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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

January 2017 Semester End Make Up Examinations

Course: Engineering Mathematics -1 Duration: **3 hrs**
Course Code: **15MA1ICMAT** Max Marks: **100**

Date: 13.01.2017

Instructions: **Answer five full questions choosing one from each unit.**

UNIT 1

1 a) If $y = e^{m\cos^{-1}x}$ then prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2+m^2)y_n = 0.$ **6**

b) Show that for the curve $r = a(1-\cos\theta)$, $\frac{\rho^2}{r}$ is a constant. **7**

c) Expand $f(x) = \tan^{-1}x$ in powers of x upto fourth degree terms. **7**

UNIT 2

2 a) If $u = e^{ax+by} f(ax-by)$ then prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu.$ **6**

b) Expand $f(x,y) = x\,y^2 + \cos(x\,y)$ in powers of $(x-1)$ and $(y-\frac{\pi}{2})$ upto second degree terms. **7**

c) At a given instant, the sides of a rectangle are 4ft and 3ft respectively. They are increasing at the rate of 1.5ft/sec. and 0.5 ft/sec. respectively. Find the rate at which the area is increasing at that instant. **7**

OR

3 a) If $u = f\left(e^{y-z},\ e^{z-x},\ e^{x-y}\right)$ then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0.$ **6**

b) Given that $u\,x = 2y\,z,\ v\,y = 3\,z\,x,\ w\,z = 4x\,y$, prove that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 96.$ **7**

c) A rectangular box open at the top is to have volume of 32 cubic feet. Find the dimension of the box requiring least material for construction. **7**

UNIT 3

4 a) Solve: $\frac{dy}{dx} = \frac{x^2+y^2+1}{2xy}.$ **6**

b) Find the orthogonal trajectories of the family of curves $\frac{2a}{r} = 1-\cos\theta.$ **7**

c) If the temperature of the air is $30^0 c$ and the substance cools from $100^0 c$ to $70^0 c$ in 15 minutes, find when the temperature will be $40^0 c$. **7**

UNIT 4

5 a) Solve: $\frac{d^2y}{dx^2} - y = (3x+1)e^x$. **6**

b) Solve: $(x-1)^3\frac{d^3y}{dx^3} + 2(x-1)^2\frac{d^2y}{dx^2} - 4(x-1)\frac{dy}{dx} + 4y = 4\log(x-1)$ **7**

c) Determine Q and I in the LRC-circuit with $L = 0.5H$, $R = 6\Omega$, $C = 0.02F$, $E(t) = 24\sin(10t)$ and $Q = I = 0$ at $t = 0$. **7**

OR

6 a) Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \sin x$ **6**

b) Using the method of variation of parameters, solve : **7**

$$\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$$

c) If the weight W=16 lb, spring constant K=10 lb/ft, damping force $= 2\frac{dx}{dt}$, external force $F(t) = 5\cos(2t)$, find the displacement of the weight at any time t , given $x = \frac{dx}{dt} = 0$ at t=0. **7**

UNIT 5

7 a) Evaluate $\int_0^\infty \frac{x^4}{(1+x^2)^4}\,dx$ **6**

b) Find the area common to the cardioids $r = a(1+\cos\theta)$ *and* $r = a(1-\cos\theta)$ **7**

c) Obtain the series solution of Bessel's differential equation. **7**

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