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First Semester B.Tech / B.Arch Degree Interim Test 1, September 2013

MA 1001: Mathematics I

Duration: 75 minutes

Max. Marks: 25

Notation: $y' = \frac{dy}{dx}$; $y'' = \frac{d^2y}{dx^2}$

1. Solve the differential equation: $xy(1 + xy^2)\frac{dy}{dx} = 1$. 3

2. Solve the following differential equation: 2

$$xy^3 + y + 2(x^2y^2 + x + y^4)\frac{dy}{dx} = 0.$$

3. The rate at which ice melts is proportional to the amount of ice at the instant. Find the amount of ice left after 2 hours if half of the quantity melts in 30 minutes. 3

4. Solve the following differential equation: 2

$$(x^2y^2 + xy + 1)y dx + (x^2y^2 - xy + 1)x dy = 0$$

5. Find the orthogonal trajectories of the family of curves given by $r = \frac{2c}{1 + \cos \theta}$, where c is a parameter. 3

6. Solve the differential equation $y'' - 2y' + y = \frac{e^x}{1 + x^2}$, using the method of variation of parameters. 3

7. Verify that e^{-x} and e^{-2x} are solutions of the differential equation $y'' + 3y' + 2y = 0$. Find the Wronskian of the given solutions and using this check whether they are linearly independent or not. 2

8. Substitute $t = 2x + 1$ in the following differential equation and reduce it to the non-homogeneous Euler-Cauchy form and then solve for y : 4

$$(2x + 1)^2 y'' - (2x + 1)y' - 2y = 2x; (x > 0).$$

9. Find a particular solution of the following differential equation using the method of undetermined coefficients: 3

$$y'' + y' - 6y = e^{2x} + 6x.$$