| Seat No. | |
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# F.E. (All Branches) (Semester - II) (New) Examination, April - 2017
## ENGINEERING MATHEMATICS - II
### Sub. Code: 59933

**Day and Date : Wednesday, 26 - 04 - 2017** **Total Marks : 100**
**Time : 10.00 a.m. to 1.00 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Use of non-programmable calculator is allowed.**

## SECTION-I

**Q1)** Solve any THREE of the following(5 marks each): **[15]**

a) $\cos^2 x\dfrac{dy}{dx}+y=\tan x$.

b) $\left\{y\left(1+\dfrac{1}{x}\right)+\cos y\right\}dx+(x+\log x-x\sin y)dy=0$

c) $(x^3y^2+x)dy+(x^2y^3-y)dx=0$

d) $xdy-\{y+xy^3(1+\log x)\}dx=0$

**Q2)** Attempt any Two of the following:

a) When a resistance R ohms is connected in series with an inductance L henries with an e.m.f. of E volts, the current $i$ amperes at time $t$ is given by $L\dfrac{di}{dt}=Ri=E$. If E = 10 sin $t$ volts and $i=0$ when t = 0, find $i$ as a function of $t$. **[7]**

b) Show that the family of confocal & coaxial parabolas $y^2=4a(x+a)$ is self orthogonal. **[7]**

c) i) If the temperature of the air is 30°C, the substance cools from 100°C to 70°C in 15minutes. Find when the temperature will be 40°C. **[4]**

ii) If 30% of radioactive substance disappeared in 10 days, how long will it take for 90% of it to disappear? **[4]**

**Q3)** Attempt any FOUR of the following (5 marks each): **[20]**

a) Using Taylor's series method obtain the numerical solution of $\frac{dy}{dx} = 3x + y^2$ with $y(0) = 1$ for $x = 0.1$.

b) Using Euler's method find the approximate value of $y$ at $x = 1.5$ in five steps. Given that $\frac{dy}{dx} = \frac{y-x}{\sqrt{xy}}; y(1) = 2$.

c) Use modified Euler's method to solve numerically the differential equation $\frac{dy}{dx} = y - \frac{2x}{y}$ with $y(0) = 1$ for $x = 0.1$ by taking $h = 0.05$.

d) Using Runge-Kutta method of order four, find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$ with $y(0) = 1$ taking $h = 0.2$.

e) Solve the following simultaneous differential equations by Runge-Kutta method for $t = 0.1$.

$\frac{dx}{dt} = yx + t, \frac{dy}{dt} = x + ty$, given $x = 1$ and $y = -1$, when $t = 0$.

## SECTION-II

**Q4)** Attempt any Three from of the following (5 marks each): **[15]**

a) Evaluate $\int_0^\infty x^9 e^{-2x^2} dx$.

b) Prove that $\int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{\sin\theta}} \times \int_0^{\frac{\pi}{2}} \sqrt{\sin\theta}\, d\theta = \pi$.

c) Evaluate $\int_0^1 \frac{x^\alpha - 1}{\log x} dx$ where α being parameter greater than or equal to zero.

d) Prove that $\frac{d}{dx} erf(ax) = \frac{2a}{\sqrt{\pi}} e^{-a^2x^2}$ where $x$ being a parameter.

**Q5)** Attempt any three from of the following (5 marks each): **[15]**

a) Trace the curve 'Witch of Agenesi' given $xy^2 = a^2(a-x)$.

b) Trace the curve 'Limacon', given $r = a(1-\sin\theta)$.

c) Find the length of loop of the curve $9y^2 = (x+7)(x+4)^2$.

d) Find the length of arc of cardioid $r = a(1-\cos\theta)$ which lies outside the circle $r = a\cos\theta$.

**Q6)** Attempt any four from of the following (5 marks each) **[20]**

a) Evaluate $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{1}{1+x^2+y^2} dxdy$.

b) Change the order of integration and hence evaluate

$$\int_0^{\pi/2} \int_0^{y} \cos 2y\sqrt{1-a^2\sin^2 x}\ dxdy.$$

c) Change into polar co-ordinates and hence evaluate $\int_0^a \int_y^a \frac{x^2 dxdy}{\sqrt{x^2+y^2}}$.

d) OA is the diameter of a semicircular disc, the density at any point varies as its distance from O. Find the position of centre of gravity, given that OA = $a$.

e) Find the area enclosed between $y = 4x - x^2$ and $y = x$.

f) Find the moment of Inertia about the line $\theta = \frac{\pi}{2}$ of the area enclosed by $r = a(1+\cos\theta)$.

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