

Code No: R10102/R10

**Set No. 1**

**I B.Tech I Semester Supplementary Examinations, Jan/Feb 2015**  
**MATHEMATICS-I**  
 ( Common to Civil Engineering, Electrical & Electronics Engineering,  
 Mechanical Engineering, Electronics & Communication Engineering,  
 Computer Science & Engineering, Chemical Engineering, Electronics &  
 Instrumentation Engineering, Bio-Medical Engineering, Information  
 Technology, Electronics & Computer Engineering, Aeronautical  
 Engineering, Bio-Technology, Automobile Engineering, Mining and  
 Petroleum Technology)

**Time: 3 hours**

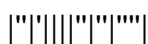
**Max Marks: 75**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Solve  $x \frac{dy}{dx} + y = x^3 y^6$   
 (b) Find the orthogonal trajectory of the family of curves  $r^2 = a \cos 2\theta$ , where 'a' is a parameter [7+8]
2. (a) Define (i) Complementary Function (ii) Particular Integral  
 (iii) Auxiliary Equation (iv) General Solution of a differential equation  
 (b) Solve  $y^{11} - 3y^1 + 2y = 0, y(0) = -1, y^1(0) = 0$  [8+7]
3. (a) Find Taylor's series expansion of  $f(x, y) = x^2 + y^2$  in powers of  $(x-1)$  and  $(y-2)$ .  
 (b) Expand  $f(x, y) = e^y \cos x$  in powers of  $(x - \frac{\pi}{4})$  and  $(y-1)$ . [8+7]
4. (a) Trace the curve  $r = 2 + 3 \sin \theta$ .  
 (b) Trace the curve  $y^2(2a - x) = x^3$ . [8+7]
5. (a) Find the surface area generated by rotating the arc of the catenary  $y = a \cosh \frac{x}{a}$  from  $x=0$  to  $a$  about the x-axis.  
 (b) Find the volume of the solid generated by revolving about the x-axis of the loop of the curve  $y^2 = x^2 \frac{(a+x)}{a-x}$ . [8+7]
6. (a) Show that  $\int_0^{4a} \int_{\frac{4a}{x}}^y \frac{x^2 - y^2}{x^2 + y^2} dx dy = 8a^2 (\frac{\pi}{2} - \frac{5}{3})$ .  
 (b) Evaluate  $\iint_R y dx dy$  where R is the domain bounded by y-axis, the curve  $y=x^2$  and the line  $x + y = 2$  in the first quadrants. [8+7]
7. (a) Prove that  $\text{div curl } f = 0$   
 (b) For what value of the constant a will the vector  $A = (axy - z^3)\mathbf{i} + (a-2)x^2\mathbf{j} + (1-a)xz^2\mathbf{k}$  have its curl identically equal to zero. [8+7]
8. (a) Find  $\int_C f \cdot dr$  where  $f = xy \mathbf{i} + yz \mathbf{j} + zx \mathbf{k}$  and the curve C is  $r = t \mathbf{i} + t^2 \mathbf{j} + t^3 \mathbf{k}$ , t varying from -1 to 1  
 (b) Show that  $\int_S (axi + byj + czk) \cdot N dS = \frac{4\pi}{3}(a + b + c)$  where S is the surface of the surface of the sphere  $x^2 + y^2 + z^2 = 1$ . [8+7]

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**Time: 3 hours**

**Max Marks: 75**

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1. (a) Solve  $(xy^3 + y) dx + 2(y^2x^2 + x + y^4) dy = 0$   
 (b) A bacterial culture, growing exponentially, increases from 100 to 400 grams in 12 hours. How much was present after 3 hours from the initial instant [8+7]
2. (a) Solve  $(D^2 + 4D + 3)y = 2e^{-3x}$   
 (b) Solve  $(D^4 - 1)y = \cos x$  [8+7]
3. (a) If  $U = e^{-2xy} \sin(x^2 - y^2)$  show that  $\frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 U}{\partial y^2} = 0$ .  
 (b) Find Taylor's series expansion of the  $f(x) = x^{\frac{3}{2}}$  in powers of  $(x-1)$ . [8+7]
4. (a) Trace the curve  $r = \cos 4\theta$ .  
 (b) Trace the curve  $y^2(1-x) = x^2(1+x)$ . [8+7]
5. (a) A man walks along the curve  $20y=3(4x^2-20x+9)$  between the points, Where  $x=\frac{1}{2}$  and  $x = \frac{9}{2}$  find the distance covered by the man?  
 (b) Find the surface area of the solid generated by the revolution of the astroid  $x^{2/3} + y^{2/3} = a^{2/3}$  about the x-axis. [8+7]
6. (a) Change the order of integration in  $\int_0^{4a} \int_{x^2/4a}^{2\sqrt{ax}} dy dx$ .  
 (b) By Changing the order of integration evaluate  $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 dy dx$ . [8+7]
7. (a) Prove that  $\text{div curl } f = 0$   
 (b) For what value of the constant a will the vector  $A = (axy-z^3)\mathbf{i} + (a-2)x^2\mathbf{j} + (1-a)xz^2\mathbf{k}$  have its curl identically equal to zero. [8+7]
8. (a) If  $f = 3xy \mathbf{i} - y^2 \mathbf{j}$ , evaluate  $\int_C f \cdot dr$  where C is the curve  $y = 2x^2$ , in xy plane from (0, 0) to (1,2).  
 (b) Evaluate  $\int_S f \cdot N ds$ , where  $f = 18z\mathbf{i} - 12\mathbf{j} + 3y\mathbf{k}$  and S is the part of the plane  $2x + 3y + 6z = 12$  located in first octant. [8+7]

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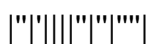
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**Answer any FIVE Questions  
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1. (a) Solve  $\frac{dy}{dx} = \frac{x^3+y^3}{xy^2}$   
 (b) Find the time required for a sum of money to double itself at 5 % per annum compounded continuously? [8+7]
  
2. (a) Solve  $y^{111} + 6y^{11} + 11y^1 + 6y = e^{2x}$   
 (b) Solve  $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \sin x$  [8+7]
  
3. (a) Expand  $f(x, y) = e^{x+y}$  in the neighborhood of (1,1).  
 (b) If  $u = \sqrt{xy}$  then find all the first and second order partial derivatives of u. [8+7]
  
4. (a) Trace the curve  $x^2(x^2 + y^2) = (x^2 - y^2)$ .  
 (b) Trace the curve  $x = \sin \theta, y = \sin^2 \theta \cos \theta$ . [8+7]
  
5. Prove that the volume of the solid generated by the revolution about the  $x - axis$  of the loop of the curve  $x = t^2, y = t - \frac{1}{3}t^3$  is  $\frac{3\pi}{4}$ . [8+7]
  
6. (a) Evaluate  $\iint xy dx dy$  over the positive Quadrant of the circle  $x^2 + y^2 = a^2$ .  
 (b) Evaluate  $\int \int \int_V (xy + yz + zx) dx dy dz$  where V is the region of space bound by  $x = 0, x = 1, y = 0, y = 2, z = 0, z = 3$ . [8+7]
  
7. (a) Find the directional derivative of  $xyz^2 + xz$  at (1,1,1) in a direction of the normal to the surface  $3x^2y + y = z$  at (0,1,1).  
 (b) Show that the vector  $(x^2-yz) i + (y^2-zx)j + (z^2-xy)k$  is irrotational and find its scalar potential. [8+7]
  
8. (a) Let  $C$  be the circle  $x^2+y^2 = 4$ , oriented counterclockwise. Use Green's Theorem to evaluate the following integral  $\oint_C (\cos(y^2) - y^3)dx + x^3dy$   
 (b) Compute  $\oint_S (ax^2 + by^2 + cz^2) dS$  over the sphere  $x^2 + y^2 + z^2 = 1$ . [8+7]

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**Time: 3 hours**

**Max Marks: 75**

**Answer any FIVE Questions  
All Questions carry equal marks**

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1. (a) Solve  $x \frac{dy}{dx} + y = x^3 y^6$   
 (b) Find the orthogonal trajectory of the family of curves  $r^2 = a \cos 2\theta$ , where 'a' is a parameter [7+8]
2. (a) Solve  $(D^3 - 6D^2 + 11D - 6)y = e^{-2x} + e^{-3x}$   
 (b) Solve  $\frac{d^2y}{dx^2} - 8 \frac{dy}{dx} + 15y = 0$  [8+7]
3. (a) Expand  $f(x, y) = e^{x+y}$  in the neighborhood of (1,1).  
 (b) If  $u = \sqrt{xy}$  then find all the first and second order partial derivatives of u. [8+7]
4. (a) Trace the curve  $y = (x - 2)(x + 3)(x - 4) ..$   
 (b) Trace the curve  $r = \frac{1}{2} \sin \theta$ . [8+7]
5. (a) Find the length of the arc of the curve  $y = \log(\sec x)$  from  $x = 0$  to  $\frac{\pi}{3}$ .  
 (b) Find the perimeter of the loop of the curve  $3ay^2 = x(x-a)^2$ . [8+7]
6. (a) Evaluate  $\int \int (x + y)^2 dx dy$ . over the area bounded by the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .  
 (b) Transform the following to Cartesian form and hence evaluate  $\int_0^\pi \int_0^a r^3 \sin \theta dr d\theta$ . [8+7]
7. (a) Prove that  $\text{div}(\bar{r}/r) = 2/r$ .  
 (b) Show that  $A = (6xy + z^3)\mathbf{i} + (3x^2 - z)\mathbf{j} + (3x^2z^2 - y)\mathbf{k}$  is irrotational. Find  $\phi$  such that  $A = \nabla\phi$ . Prove that  $\text{div curl } A = 0$  [8+7]
8. (a) Evaluate  $\iint_S (yzi + zxyj + xyk) \cdot dS$  where S is the surface of the sphere  $x^2 + y^2 + z^2 = a^2$  in the first octant.  
 (b) Evaluate  $\oint_C (x^2 - 2xy)dx + (x^2y + 3)dy$  around the boundary of the region defined by  $y^2 = 8x$  and  $x = 2$ . [8+7]

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