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B. Tech. 3rd Semester (Civil Engg.)
Examination – February, 2022

MATHEMATICS-III

Paper : BSC-Math-205-G

Time : Three hours]

[Maximum Marks : 75

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note: Question 1 is compulsory. Attempt total five questions with selecting one Question from each Unit. All questions carry equal marks.

1. (a) Write down one dimensional heat and wave equations.

(b) What is interpolation?

(c) State Newton's forward Interpolation formula.

(d) If $L\{f(t)\} = F(s)$, then

(i) $L\{t f(t)\} = ?$

(ii) $L\{t^n f(t)\} = ?$

(e) Solve :

$$z = px + qy + \sqrt{pq}$$

(f) Discuss Coset with example.

SECTION – A

2. (a) Solve :

$$x^2(y-z)p + y^2(z-x)q = z^2(x-y)$$

(b) Solve the equation by Charpit's method :

$$2z + p^2 + qy + 2y^2 = 0$$

3. (a) Using method of separation of variables,

$$4\left(\frac{\partial u}{\partial x}\right) + \left(\frac{\partial u}{\partial y}\right) = 3u, \text{ given } u = 3e^{-y} - e^{-5y} \text{ when } x = 0.$$

(b) A string is stretched and fastened to two points $x = 0$ $x = l$. Motion is started by displacing the

string in the form $y = a \sin\left(\frac{\pi x}{l}\right)$ from which it is released at time $t = 0$. Show that the displacement is given by

$$y(x, t) = a \sin\left(\frac{\pi x}{l}\right) \cos\left(\frac{\pi ct}{l}\right)$$

SECTION – B

4. (a) Find a real root of the equation $x \log_{10} x = 1.2$ by Newton Raphson Method.

(b) From the following table, estimate the number of students who obtained marks between 40 and 45 :

Marks	30-40	40-50	50-60	60-70	70-80
No. of Students	31	73	124	35	31

5. (a) Given that :

x	:	150	152	154	156
$y = \sqrt{x}$:	12.247	12.329	12.410	12.490

Evaluate $\sqrt{155}$ using Lagrange's interpolation formula.

- (b) Evaluate $\int_0^6 \frac{1}{1+x^2} dx$ using (i) Trapezoidal rule
(ii) Simpson's rule

SECTION - C

6. (a) Find the Laplace transform of (i) $\cos h$ at $\cos at$

(ii) $\int_0^t t \sin 3t dt$

(b) Apply convolution theorem to evaluate :

$$L^{-1} \left[\frac{s^2}{(s^2 + a^2)(s^2 + b^2)} \right]$$

7. (a) Solve :

$$\frac{d^2x}{dt^2} + 9x = \cos 2t, \text{ if } x(0) = 1, x\left(\frac{\pi}{2}\right) = -1$$

(b) Find the inverse Laplace transform of :

$$\frac{s}{s^4 + s^2 + 1}$$

SECTION - D

8. (a) Define monoid and give examples. Prove that identify elements is unique in monoid.
(b) State and prove Lagrange's theorem.
9. Define the following with suitable examples :
- (i) Group
 - (ii) Semi-group
 - (iii) Cyclic Group
 - (iv) Normal Subgroup