BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTECH **SEMESTER : I**
BRANCH: CIVIL **SESSION : MO/18**

SUBJECT: CE541 ANALYTICAL AND NUMERICAL METHODS IN STRUCTURAL ENGINEERING
TIME: 3:00 HRS. **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1 You have built a bookshelf for your books with book shelf thickness 9.525mm and width 304.8m. The Young's modulus of shelf material is 2.5 X 10^{10} Pa. Your books range from 215.9mm to 279.4mm in height and would take 736.6mm of space along the length. Determine the maximum sag of your bookshelf. [10]
Assume that the total weight of books as 46.72kg and. The weight distribution of books can be assumed to be in the same ratio as the height of the books at the two ends.

Q.2(a) Find the largest (in absolute value) eigenvalue and the corresponding eigenvector of the matrix given below by power method. Perform 5 iterations and compute the error: [5]

$$\mathbf{A} = \begin{bmatrix} 8 & -2 & -2 \\ -2 & 4 & -2 \\ -2 & -2 & 13 \end{bmatrix}$$

Q.2(b) Interpret whether the given system of equation below is well conditioned or ill conditioned using norms and condition number. [5]

$$x_1 + x_2 = 2$$
$$x_1 + 1.0001x_2 = 2$$

Q.3(a) Suppose that you have the task of measuring the lengths of a bridge and a rivet and come up with 9999 and 9 cm, respectively. If the true values are 10,000 and 10 cm, respectively, compute (a) the true error and (b) the true percent relative error for each case [5]

Q.3(b) Formulate an algorithm for bisection method. [5]

Q.4(a) Given a function $f(x) = ax^3 + bx^2 + cx + d$, which numerical method will you use for numerical integration and why? (Assess Trapezoidal, Simpson and Guass Quadrature approximations) [5]

Q.4(b) Find second derivative of $f(x) = 5x^2 + 3\sin(x)$ at $x = 2$ using central differences approximation with $h = 0.5$. Compute the error. [5]

Q.5(a) Given a second order ODE $y'' = x + y$, Explain how you would proceed to solve the initial value problem when it's given that $y(0) = 0$ and $y'(0) = 0$ and you must find out value of $y(2)$. [5]

Q.5(b) Differentiate between shooting method and finite difference method for solving boundary value problems and choose the best one. [5]

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