CBCS SCHEME

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20MMD11

First Semester M.Tech. Degree Examination, Jan./Feb. 2021
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. Define: i) Error ii) Roundoff Error iii) Relative Error iv) Truncation Error and find the value of $s = \frac{x^2\sqrt{y}}{z^3}$ where $x = 6.54 \pm 0.01$, $y = 48.64 \pm 0.02$ and $z = 13.5 \pm 0.03$. Also find the relative error in the result. **(10 Marks)**

b. A horizontal tie-rod is freely pinned at each end. It carries a uniform load 'w' lb per unit length and has a horizontal pull 'P'. Find the central deflection and the maximum bending moment, taking origin at one of its ends. **(10 Marks)**

OR

2 a. The differential equation for the displacement 'y' of a whirling shaft when weight of the shaft is taken into account is $EI\frac{d^4y}{dx^4} - \frac{Ww^2}{g}y = W$. Taking the shaft of length '$2l$' with the origin at the centre and short bearings at both ends, show that the maximum deflection of the shaft is $\frac{g}{2w^2}$ (sechal + secal-2) **(10 Marks)**

b. Derive the expression $v(t) = \frac{gm}{c}(1 - e^{-\frac{c}{m}t})$ for a parachutist jumps out of a stationary hot air balloon. Compute the velocity attained after 10 seconds. Mass of parachutist is 68.1kg. The drag coefficient is equal to 12.5kg/s. Gravitational force is 9.8m/s^2 (Take t = 2 sec as step size). **(10 Marks)**

Module-2

3 a. Solve the system of equations by using Gauss Jordan method

$$\begin{bmatrix} 1 & -1 & 2 \\ 1 & 1 & 1 \\ 2 & -2 & 3 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -8 \\ -2 \\ -20 \end{bmatrix}$$

(10 Marks)

b. Use Givens technique on the tridiagonal matrix generated in

$$A = \begin{bmatrix} 4 & -2 & 1 & 2 \\ -2 & 3 & 0 & -2 \\ 1 & 0 & 2 & 1 \\ 2 & -2 & 1 & -1 \end{bmatrix}$$

To obtain the ranges of integers between which the four roots of the characteristic equation lie. **(10 Marks)**

OR

4 a. Solve by Cholesky's method
$4x_1 - x_2 = 1$; $-x_1 + 4x_2 - x_3 = 0$; $-x_2 + 4x_3 - x_4 = 0$; $-x_3 + 4x_4 = 0$. **(10 Marks)**

b. Find the inverse of the matrix by Partition method.

$$\begin{bmatrix} 2 & 1 & 0 & 0 \\ 1 & 2 & 1 & 0 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 1 & 2 \end{bmatrix}$$

(10 Marks)

Module-3

5 a. Solve $\frac{dy}{dx} = 1 + xy$, $y(0) = 1$. Find $y(0.1)$ using Picards method upto fourth approximation. **(10 Marks)**

b. Given $\frac{dy}{dx} = z - y$, $\frac{dz}{dx} = y - z$ with $y(0) = 1$ and $z(0) = 0$. Solve by Runge-Kutta method of second order choosing $h = 0.05$. Obtain the value of 'y' at $x = 0.1$. **(10 Marks)**

OR

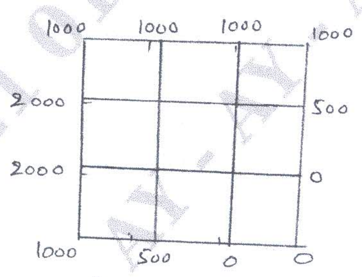
6 a. Find the real roots of the equation $x^3 - 6x^2 + 11x - 6 = 0$ by Graffe's method. **(10 Marks)**

b. Find the root of the equation $y(x) = x^3 - 2x - 5 = 0$ which lie between 2 and 3 by Muller's method. **(10 Marks)**

Module-4

7 a. Solve $\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}$ explicitly with the initial and the boundary conditions
$u(x, 0) = x^2(1 - x^2)$, $\frac{\partial u}{\partial t}(x, 0) = 0$, $u(0, t) = 0$, $u(1, t) = 0$ with $\Delta x = \frac{1}{4}$, $\Delta t = \frac{1}{64}$. Obtain the solution at first time level. **(10 Marks)**

b. Given the values of $\phi(x, y)$ on the boundary of the square in the below. Evaluate the function $\phi(x, y)$ satisfying the Laplace equation $\nabla^2\phi = 0$ at the pivoted points by Gauss Siedel method. **(10 Marks)**



OR

8 a. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, $t \ge 0$, $0 \le x \le 1$, $u(x, 0) = x(1 - x)$, $\left.\begin{matrix} u(0,t) = 0 \\ u(1, t) = 1 \end{matrix}\right\} t \ge 0$ $\Delta x = \frac{1}{4}$, $\Delta t = \frac{1}{64}$,
Using Schmidt method at second time level. **(10 Marks)**

b. Consider the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ where $0 \le x, y \le 1$ subjected to $u(x, 0) = x$, $u(x, 1) = 0$, $0 \le x \le 1$, $u(0, y) = 0$, $u(1, y) = 0$, $0 \le y \le 1$. Choose $\Delta x = \Delta y = h = \frac{1}{3}$. Solve the system of linear equations by four iterations of Gauss Seidel method. **(10 Marks)**

Module-5

9 a. A set of five similar coins tossed 320 times and the result is

Number of heads :	0	1	2	3	4	5
Frequency :	6	27	72	112	71	32

Test the hypothesis that the data follow a binomial distribution. **(10 Marks)**

b. Explain and illustrate the Random Block Design (RBD). **(10 Marks)**

OR

10 a. Measurements on the length of a copper wire were taken in 2 experiments A and B as under.

A's measurement	12.29	12.25	11.86	12.13	12.44
B's measurement	12.39	12.46	12.34	12.22	11.98

A's measurement	12.78	12.77	11.90	12.47
B's measurement	12.46	12.23	12.06	

(10 Marks)

b. Suppose a person claims that Lorry Bird's free throw success follow a binomial distribution with P = 0.80. For the 1980-81 and 1981-82 seasons Lorry Bird shot 338 pairs of free throws with the following results:

Number of Makes :	0	1	2
Observed count :	5	82	251

Calculate the pair of free throws using chi square distribution. **(10 Marks)**

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