$

Using

(i) Simpson's $\frac{1}{3}$ rule

(ii) Simpson's $\frac{3}{8}^{th}$ rule

taking eight sub – intervals for each of the above two method

Q-6) Find the root correct upto three decimal places for the following equation using Bisection method 10 Marks

$$x^3 + x^2 - 1 = 0$$

or

Write program/ algorithm to solve it

Q-7) Solve the following set of equations using Gauss-Elimination method: 10 Marks

$$\begin{aligned} 10x - 7y + 3z + 5u &= 6 \\ -6x + 8y - z - 4u &= 5 \\ 3x + y + 4z + 11u &= 2 \\ 5x - 9y - 2z + 4u &= 7 \end{aligned}$$

Q-8) Solve the following set of equations, correct upto three decimal places, using Gauss-Seidel method 10 Marks

$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$

or

Write program or algorithm to solve the above set of equations

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Master of Biomedical Engineering, 1st Semester, Examination 2017

Subject: BIOMATHEMATICS AND BIOSTATISTICS

Time: Three Hours **Full Marks: 100**

(50 Marks for each part)

Use a separate Answer-Script for each part

PART-II

Answer any FIVE

1. State Central limit theorem for the nature of distributions of sample means of the same size from a non-normal population. 2+1+6+1

What do you understand by sample error of the Mean?

If a population of measurements has Mean 47 mm and S.D. 12 mm, find the probability of drawing from it a random sample of 36 measurements that has a mean larger than 50 mm.[Given Z (1.5) = .0668].

If such random samples are 500 in number, find out how many of them would have means larger than 50 mm.

Do you think that the same statistic can be used to solve the problem if the sample size is 16? Justify your argument.

2. Distinguish between simple random sampling with Replacement (SRSWR) and the same without Replacement (SRSWOR). Prove that 2+5+3

$\text{Mean}(\bar{x}) = \mu$ in SRSWR and SRSWOR, where μ is the population mean

$\text{Var}(\bar{x}) = \frac{\sigma^2}{n}$ in SRSWR, where σ is the population variance

Deduce that if the population is infinite, then $S^2 = \sum (x_i - \bar{x})^2 / n$ is a biased estimator of σ^2, bias being negligible for large n. But $s^2 = \sum (x_i - \bar{x})^2 / (n-1)$ is an unbiased estimator of σ^2.

3. Body temperatures measured in (^0C) of 25 intertidal crabs placed in air at 24.3 (^0C) are: 6+2+2

25.8,24.6,26.1,22.9,25.1,27.3,24.0,24.5,23.9,26.2,24.3,24.6,23.3,25.5,28.1,24.8, 23.5,26.3,25.4,25.5,23.9,27.0,24.8,22.9,25.4 - Test:

$H_0 : \mu = 24.3, H_A : \mu \neq 24.3$, given the values of t statistic as

ν	$\alpha(2)$	0.50	0.20	0.10	0.05	0.02	0.01
24	.05	0.685	1.318	1.711	2.064	2.492	2.791

Find .the exact probability of accepting or rejecting the null hypothesis.

Find also the confidence intervals and confidence limits for the mean.

4. Deduce the formula of 'Pooled variance' for two sample variances, mentioning restrictions, if any.

The data are the number of moths caught during the night by eleven traps of one style and eight traps of a second style

Trap Type 1: 41,34,33,36,40,25,31,37,34,30,38

Trap Type 2 : 52,57,62,55,64,57,56,55

Test the hypothesis

$H_0 : \mu_1 = \mu_2, H_A : \mu_1 \neq \mu_2$, $\alpha = .05$, μ_1, μ_2 are the population means,given $t_{0.05(2)17} = 2.11$

5. If the problem is to check whether the means of three populations are same or not, what is the drawback in testing the equality of first two means and second and third means sequentially? 1+9

A Laboratory employs a certain technique for determining the phosphorous content of a hay. Each of four randomly selected technicians was given five samples from the same batch of hay. 'Do phosphorous determinations differ with the technician performing the analyses?

The results of the twenty phosphorous determinations in mg phosphorous/g of bay) are given as

Technician			
1	2	3	4
34	37	34	36
36	36	37	34
34	35	35	37
35	37	37	34
34	37	36	35

6. Obtain the equation of regression line of Y on X for two 8+2

data sets X = x_1 , x_2, ..., x_n and Y = y_1 , y_2, ..., y_n in the form $y-\bar{y}=b_{yx}(x-\bar{x})$. Write down the regression line as $x-\bar{x}=b_{xy}(y-\bar{y}),\bar{x},\bar{y}$ being the mean values the data sets X and Y respectively. Deduce that $b_{yx}\cdot b_{xy}=r^2$, r being the correlation coefficients between X and Y.

7. Prove that the correlation coefficient r satisfies the relation $|r|\leq 1$. What are the geometrical interpretations of r = 1 or -1, and r<1. 3+2+5

A random sample of 28 pairs of observations shows a correlation coefficient of .74. Is it reasonable to believe that the sample comes from a bivariate normal population with correlation coefficient 0.6?