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Course Code

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Fourth Semester B.E. Degree Examinations, July 2026

APPLIED MATHEMATICS FOR CIVIL ENGINEERING

Duration: 3 hrs

Max. Marks: 100

- Note:**
1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. Use of Mathematics Formula Handbook is permitted.
 3. Missing data, if any, may be suitably assumed.

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>														
<u>Module-1</u>																	
1. a.	Find the Laplace transform of $\frac{\cos at - \cos bt}{t}$	06	(2:1:1.2.1)														
b.	If $f(t) = \begin{cases} E, & 0 < t < a \\ -E, & a < t < 2a \end{cases}$ show that $L[f(t)] = \frac{E}{s} \tanh\left(\frac{as}{2}\right)$	07	(2:1:1.2.1)														
c.	Find the Laplace transform of the following function $\left[e^{t-1} + \sin(t-1) \right] u(t-1)$	07	(2:1:1.2.1)														
<u>(OR)</u>																	
2. a.	Find the inverse Laplace transform by partial fraction method $\frac{4s+5}{(s+1)^2(s+2)}$	06	(2:1:1.2.1)														
b.	Using convolution theorem, obtain the inverse Laplace transform of the function. $\frac{1}{(s^2+a^2)^2}$	07	(2:1:1.2.1)														
c.	Solve by using Laplace transforms: $\frac{d^2y}{dt^2} + k^2y = 0$; Given that $y(0) = 2, y'(0) = 0$.	07	(2:1:1.2.1)														
<u>Module-2</u>																	
3. a.	A simply supported beam carries a concentrated load P at its mid-point. Corresponding to various values of P the maximum deflection Y is measured and is given in the following table. <table><tr><td>P</td><td>100</td><td>120</td><td>140</td><td>160</td><td>180</td><td>200</td></tr><tr><td>Y</td><td>0.45</td><td>0.55</td><td>0.60</td><td>0.70</td><td>0.80</td><td>0.85</td></tr></table> Find the law of the form $Y = a + bP$ and hence estimate Y when P is 150.	P	100	120	140	160	180	200	Y	0.45	0.55	0.60	0.70	0.80	0.85	06	(2:2:1.2.1)
P	100	120	140	160	180	200											
Y	0.45	0.55	0.60	0.70	0.80	0.85											
b.	Fit a parabola $y = ax^2 + bx + c$ by the method of least squares for the following data <table><tr><td>x</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr><tr><td>y</td><td>3.07</td><td>12.85</td><td>31.47</td><td>57.38</td><td>91.29</td></tr></table>	x	2	4	6	8	10	y	3.07	12.85	31.47	57.38	91.29	07	(2:2:1.2.1)		
x	2	4	6	8	10												
y	3.07	12.85	31.47	57.38	91.29												

- c. Fit a least square geometric curve $y = ax^2$ for the following data. 07 (2:2:1.2.1)

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

(OR)

4. a. Obtain the lines of regression and hence find the coefficient of correlation for the data 06 (2:2:1.2.1)

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

- b. Show that if θ is the angle between the lines of regression, 07 (2:2:1.2.1)

$$\text{then } \tan \theta = \frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2} \left(\frac{1-r^2}{r} \right)$$

- c. Ten competitors in a beauty contest are ranked by two judges in the following order. Compute the coefficient of rank correlation. 07 (2:2:1.2.1)

I	1	6	5	3	10	2	4	9	7	8
II	6	4	9	8	1	2	3	10	5	7

Module-3

5. a. Use Picard's method to find $y(0.1)$ and $z(0.1)$ given that $\frac{dy}{dx} = x + z$, 06 (2:3:1.2.1)

$$\frac{dz}{dx} = x - y^2 \text{ and } y(0) = 2, z(0) = 1, \text{ consider upto 2 iterations}$$

- b. Obtain the Picard's third approximation to the solution of the system of 07 (2:3:1.2.1)

$$\text{equations } \frac{dx}{dt} = 2x + 3y, \frac{dy}{dt} = x - 3y, t = 0, x = 0, y = 1/2. \text{ Hence find } x \text{ and } y \text{ at } t = 0.2.$$

- c. Use fourth order R-K method to solve the system of equations 07 (2:3:1.2.1)

$$\frac{dx}{dt} = y - t, \frac{dy}{dt} = x + t, x = 1, y = 1 \text{ at } t = 0. \text{ Compute } x(0.1) \text{ and } y(0.1).$$

(OR)

6. a. By R-K method of fourth order, solve $\frac{d^2y}{dx^2} = x \left(\frac{dy}{dx} \right)^2 - y^2$ for $x = 0.2$ 06 (2:3:1.2.1)

correct to four decimal places, using the initial conditions $y = 1$ and $y' = 0$ when $x = 0$.

- b. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, 07 (2:3:1.2.1)

$y'(0) = 0$, compute $y(0.2)$ and $y'(0.2)$ using R-K method of fourth order.

- c. Apply Milne's method to compute $y(0.8)$ given that $\frac{d^2y}{dx^2} = 1 - 2y \frac{dy}{dx}$ 07 (2:3:1.2.1)

and the following table of initial values.

x	0	0.2	0.4	0.6
y	0	0.02	0.0795	0.1762
y'	0	0.1996	0.3937	0.5689

Module-4

- 06 a.** A company produces two types of hats. Each hat of the first type requires twice as much labour time as the second type. If all hats are of the second type only, the company can produce a total of 500 hats a day. The market limits daily sales of the first and second to 150 and 200 hats. Assuming that the profits per hat are Rs. 8 for first type and Rs. 5 for second type. Formulate the problem as a Linear Programming Model in order to determine the number of hats to be produced of each type so as to maximize the profit. **(2:4:1.2.1)**
- b.** Maximize $z = x + 1.5y$, given $x \geq 0, y \geq 0$ subject to the constraints: $x + 2y \leq 160, 3x + 2y \leq 240$ by graphical method. **07 (2:4:1.2.1)**
- c.** Use simplex method to maximize $z = 2x + 4y$ subject to the constraints: $x + 2y \leq 5, x + y \leq 4, x \geq 0, y \geq 0$. **07 (2:4:1.2.1)**

(OR)

- 8. a.** A company produces two types of food stuffs F_1 and F_2 which contains three vitamins V_1, V_2, V_3 respectively. Minimum daily requirement of these vitamins are 1 mg, 50 mg and 10 mg respectively. Suppose that the food stuff F_1 contains 1 mg of V_1 , 100 mg of V_2 and 10 mg of V_3 whereas F_2 contains 1 mg of V_1 , 10 mg of V_2 and 100 mg of V_3 . If the cost of food stuff F_1 is Rs. 2 and that of F_2 is Rs. 3, find the minimum cost diet that would supply the body the minimum requirement of each vitamin. Formulate the problem as a Linear Programming Problem. **06 (2:4:1.2.1)**
- b.** Use the graphical method to solve the following LPP. Minimize $z = 8x + 5y$ subject to the constraints: $6x + y \geq 21, x + 3y \geq 12, x + y \leq 10, x \geq 0, y \geq 0$. **07 (2:4:1.2.1)**
- c.** Use simplex method to Maximize $z = 3x + 6y$ subject to the constraints: $x + y \leq 5, x + 2y \leq 6$ given $x \geq 0, y \geq 0$. **07 (2:4:1.2.1)**

Module-5

- 9. a.** The p.d.f. of variate x is given by the following table. **06 (2:5:1.2.1)**
- | | | | | | | | |
|--------|-----|------|------|------|------|-------|-------|
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| $P(x)$ | k | $3k$ | $5k$ | $7k$ | $9k$ | $11k$ | $13k$ |
- For what value of k , this represents a valid probability distribution ?
also find $P(x \geq 5), P(3 < x \leq 6)$.
- b.** Find the mean and standard deviation of Binomial distribution. **07 (2:5:1.2.1)**
- c.** In an examination 7 % of students score less than 35 % marks and 89 % of students score less than 60 % marks. Find the mean and standard deviation if the marks normally distributed. **07 (2:5:1.2.1)**
- Given : $\phi(1.2263) = 0.39$ and $\phi(1.4757) = 0.43$

(OR)

10. a. The joint distribution table for two random variables X and Y is as follows: 06 (2:5:1.2.1)

$X \backslash Y$	-2	-1	4	5
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Determine the marginal distribution of X and Y . Also compute

- (i) Expectations of X and Y (ii) S.Ds of X and Y
 (iii) Covariance of X and Y (iv) Correlation of X and Y .

Further verify that X and Y are dependent random variables.

- b. Suppose X and Y are independent random variables with the following respective distribution, find the joint distribution of X and Y . Also verify that $COV(X, Y) = 0$. 07 (2:5:1.2.1)

x_i	1	2
$f(x_i)$	0.7	0.3

y_j	-2	5	8
$g(y_j)$	0.3	0.5	0.2

- c. X and Y are independent random variables. X takes the values 2, 5, 7 with probability $1/2, 1/4, 1/4$ respectively. Y takes the values 3, 4, 5 with probabilities $1/3, 1/3, 1/3$. 07 (2:5:1.2.1)
- (i) Find the joint probability distributions of X and Y
 (ii) Show that Covariance of X and Y is zero.

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