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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

December 2016 Semester End Main Examinations

Course: Engineering Mathematics -1 — Duration: **3 hrs**

Course Code: **15MA1ICMAT** — Max Marks: **100**

Date: 16.12.2016

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

UNIT 1

1 a) If $y=\left(x+\sqrt{x^2-1}\right)^m$, then prove that $\left(x^2-1\right)y_{n+2}+\left(2n+1\right)x\,y_{n+1}+\left(n^2-m^2\right)y_n=0.$ **6**

b) Write the Maclaurin's series for $f\left(x\right)=\log\left(1+e^x\right)$ up to the third degree terms. **7**

c) Obtain an expression for angle between tangent and radius vector for the polar curve $r=f\left(\theta\right)$. **7**

UNIT 2

2 a) If $u=e^{xy}$, then show that $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=\frac{1}{u}\left\{\left(\frac{\partial u}{\partial x}\right)^2+\left(\frac{\partial u}{\partial y}\right)^2\right\}$. **6**

b) Expand $f\left(x,y\right)=e^x\log\left(1+y\right)$ in powers of x and y up to third degree terms. **7**

c) If $u=\frac{x+y}{1-xy}$, $v=\tan^{-1}x+\tan^{-1}y$, then show that u and v are functionally dependent. **7**

OR

3 a) If $\theta=t^n e^{-r^2/4t}$, what value of n will make $\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\theta}{\partial r}\right)=\frac{\partial\theta}{\partial t}$. **6**

b) If $u=f\left(2x-3y,\ 3y-4z,\ 4z-2x\right)$ then show that $\frac{1}{2}\frac{\partial u}{\partial x}+\frac{1}{3}\frac{\partial u}{\partial y}+\frac{1}{4}\frac{\partial u}{\partial z}=0$. **7**

c) Find the extreme values for the function $f\left(x,y\right)=x^3+y^3-3x-12y+20$. **7**

UNIT 3

4 a) Solve the differential equation: $x^3\frac{dy}{dx}-x^2y=-y^4\cos x$. **6**

b) Show that the family of parabolas $y^2=4a\left(x+a\right)$ is self-orthogonal, where a is a parameter. **7**

c) A body originally at $80^0 c$ cools down to $60^0 c$ in 20 minutes, the temperature of the air being $40^0 c$. What will be the temperature of the body after 20 minutes from the original? **7**

UNIT 4

5 a) Solve: $\frac{d^3y}{dx^3} - 7\frac{dy}{dx} - 6y = e^{2x}(1+x)$. **6**

b) Apply the method of variation of parameters to solve, $\frac{d^2y}{dx^2} + a^2y = \tan ax$. **7**

c) Find the current in the RLC circuit connected in series, given $R = 400\Omega,\ L = 0.12H,\ C = 0.04F,\ E = 120\sin 20t$ volts. Assume zero initial current and charge. **7**

OR

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

b) Solve: $(3x-2)^2 y'' - 3(3x-2)y' = 9(3x-2)\sin\left[\log(3x-2)\right]$. **7**

c) A 32 *lb* weight is suspended from a coil spring stretches the spring to 2ft. The weight is then pulled down 6 inches from the equilibrium position and released at $t = 0$. Find the motion of the weight, if the resistance of the medium is $4\frac{dx}{dt}$. **7**

UNIT 5

7 a) Find the area of the cardioid $r = a(1-\cos\theta)$. **6**

b) Obtain the reduction formula for $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$ **7**

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

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