Model Question Paper
SIXTH SEMESTER BTECH DEGREE EXAMINATION
(2013 Scheme)
Branch: AERONAUTICAL ENGINEERING

13.602 Computational Methods in Engineering(S)

Time: 3 Hours Max Marks: 100

Part-A
Answer all question. Each question carries 2 marks.

1. Find the root of the following equation using Newton-Raphson Method.
   \(-5x + 3\).

2. Find the dominant eigen value and eigen vector of: \(\begin{bmatrix} 3 & -5 \\ -2 & 4 \end{bmatrix}\).

3. Find the inverse of the matrix: \(\begin{bmatrix} -1 & 3 \\ 1 & 6 \end{bmatrix}\) using Guass-Jordan Method.

4. Evaluate \((x + 1)(x + 2)(x + 3)\].

5. Evaluate \(\frac{dx}{dx^2}\) taking h=0.2 using Trapezoidal rule. Can we use Simpson’s rule? Give reason.

6. Write the formula for third order and fourth order Runge-Kutta Method.

7. Write the formula for Adam-Bash fourth predictor corrector formula.

8. Explain weighted residual for initial value problems.


10. How to use Crank-Nicolson formula?

Part-B
Answer one question from each module. Each question carries 20 marks

Module -I

11. a) Solve the system of equation using Jacobi’s iteration Method.
\[30x_1 - 2x_2 + 3x_3 = 75; x_1 + 17x_2 - 2x_3 = 48; x_1 + x_2 + 9x_3 = 15.\]

b) Solve the system of equation using Gauss-Elimination Method.
\[3x + 4y + 5z = 18; 2x - y + 8z = 13; 5x - 2y + 7z = 20\]

12. a) Using Guass–Jordan method , solve the system of equation
\[5x_1 + x_2 + x_3 + x_4 = 4; x_1 + 7x_2 + x_3 + x_4 = 12; x_1 + x_2 + 6x_3 + x_4 = -5; \]
\[x_1 + x_2 + x_3 + 4x_4 = -6\]

b) Find numerically the largest eigenvalue of: \(\begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}\) by power method.
13. a) Using Newton's Interpolation formula find \( y \) at \( x=8 \) from the table.

\[
\begin{array}{ccccccc}
    x & 0 & 5 & 10 & 15 & 20 & 25 \\
    y & 7 & 11 & 14 & 18 & 24 & 32 \\
\end{array}
\]

b) Using Lagrangian formula of interpolation find \( y \) from the following table.

\[
\begin{array}{cccccc}
    x & 1 & 2 & 3 & 4 & 7 \\
    y & 2 & 4 & 8 & 16 & 128 \\
\end{array}
\]

14. a) Fit the following four points by the cubic splines

\[
\begin{array}{cccc}
    i & 0 & 1 & 2 & 3 \\
    x_i & 1 & 2 & 3 & 4 \\
    y_i & 1 & 5 & 11 & 8 \\
\end{array}
\]

Use the end conditions \( y''_3 = 0 \). Hence compute \( y(1.5) \) and \( y'(2) \).

b) Evaluate the integral \( \int_1^2 \int_1^2 \frac{dx}{x+y} \) using trapezoidal rule with \( k = 0.5 \) and \( k = 0.25 \).

Module-III

15. a) Given \( y = 3x + \frac{y}{2} \) and \( \lambda = 1 \). Find the values of .1) \( \) and .2) \( \) using Taylor series method

b) By applying fourth order Runge-Kutta method find .2) \( \) from \( y = x, y(0) = 2 \)

taking \( \lambda = 0.1 \).

16. a) Using Adam's predictor–corrector method find .4) \( \) if satisfies \( \frac{1-xy}{x^2} \) and \( \lambda = 1, y(1.1) = 0.996, y(1.2) = 0.986, y(1.3) = 0.972 \).

Module-IV

b) Using improved Euler's method find \( y \) at \( \lambda = 0.1 \) and \( \lambda = 0.2 \) given \( y = 2x + \frac{y}{y}, y(0) = 1 \).
Module-IV

17. a) Solve the differential equation \(- y' = x\) with \(y(0) = 0, y(1) = 0\) with \(y' = \frac{1}{4}\). Using finite difference method.

b) Solve \(u_{yy} = 0\) in \(x \leq 4, 0 \leq y \leq 4\). Given \(u(0, y) = 0, u(4, y) = 8 + 2y, u(x, 0) = \frac{x^2}{2}\) and \(u(x, 4) = x^2\) taking \(k = 1\). Obtain the result correct to three decimal.

18. a) Solve \(\frac{\partial^2 u}{\partial x^2}\) subject to the conditions \(u(0, 0) = 0, u(0, t) = 0\) and \(u(t, t) = t\).

Compute for \(\frac{1}{6}\) in two steps, using Crank-Nicolson formula.

b) Solve Laplace’s equation \(\Delta u = 0\) at the interior points of the square region given in the figure.

```
<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>11.1</th>
<th>17</th>
<th>19.7</th>
<th>18.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>11.1</td>
<td>17</td>
<td>19.7</td>
<td>18.6</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>21.9</td>
<td>21</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>21</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>12.1</td>
<td>12.8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
```

***************