Register No : ____________________

# THE KAVERY ENGINEERING COLLEGE

*(An Autonomous Institution)*

**UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APR/MAY 2026**

***Third Semester***

***Chemical Engineering***

**MA3356/UMAT24303 – DIFFERENTIAL EQUATIONS**

***Regulations – 2021/2024***

***Duration : 3 Hrs*** ***Maximum : 100 Marks***

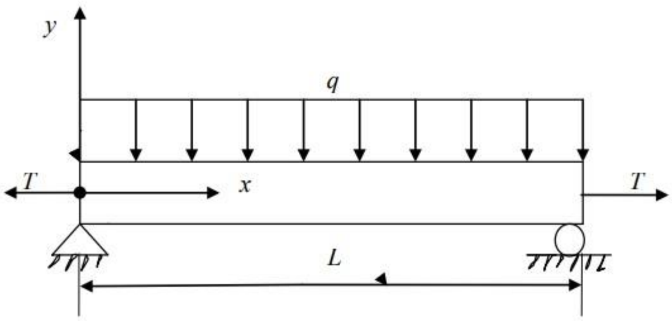
***PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)***

| Q.No | Questions | BLT | CO | Marks |
|---|---|---|---|---|
| 1. | Solve $(D^2-4D+13)y=0$. | UN | 1 | 2 |
| 2. | Convert the equation $x^2y''-xy'+y=x^2$. | RE | 1 | 2 |
| 3. | Form the PDE by eliminating 'a' and 'b' from $\mathrm{z}=(\mathrm{x}+\mathrm{a})(\mathrm{y}+\mathrm{b})$. | RE | 2 | 2 |
| 4. | Find the Particular Integral of $(\mathrm{D}^2-\mathrm{DD}')\mathrm{z}=\mathrm{e}^{\mathrm{x}+\mathrm{y}}$. | UN | 2 | 2 |
| 5. | Describe Adams-Moulton Technique. | UN | 3 | 2 |
| 6. | What is Orthogonal Collocation method? | UN | 3 | 2 |
| 7. | State Standard Five Point Formula. | UN | 4 | 2 |
| 8. | Write down the Laplace equation in polar coordinates. | RE | 4 | 2 |
| 9. | Give the analytical solution of the pure diffusion equation. | RE | 5 | 2 |
| 10. | Mention any two examples of real-time time-dependent partial differential equations. | UN | 5 | 2 |

***PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)***

| Q.No | | | Questions | BLT | CO | Marks |
|---|---|---|---|---|---|---|
| 11. | a | i | Solve $(D^2+4)y=e^{4x}+cos^2x$. | AP | 1 | 8 |
| | | ii | Solve $(D^2+1)y=cosec\ x$ using method of variation of parameters. | AP | 1 | 8 |
| | | | **Or** | | | |
| | b | | Solve $Dx+y=sint+1, Dy+x=cos\ t$, given that $x=1, y=2\ at\ t=0$. | AP | 1 | 16 |
| 12. | a | i | Solve $z=p^2+q^2$. | AP | 2 | 8 |
| | | ii | Solve $(mz-ny)p\ +\ (nx-lz)q\ =\ ly-mx$. | AP | 2 | 8 |
| | | | **Or** | | | |
| | b | | Solve $\left(D^2-DD'-2D'^2\right)z=2x+3y+e^{3x+4y}$. | AP | 2 | 16 |
| 13. | a | | Solve and get y(2) given $\frac{dy}{dx}=\frac{1}{2}(x+y), y(0)-2, y(0.5)=2.636$, $y(1)=3.595, y(1.5)=4.968$ by Adam's method. | AP | 3 | 16 |
| | | | **Or** | | | |
| | b | | The deflection y in a simply supported beam (figure given) with a uniform load q and a tensile axial load T is given by $\frac{\partial^2 y}{\partial x^2}-\frac{Ty}{EI}=\frac{qx(L-x)}{2EI}$ where x = location along the beam (in), T = tension applied (lbs), E = Young's modulus of elasticity of the beam (psi), I = second moment of area (in$^4$), q = uniform loading density (lb/in), L = length of beam (in). Given, T=7200 lbs, q=5400 lbs/in, L=75 in, E=30 Msi and I=120 in$^4$, Find (a) Find the deflection of the beam at x=50". Use a step size of Δx=25" and | AP | 3 | 16 |

approximate the derivatives by central divided difference approximation, (b) Find the relative true error in the calculation of y(50).



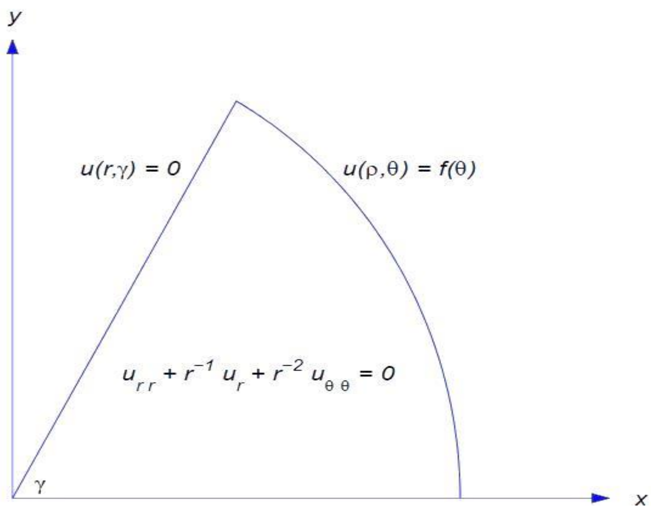

14. a By iteration method solve the elliptic equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ over the square region of side 4 satisfying the boundary conditions AP 4 16

$$\text{(i) } u(0, y) = 0 \; for \; 0 \leq y \leq 4, \text{(ii) } u(4, y) = 12 + y \; for \; 0 \leq y \leq 4,$$
$$(iii) u(x, 0) = 3x \; for \; 0 \leq x \leq 4, (iv) u(x, 4) = x^2 \; for \; 0 \leq x \leq 4.$$

**Or**

b Define the bounded formal solution of AP 4 16

$$u_{rr} + \frac{1}{r} u_r + \frac{1}{r^2} u_{\theta\theta} - 0, 0 < r < \rho, 0 < \theta < \gamma,$$
$$u(\rho, \theta) = f(\theta), 0 \leq \theta \leq \gamma,$$
$$u(r, 0) = 0, u(r, \gamma) = 0, 0 < r < \rho, \text{ where } 0 < \gamma < 2\pi.$$




15. a Explain the weighted average approximation method for deriving the solution of parabolic equations. AP 5 16

**Or**

b Consider the 1D wave equation $\frac{\partial^2 u}{\partial t^2} = v^2 \frac{\partial^2 u}{\partial x^2}$ . (a) Write down the straightforward finite-difference approximation (b) What order approximation is this in time and in space? (c) Use the von Neumann stability criterion to find the mode amplitudes (d) Use this to find a condition on the velocity, time step, and space step for stability (e) Do different modes decay at different rates for the stable case? (f) Numerically solve the wave equation for the evolution from an initial condition with u = 0 except for one nonzero node, and verify the stability criterion. AP 5 16