

I B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018  
 MATHEMATICS-I

Time: 3 hours

Max. Marks: 70

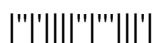
- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
 2. Answering the question in **Part-A** is Compulsory  
 3. Answer any **FOUR** Questions from **Part-B**

**PART -A**

1. a) State Newton's law of cooling. (2M)
- b) Test whether the functions  $e^x \cos x$  and  $e^x \sin x$  are linearly independent or not. (2M)
- c) Write the Laplace transform of  $y''$ , given that  $y(0)=1$  and  $y'(0)=1$ . (2M)
- d) Verify whether  $u = 2x - y, v = x - 2y$  are functionally dependent. (2M)
- e) Find the general solution of  $3p^2 = q$ . (2M)
- f) Find the general solution of  $(D^2 - 4DD' + 4D'^2) = 0$ . (2M)
- g) Find Laplace transform of  $t \cos at$ . (2M)

**PART -B**

2. a) Solve  $3e^x \tan y dx + (1 - e^x) \sec^2 y dy = 0$ . (7M)
- b) Find the equation of the system of orthogonal trajectories of the parabolas (7M)  
 $r = \frac{2a}{1 + \cos \theta}$ , where  $a$  is the parameter.
3. a) Solve  $(D^2 - 3D + 2)y = \cos 3x$ . (7M)
- b) Solve  $(D^2 - 5D + 6)y = e^x \sin x$ . (7M)
4. a) Find  $L [t^3 e^{2t} \sin t]$ . (7M)
- b)  $y'' - 3y' + 2y = 4t + e^{3t}$  when  $y(0) = 1$  and  $y'(0) = -1$ . (7M)
5. a) If  $x + y + z = u, y + z = uv, z = uvw$ , then evaluate  $\frac{\partial(x, y, z)}{\partial(u, v, w)}$ . (7M)
- b) Find the volume of the largest rectangular parallelepiped that can be inscribed in (7M)  
 the ellipsoid  $\frac{x^2}{4} + \frac{y^2}{9} + \frac{z^2}{25} = 1$ .
6. a) Form a partial differential equation by eliminating the arbitrary functions  $f$  and  $g$  (7M)  
 from  $z = xf(ax + by) + g(ax + by)$ .
- b) Solve  $z^2(p^2 + q^2) = x^2 + y^2$ . (7M)



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SET - 1

7. a) Solve  $(4D^2 + 12DD' + 9D'^2)z = e^{3x-2y}$ . (7M)

b) Classify the nature of the partial differential equation (7M)

$$x^2 \frac{\partial^2 u}{\partial x^2} + (1 - y^2) \frac{\partial^2 u}{\partial y^2} = 0, \quad -\infty < x < \infty, \quad -1 < y < 1.$$



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**PART -A**

1. a) Write the differential equation for L-R circuit, explain the terms involved in it and write the solution of the differential equation. (2M)
- b) Test whether the functions  $e^x$  and  $xe^x$  are linearly independent or not. (2M)
- c) Write the second shifting theorem of Laplace transforms. (2M)
- d) If  $u = \frac{y}{x}, v = xy$ , then find  $J\left(\frac{u,v}{x,y}\right)$ . (2M)
- e) Find the general solution of  $p^2 + q^2 = 1$ . (2M)
- f) Find the general solution of  $(D^2 + DD' - 2D'^2) = 0$ . (2M)
- g) Find L [sin 2t sin 3t]. (2M)

**PART -B**

2. a) Solve  $\frac{dy}{dx} + \frac{y}{x} \log y = \frac{y}{x^2} (\log y)^2$ . (7M)
- b) Find the orthogonal trajectories of the following family of curves:  $r^n = a^n \sin n\theta$ . (7M)
3. a) Solve  $(D^2 - p^2)y = \text{Sinh } px$ . (7M)
- b) Solve  $(D^2 - 6D + 13)y = 8e^{3x} \text{Sin} 2x$ . (7M)
4. a) Find L  $[(t+3)^3 e^{2t}]$  (7M)
- b) Solve  $(D^2 + 2D + 1)y = 3te^{-t}$  given that  $y(0) = 4, y'(0) = 2$ . (7M)
5. a) Prove that  $u = \frac{x^2 - y^2}{x^2 + y^2}, v = \frac{2xy}{x^2 + y^2}$  are functionally dependent and find the relation between them. (7M)
- b) Find the maximum and minimum values  $x + y + z$  subject to  $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$ . (7M)
6. a) Form a partial differential equation by eliminating the arbitrary function  $z = f(x^2 + y^2 + z^2)$ . (7M)
- b) Solve  $x^2(z - y)p + y^2(x - z)q = z^2(y - x)$ . (7M)
7. a) Solve  $(D^3 + D^2D' - DD'^2 - D'^3)z = 3\sin(x + y)$ . (7M)
- b) Classify the nature of the partial differential equation  $\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial x \partial y} + (x^2 + y^2)\frac{\partial^2 u}{\partial y^2} = \sin(x + y)$ . (7M)



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**PART -A**

1. a) Write the differential equation for C-R circuit, explain the terms involved in it and write the solution of the differential equation. (2M)
- b) Test whether the functions  $\sin x$  and  $x \sin x$  are linearly independent or not. (2M)
- c) State convolution theorem in Laplace transforms. (2M)
- d) Find the stationary points of  $f(x, y) = xy + (x - y)$ . (2M)
- e) Find the general solution of  $pq=l$ . (2M)
- f) Find the general solution of  $(D^2 + 7DD' + 12D'^2) = 0$ . (2M)
- g) Find Laplace transform of  $t^2 e^{-2t}$ . (2M)

**PART -B**

2. a) Solve  $(x + 2y^3) \frac{dy}{dx} = y$ . (7M)
- b) Find the orthogonal trajectories of the family  $r = 2a(\cos \theta + \sin \theta)$  (7M)
3. a) Solve  $(D^2 - 4D + 3)y = \sin 3x \cos 2x$ . (7M)
- b) Solve  $(D^2 - 2D + 1)y = xe^x \sin x$  (7M)
4. a) Find  $L [t^2 \sin at]$ . (7M)
- b) Solve  $(D^2 + 6D + 9)y = \sin t$  given that  $y(0) = 1, y'(0) = 0$ . (7M)
5. a) If  $u = \frac{yz}{x}, v = \frac{xz}{y}, w = \frac{xy}{z}$  find  $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ . (7M)
- b) Find the stationary points of  $u(x, y) = \sin x \sin y \sin(x + y)$  where  $0 < x < \pi, 0 < y < \pi$  and find the maximum  $u$ . (7M)
6. a) Form a partial differential equation by eliminating the arbitrary function  $f$  from  $xyz = f(x^2 + y^2 + z^2)$ . (7M)
- b) Solve  $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$ . (7M)
7. a) Solve  $(D^3 - 4D^2D' + 4DD'^2)z = 6 \sin(3x + 6y)$ . (7M)
- b) Classify the nature of the partial differential equation  $\frac{\partial^2 u}{\partial x^2} + 2 \frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = 0$ . (7M)



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**PART -A**

1. a) State law of natural growth or decay and write the corresponding differential equations and their solutions. (2M)
- b) Test whether the functions  $e^{2x}$  and  $e^{5x}$  are linearly independent or not. (2M)
- c) Find the Laplace transform of Heaviside's unit function. (2M)
- d) Expand  $e^x \cos y$  near  $(1, \frac{\lambda}{4})$  (2M)
- e) Find the general solution of  $p+q=1$ . (2M)
- f) Find the general solution of  $(D^2 - 4DD'+4D'^2) = 0$ . (2M)
- g) If  $L\left(\frac{\sin t}{t}\right) = \tan^{-1} \frac{1}{s}$ , find  $L\left(\frac{\sin at}{t}\right)$ . (2M)

**PART -B**

2. a) Solve  $\cosh x \frac{dy}{dx} + y \sinh x = 2 \cosh^2 x \sinh x$ . (7M)
- b) Find the orthogonal trajectories of  $r^2 = a \sin 2\theta$ . (7M)
3. a) Solve  $(D^2 + 3D + 2)y = e^{-x} + \cos x$ . (7M)
- b) Solve  $(D^2 + 2D - 3)y = x^2 e^{-3x}$ . (7M)
4. a) Find  $L\left[e^{-3t} \int_0^t \frac{1 - \cos t}{t^2} dt\right]$  (7M)
- b) Solve  $y''' - 3y'' + 3y' - y = t^2 e^t$  given that  $y=1, y'=0, y''=-2$  at  $t=0$ . (7M)
5. a) Determine whether the functions  $U = \frac{x}{y-z}, V = \frac{y}{z-x}, W = \frac{z}{x-y}$  are dependent. (7M)  
 If dependent find the relationship between them.
- b) Examine the function for extreme values  $f(x, y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$ . (7M)
6. a) Form a partial differential equation by eliminating  $a$  and  $b$  from  $\log(az - 1) = x + ay + b$ . (7M)
- b) Solve  $px(z - 2y^2) = (z - qy)(z - y^2 - 2x^3)$ . (7M)
7. a) Solve  $(D^2 - 4DD'+4D'^2)z = e^{2x+y}$ . (7M)
- b) Classify the nature of the partial differential equation  $\frac{\partial^2 u}{\partial x^2} + 4 \frac{\partial^2 u}{\partial x \partial y} + 4 \frac{\partial^2 u}{\partial y^2} - \frac{\partial u}{\partial x} + 2 \frac{\partial u}{\partial y} = 0$ . (7M)