| Reg. No. | | | | | | | | | | |
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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

FIRST SEMESTER M.TECH (MECHTRONICS) SEMESTER EXAMINATIONS

MARCH 2021

SUBJECT: MATHEMATICS FOR SIMULATION AND MODELLING

**[MAT -5162]**

**REVISED CREDIT SYSTEM**

**(05/ 03/2021)**

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** questions.
- Missing data's can be assumed suitably

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| **1A.** | Write the twelve point procedure for solving problems through Mathematical modelling. | **3** |
| **1B.** | Explain 15 characteristics of Mathematical Modelling. | **3** |
| **1C.** | Solve the system of equations by LU decomposition method<br>$3x + 2y + 7z = 9,\ x + 2y + 3z = 6,\ 3x + y + 2z = 8$ | **4** |
| **2A.** | solve the following system of equations using Gauss-Seidal method<br>$10x - 2y - z - w = 3, -2x + 10y - z - w = 15, -x - y + 10z - 2w = 27,$<br>$-x - y - 2z + 10w = -9$ . Carryout three iterations | **3** |
| **2B.** | solve the tridiagonal system of equations using Thomas Algorithm method<br>$2x - y = 0,\quad -x + 2y - z = 0,\quad -y + 2z - w = 0,\quad -z + 2w = 1$ | **3** |
| **2C.** | Solve the system of non-Linear equations $x^2 + xy + y^2 = 7,\ y^3 + x^3 = 9$. The initial approximation $x_0 = 1.5,\ y_0 = 0.5$ , carry out three iterations. | **4** |
| **3A.** | Solve wave equation $u_{tt} = u_{xx}$ , $0 < x < 1$, $t > 0$, u $(x, 0) = 100\ (x\text{-}x^2)$, $\frac{\partial u(x,0)}{\partial t} = 0$,<br>u (0, t) = u (1, t) = 0. Compute u for three time steps with h = 0.25. | **3** |
| **3B.** | Perform one iteration to extract a quadratic factor using Lin – Bairstow's method from the polynomial $x^4 - 5x^3 + 20x^2 - 40x + 60 = 0$ . $P_0 = -4$, $Q_0 = 8$ | **3** |

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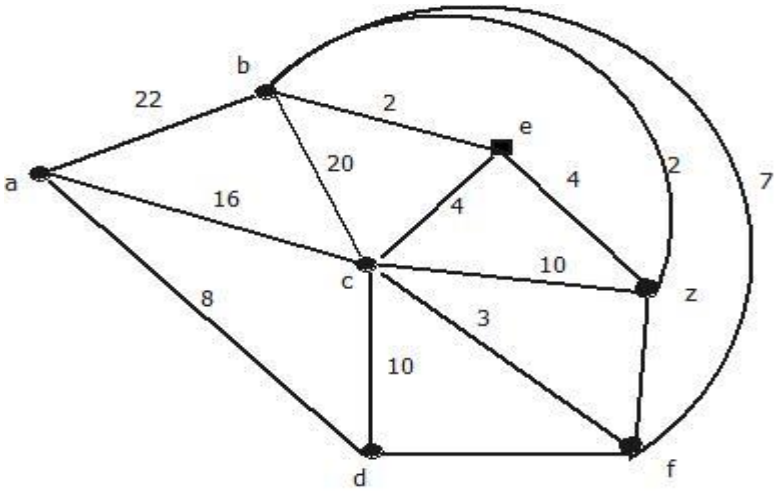
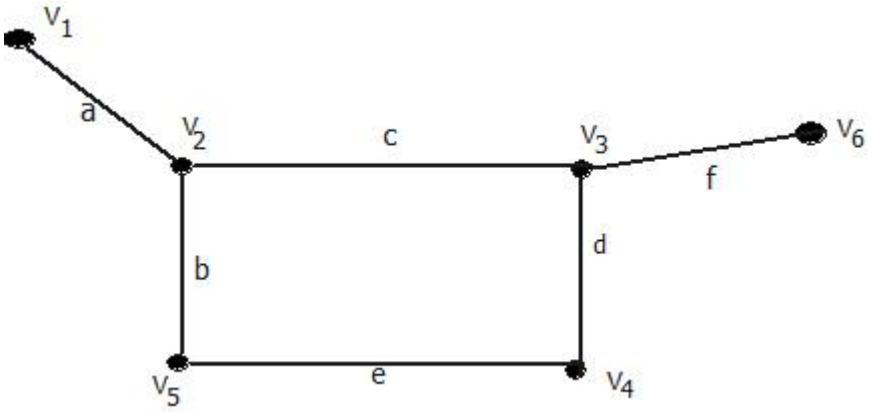
| **3C.** | Solve the boundary value problem $y'' + (1 + x^2)y + 1 = 0$ , $y(1) = 0 = y(-1)$ , using Weighted Residual method. Take second degree interpolating polynomial in each sub intervals with three nodes. | **4** |
| **4A.** | Find the second order Taylor series approximation of the function $f(\mathrm{x}_1, \mathrm{x}_2, \mathrm{x}_3) = \mathrm{x}_2^2 + \mathrm{x}_3^2\mathrm{x}_1^2 + \mathrm{x}_2^2\mathrm{e}^{x_1\mathrm{x}_3}$ about the point (1,0,-2). | **3** |
| **4B.** | Find the extreme points of the function $f(x_1, x_2) = x_1^3 + x_2^3 + 4x_1^2 + 2x_2^2 + 8$ using Hessian matrix | **3** |
| **4C.** | Minimize $f(x_1, x_2, x_3) = x_1^2 + x_2^2 + x_3^2$ subject to $x_1 + x_2 + x_3 \geq 5$ , $2 - x_2x_3 \leq 0$, $x_1 \geq 0$, $x_2 \geq 0, x_3 \geq 2$ . Determine whether the Kuhn –Tucker conditions are satisfied at the following points. $X_1 = (1.5, 1.5, 2)$, $X_2 = (4/3, 2/3, 3)$, $X_3 = (2,\ 1,\ 2)$ | **4** |
| **5A.** | Maximize the function f $(x_1, x_2) = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$ using Steepest ascent method. starting from the point $X_1 = (1,1)^T$ , Carry out three iterations. | **3** |
| **5B.** | Use Dijkstra's algorithm on the connected weighted graph to find the shortest path from 'a' to 'z '<br>  | **3** |
| **5C.** | Write adjacency, incidence matrix for the graph shown in figure below<br>  | **4** |