CBCS SCHEME

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18MEM/MPD/MPE/MPM/MPT/
MPY/MSE/MDE/MEA/MMD11

First Semester M.Tech. Degree Examination, Dec.2019/Jan.2020

Mathematical Methods in Engineering

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. If $R = 10x^3y^2z^2$ and errors in x, y, z are respectively 0.03, 0.02, 0.01 respectively at x = 3, y = 2, z = 1. Calculate the absolute error and percentage error in R. **(10 Marks)**

b. A parachute of mass 68.1kg jumps out of a stationary hot air ballon. Use finite difference scheme to compute velocity prior to opening the chute, the drag coefficient is 12.5 kg/sec. Employ a step size of 2 seconds for calculation. **(10 Marks)**

OR

2 a. Using the data sin (0.1) = 0.09983 and sin (0.2) = 0.19867. Find an approximate value of sin (0.15) by Lagrange interpolation. Obtain a bound on the truncation error. **(10 Marks)**

b. Suppose that in winter the daytime temperature in a certain office building is maintained at 70°F. The heating is shut off at 10PM and turned on again 6AM. On a certain day the temperature inside the building at 2AM was found to be 65°F. The outside temperature was 50°F at 10PM and had dropped to 40°F by 6AM. What was the temperature inside the building when the heat was turned on at 6AM? Use Newton's law of cooling equation $\frac{dT}{dt} = K(T - T_A)$. **(10 Marks)**

Module-2

3 a. Two samples are drawn from two normal populations. From the following data, test whether the two samples have the same variance at 5% level.

Sample 1:	60	65	71	74	76	82	85	87	
Sample 2:	61	66	67	85	78	63	85	86	88

(10 Marks)

b. The three drying techniques for curing a glue were studied and the following times were observed:

Formula A:	13	10	8	11	8	
Formula B:	13	11	14	14		
Formula C:	4	1	3	4	2	4

At $\alpha = 0.01$, test the hypothesis that the average times for the three formulae are same. **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

4 a. Certain tubes manufactured by a company have mean life time of 800 hours and standard deviation of 60 hours. Find the probability that a random samples of 16 tubes taken from the group will have a mean life time
   i) Between 790 hours and 810 hours
   ii) Less than 785 hours
   iii) More than 820 hours. **(10 Marks)**

b. A die is thrown 264 times and the number appearing on the face (x) follows the frequency distribution:

x	1	2	3	4	5	6
f	40	32	28	58	54	60

Calculate the value of Chi-square. **(10 Marks)**

Module-3

5 a. Find out the Eigen values and the corresponding Eigen vector of the matrix $A = \begin{bmatrix} 1 & 2 & -2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$ and verify that $S^{-1}AS$ is a diagonal matrix. Where 'S' is the matrix of Eigen vector. **(10 Marks)**

b. Find the inverse of the following matrix 'A' by using partition method. Hence solve the system of equation AX = b.

where $A = \begin{bmatrix} 2 & 1 & 1 & -2 \\ 4 & 0 & 2 & 1 \\ 3 & 2 & 2 & 0 \\ -1 & 3 & 2 & -1 \end{bmatrix}$ $b = [-10, 8, 7, -5]^T$ **(10 Marks)**

OR

6 a. Apply Gauss-Jordan method to solve the equation
$x + y + z = 9$
$2x - 3y + 4z = 13$
$3x + 4y + 5z = 40$ **(10 Marks)**

b. Transform the matrix $A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & 1 & 2 \\ 4 & 2 & 1 \end{bmatrix}$ to diagonal form by Givens method. Obtain the intervals of unit length, each containing one eigen value of A. Find the largest eigen value correct to two decimal places using Newton-Raphson method. **(10 Marks)**

Module-4

7 a. Derive Newton-Raphson formula for finding a root of a non-linear equation. Find a root of $f(x) = x^3 + 2x^2 + 10x - 20$ correct to upto 4 decimal places. **(10 Marks)**

b. Solve numerically $u_{xx} = 0.0625\ u_{tt}$ subject to $u(0, t) = 0 = u(5, t)$ $u(x, 0) = x^2(x - 5)$ and $u_t(x, 0) = 0$ by taking $h = 1$ for $0 \le t \le 1$. **(10 Marks)**

OR

8 a. Find the numerical solution of the parabolic equation $\frac{\partial^2 u}{\partial x^2} = 2\frac{\partial u}{\partial t}$ when $u(0, t) = 0 = u(4, t)$ and $u(x, 0) = x(4-x)$ by taking $h = 1$. Find the values upto $t = 5$. **(10 Marks)**

b. Solve the Laplace's equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary. Value as shown in the following Fig.Q.8(b).

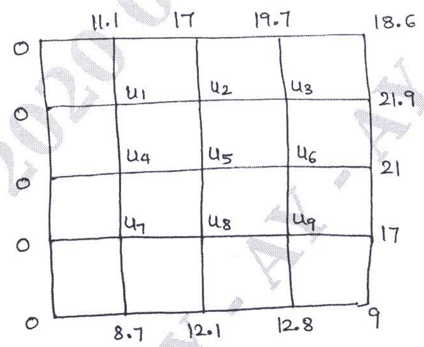

Fig.Q.8(b)

(10 Marks)

Module-5

9 a. A sample of 6 persons in an office revealed an average daily smoking of 10, 12, 8, 9, 16, 5 cigarates. The average level of smoking in the whole office has to be estimated at 90% level of confidence t = 2.015 for 5 degrees of freedom. **(10 Marks)**

b. Obtain the solution of the wave equation $u_{tt} = c^2 u_{xx}$ by variable seperable method under the following conditions:

i) $u(0, t) = u(2, t) = 0$

ii) $u(x, 0) = \sin^3\left(\frac{\pi x}{2}\right)$

iii) $u(x, 0) = 0$ **(10 Marks)**

OR

10 a. A fertilizer mixing machining is set to give 12kg of nitrate for quintal bag of fertilizer: Ten 100 kg bags are examined. The percentages of nitrate per bag are as follows:
11, 14, 13, 12, 13, 12, 13, 14, 11, 12
Is there any reason to believe that the machine is defective? Value of t for 9 degrees of freedom is 2.262. **(10 Marks)**

b. Prove that the total energy of a string, which is fixed at the point x = 0, x = L and executing small transverse vibrations, is given by

$$\frac{1}{2}T\int_0^L \left(\frac{\partial y}{\partial x}\right)^2 + \frac{1}{C^2}\left(\frac{\partial y}{\partial t}\right)^2 dx$$ **(10 Marks)**

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