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Ordinary Differential Equations

Previous year Questions from 2016 to 1992

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2016

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2016

1. Find a particular integral of $\frac{d^2y}{dx^2} + y = e^{x/2}\sin\frac{x\sqrt{3}}{2}$ **(10 marks)**

2. Show that the family of parabolas $y^2 = 4cx + 4c^2$ is self orthogonal. **(10 marks)**

3. Solve $\{y(1 - x\tan x) + x^2\cos x\}dx - xdy = 0$ **(10 marks)**

4. Using the method of variation of parameter solve the differential equation $(D^2 + 2D + 1)y = e^{-x}\log(x), \quad \left[D \equiv \frac{d}{dx}\right]$ **(15 marks)**

5. Find the general solution of the equation $x^2\frac{d^3y}{dx^3} - 4x\frac{d^2y}{dx^2} + 6\frac{dy}{dx} = 4$ **(15 marks)**

6. Using Laplace transformation solves the following: $y'' - 2y' - 8y = 0, y(0) = 3, y'(0) = 6$ **(10 marks)**

2015

7. Solve the differential equation: $x\cos x\frac{dy}{dx} + y(x\sin x + \cos x) = 1$ **(10 Marks)**

8. Solve the differential equation: $(2xy^4e^y + 2xy^3 + y)dx + (x^2y^4e^y - x^2y^2 - 3x)dy = 0$ **(10 Marks)**

9. Find the constant a so that $(x+y)^a$ is the integrating factor of $(4x^2 + 2xy + 6y)dx + (2x^2 + 9y + 3x)dy = 0$ and hence solve the differential equation **(12 Marks)**

10. (i) Obtain Laplace Inverse transform of $\left\{\ln\left(1 + \frac{1}{s^2}\right) + \frac{s}{s^2 + 25}e^{-5s}\right\}$

    (ii) Using Laplace transform, solve $y'' + y = t, y(0) = 1, y'(0) = -2$ **(6+6=12 Marks)**

11. Solve the differential equation $x = py - p^2$ where $p = \frac{dy}{dx}$ **(13 Marks)**

12. Solve $x^4\frac{d^4y}{dx^4} + 6x^3\frac{d^3y}{dx^3} + 4x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^2 + 2\cos(\log_e x)$ **(13 Marks)**

2014

13. Justify that a differential equation of the form: $\left[y + xf(x^2+y^2)\right]dx + \left[yf(x^2+y^2) - x\right]dy = 0$ where $f(x^2+y^2)$ is an arbitrary function of (x^2+y^2), is not an exact differential equation and $\frac{1}{x^2+y^2}$ is an integrating factor for it. Hence solve this differential equation for $f(x^2+y^2) = (x^2+y^2)^2$ **(10 Marks)**

14. Find the curve for which the part of the tangent cut-off by the axes is bisected at the point of tangency **(10 Marks)**

15. Solve by the method of variation of parameters: $\frac{dy}{dx} - 5y = \sin x$ **(10 Marks)**

16. Solve the differential equation: $x^3\frac{d^3y}{dx^3} + 3x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + 8y = 65\cos\left(\log_e x\right)$ **(20 Marks)**

17. Solve the following differential equation: $x\frac{d^2y}{dx^2}-2(x+1)\frac{dy}{dx}+(x+2)y=(x-2)e^{2x}$, when e^x is a solution to its corresponding homogeneous differential equation. **(15 Marks)**

18. Find the sufficient condition for the differential equation $M(x,y)dx+N(x,y)dy=0,$ to have an integrating factor as a function of $(x+y)$. What will be the integrating factor in that case? Hence find the integrating factor for the differential equation of $(x^2+xy)dx+(y^2+xy)dy=0$ and solve it. **(15 Marks)**

19. Solve the initial value problem $\frac{d^2y}{dt^2}+y=8e^{-2t}\sin t,\ y(0)=0, y'(0)=0$ by using Laplace transform. **(20 Marks)**

2013

20. If y is a function of x, such that the differential coefficient $\frac{dy}{dx}$ is equal to $\cos(x+y)+\sin(x+y)$. Find out a relation between x and y, which is free from any derivative / differential. **(10 Marks)**

21. Obtain the equation of the orthogonal trajectory of the family of curves represented by $r^n=a\sin n\theta,\ (r,\theta)$ being the plane polar coordinates. **(10 Marks)**

22. Solve the differential equation $(5x^3+12x^2+6y^2)dx+6xydy=0$ **(15 Marks)**

23. Using the method of variation of parameters, solve the differential equation $\frac{d^2y}{dx^2}+a^2y=\sec ax$ **(15 Marks)**

24. Find the general solution of the equation $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=\ln x\sin(\ln x)$ **(15 Marks)**

25. By using Laplace transform method, solve the differential equation $(D^2+n^2)x=a\sin(nt+\alpha)$, $D^2=\frac{d^2}{dt^2}$ subject to the initial conditions $x=0$ and $\frac{dx}{dt}=0$, at $t=0$, in which a, n and α are constants. **(15 Marks)**

2012

26. Solve $\frac{dy}{dx}=\frac{2xye^{(x/y)^2}}{y^2(1+e^{(x/y)^2})+2x^2e^{(x/y)^2}}$ **(12 Marks)**

27. Find the orthogonal trajectory of the family of curves $x^2+y^2=ax$ **(12 Marks)**

28. Using Laplace transforms, solve the initial value problem $y''+2y'+y=e^{-t},\ y(0)=-1, y'(0)=1$ **(12 Marks)**

29. Show that the differential equation $(2xy\log y)dx+(x^2+y^2\sqrt{y^2+1})dy=0$ is not exact. Find an integrating factor and hence, the solution of the equation **(20 Marks)**

30. Find the general solution of the equation $y'''-y''=12x^2+6x$ **(20 Marks)**

31. Solve the ordinary differential equation $x(x-1)y''-(2x-1)y'+2y=x^2(2x-3)$ **(20 Marks)**

2011

32. Obtain the solution of the ordinary differential equation $\frac{dy}{dx} = (4x + y + 1)^2$, if $y(0) = 1$ **(10 Marks)**

33. Determine the orthogonal trajectory of a family of curves represented by the polar equation $r = a(1 - \cos\theta)$, (r, θ) being the plane polar coordinates of any point. **(10 Marks)**

34. Obtain Clairaut's form of the differential equation $\left(x\frac{dy}{dx} - y\right)\left(y\frac{dy}{dx} + x\right) = a^2\frac{dy}{dx}$. Also find its general solution **(15 Marks)**

35. Obtain the general solution of the second order ordinary differential equation $y'' - 2y' + 2y = x + e^x \cos x$, where dashes denote derivatives w.r.t. x **(15 Marks)**

36. Using the method of variation of parameters, solve the second order differential equation $\frac{d^2y}{dx^2} + 4y = \tan 2x$ **(15 Marks)**

37. Use Laplace transform method to solve the following initial value problem: $\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^t$, $x(0) = 2$ and $\left.\frac{dy}{dt}\right|_{t=0} = -1$ **(15 Marks)**

2010

38. Consider the differential equation $y' = \alpha x$, $x > 0$ where α is a constant. Show that
    (i) If $\phi(x)$ is any solution and $\psi(x) = \phi(x)e^{-\alpha x}$, then $\psi(x)$ is a constant;
    (ii) If $\alpha < 0$, then every solution tends to zero as $x \to \infty$ **(12 Marks)**

39. Show that the differential equation $(3y^2 - x) + 2y(y^2 - 3)y' = 0$ admits an integrating factor which is a function of $(x + y^2)$. Hence solve the equation **(12 Marks)**

40. Verify that $\frac{1}{2}(Mx + Ny)d\left[\log_e(xy)\right] + \frac{1}{2}(Mx - Ny)d\left[\log_e(x/y)\right] = Mdx + Ndy$. Hence show that-
    (i) If the differential equation $Mdx + Ndy = 0$ is homogeneous, then $(Mx + Ny)$ is an integrating factor unless $Mx + Ny \equiv 0$;
    (ii) If the differential equation $Mdx + Ndy = 0$ is not exact but is of the form $f_1(xy)ydx + f_2(xy)xdy = 0$ then $(Mx - Ny)^{-1}$ is an integrating factor unless $Mx + Ny \equiv 0$;
    (20 Marks)

41. Use the method of undermined coefficients to find the particular solutions of $y'' + y = \sin x + (1 + x^2)e^x$ and hence find its general solution. **(20 Marks)**

2009

42. Find the Wronskian of the set of functions: $\{3x^3, |3x^3|\}$ on the interval $[-1, 1]$ and determine whether the set is linearly dependent on $[-1, 1]$ **(12 Marks)**

43. Find the differential equation of the family of circles in the xy-plane passing through $(-1, 1)$ and $(1, 1)$ **(20 Marks)**

44. Find the inverse Laplace transform of $F(s)=1n\left(\frac{s+1}{s+s}\right)$ **(20 Marks)**

45. Solve : $\frac{dy}{dx}=\frac{y^2(x-y)}{3xy^2-x^2y-4y^3}$, $y(0)=1$ **(20 Marks)**

2008

46. Solve the differential equation $ydx+(x+x^3y^2)dy=0$ **(12 Marks)**

47. Use the method of variation of parameters to find the general solution of $x^2y''-4xy'+6y=-x^4\sin x$ **(12 Marks)**

48. Using Laplace transform, solve the initial value problem $y''-3y'+2y=4t+e^{3t}$, $y(0)=1$, $y'(0)=-1$ **(15 Marks)**

49. Solve the differential equation $x^3y''-3x^2y'+xy=\sin(\ln x)+1$ **(15 Marks)**

50. Solve the equation $y-2xp+yp^2=0$, where $p=\frac{dy}{dx}$ **(15 Marks)**

2007

51. Solve the ordinary differential equation $\cos 3x\frac{dy}{dx}-3y\sin 3x=\frac{1}{2}\sin 6x+\sin^2 3x, 0<x<\frac{\pi}{2}$ **(12 Marks)**

52. Find the solution of the equation $\frac{dy}{y}+xy^2dx=-4xdx$ **(12 Marks)**

53. Determine the general and singular solutions of the equation $y=x\frac{dy}{dx}+a\frac{dy}{dx}\left[1+\left(\frac{dy}{dx}\right)^2\right]^{-\frac{1}{2}}$, a being a constant. **(15 Marks)**

54. Obtain the general solution of $[D^3-6D^2+12D-8]y=12\left(e^{2x}+\frac{9}{4}e^{-x}\right)$, where $D\equiv\frac{dy}{dx}$ **(15 Marks)**

55. Solve the equation $2x^2\frac{d^2y}{dx^2}+3x\frac{dy}{dx}-3y=x^3$ **(15 Marks)**

56. Use the method of variation of parameters to find the general solution of the equation $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=2e^x$ **(15 Marks)**

2006

57. Find the family of curves whose tangents form an angle $\frac{\pi}{4}$ with the hyperbolas $xy=c, c>0$ **(12 Marks)**

58. Solve the differential equation $\left(xy^2+e^{-\frac{1}{x^3}}\right)dx-x^2ydy=0$ **(12 Marks)**

59. Solve: $(1+y^2)+(x-e^{-\tan^{-1}y})\dfrac{dy}{dx}=0$ **(15 Marks)**

60. Solve the equation $x^2p^2+py(2x+y)+y^2=0$ using the substitution $y=u$ and $xy=v$ and find its singular solution, where $p=\dfrac{dy}{dx}$ **(15 Marks)**

61. Solve the differential equation $x^2\dfrac{d^3y}{dx^3}+2x\dfrac{d^2y}{dx^2}+2\dfrac{y}{x}=10\left(1+\dfrac{1}{x^2}\right)$ **(15 Marks)**

62. Solve the differential equation $(D^2-2D+2)y=e^x\tan x,\ D\equiv\dfrac{dy}{dx}$ by the method of variation of parameters. **(15 Marks)**

2005

63. Find the orthogonal trajectory of the family of co-axial circles $x^2+y^2+2gx+c=0$, where g is the parameter. **(12 Marks)**

64. Solve: $xy\dfrac{dy}{dx}=\sqrt{(x^2-y^2-x^2y^2-1)}$ **(12 Marks)**

65. Solve the differential equation: $\left[(x+1)^4D^3+2(x+1)^3D^2-(x+1)^2D+(x+1)\right]y=\dfrac{1}{(x+1)}$ **(15 Marks)**

66. Solve the differential equation: $(x^2+y^2)(1+p)^2-2(x+y)(1+p)(x+yp)+(x+yp)^2=0$ where $p=\dfrac{dy}{dx}$, by reducing it to Clairaut's form by using suitable substitution. **(15 Marks)**

67. Solve the differential equation $(\sin x-x\cos x)y''-x\sin x\ y'+y\sin x=0$ given that $y=\sin x$ is a solution of this equation. **(15 Marks)**

68. Solve the differential equation $x^2y''-2xy'+2y=x\log x,\ x>0$ by variation of parameters **(15 Marks)**

2004

69. Find the solution of the following differential equation $\dfrac{dy}{dx}+y\cos x=\dfrac{1}{2}\sin 2x$ **(12 Marks)**

70. Solve: $y(xy+2x^2y^2)dx+x(xy-x^2y^2)dy=0$ **(12 Marks)**

71. Solve: $(D^4-4D^2-5)y=e^x(x+\cos x)$ **(15 Marks)**

72. Reduce the equation $(px-y)(py+x)=2p$, where $p=\dfrac{dy}{dx}$ to Clairaut's equation and hence solve it. **(15 Marks)**

73. Solve: $(x+2)\dfrac{d^2y}{dx^2}-(2x+5)\dfrac{dy}{dx}+2y=(x+1)e^x$ **(15 Marks)**

74. Solve the following differential equation: $(1-x^2)\dfrac{d^2y}{dx^2}-4x\dfrac{dy}{dx}-(1+x^2)y=x$ **(15 Marks)**

2003

75. Show that the orthogonal trajectory of a system of confocals ellipses is self orthogonal **(12 Marks)**

76. Solve: $x\frac{dy}{dx}+y\log y = xye^x$ **(12 Marks)**

77. Solve $(D^5 - D) = 4(e^x + \cos x + x^3)$, where $D \equiv \frac{dy}{dx}$. **(15 Marks)**

78. Solve the differential equation $(px^2 + y^2)(px + y) = (P+1)^2$, where $p = \frac{dy}{dx}$, by reducing it to Clairaut's form using suitable substitutions **(15 Marks)**

79. Solve $(1-x^2)y'' + (1+x)y' + y = \sin 2\left[\log(1+x)\right]$ **(15 Marks)**

80. Solve the differential equation $x^2y'' - 4x\ y' + 6y = x^4\sec^2 x$ by variation of parameters. **(15 Marks)**

2002

81. Solve : $x\frac{dy}{dx} + 3y = x^3y^2$ **(12 Marks)**

82. Find the values of λ for which all solutions of $x^2\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - \lambda y = 0$ tend to zero as $x \to \infty$.

(12 Marks)

83. Find the value of constant λ such that the following differential equation becomes exact. $(2xe^y + 3y^2)\frac{dy}{dx} + (3x^2 + \lambda e^y) = 0$. Further, for this value of λ, solve the equation. **(15 Marks)**

84. Solve : $\frac{dy}{dx} = \frac{x+y+4}{x-y-6}$ **(15 Marks)**

85. Using the method of variation of parameters, find the solutions of $\frac{d^2y}{d^2x} - 2\frac{dy}{dx} + y = xe^x\sin x$ with $y(0) = 0$ and $\left(\frac{dy}{dx}\right)_{x=0} = 0$ **(15 Marks)**

86. Solve : $(D-1)(D^2 - 2D + 2)y = e^x$ where $D \equiv \frac{dy}{dx}$ **(15 Marks)**

2001

87. A continuous function $y(t)$ satisfies the differential equation $\frac{dy}{dx} = \begin{cases} 1 + e^{1-t}, & 0 \le t < 1 \\ 2 + 2t - 3t^2, & 1 \le t < 5 \end{cases}$ If $y(0) = -e$ find $y(2)$ **(12 Marks)**

88. Solve : $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} - 3y = x^2\log_e x$ **(12 Marks)**

89. Solve : $\frac{dy}{dx} + \frac{y}{x}\log_e y = \frac{y(\log_e y)^2}{x^2}$ **(15 Marks)**

90. Find the general solution of $ayp^2 + (2x-b)p - y = 0,\ a > 0$ **(15 Marks)**

91. Solve: $(D^2+1)^2 y = 24x\cos x$ given that $y = Dy = D^2y = 0$ and $D^3y = 12$ when $x = 0$ **(15 Marks)**

92. Using the method of variation of parameters, solve $\frac{d^2y}{dx^2}+4y=4\tan 2x$ **(15 Marks)**

2000

93. Show that $3\frac{d^2y}{dx^2}+4x\frac{dy}{dx}-8y=0$ has an integral which is a polynomial in x. Deduce the general solution. **(12 Marks)**

94. Reduce $\frac{d^2y}{dx^2}+P\frac{dy}{dx}+Qy=R$, where P,Q,R are functions of x, to the normal form. Hence solve $\frac{d^2y}{dx^2}-4x\frac{dy}{dx}+(4x^2-1)y=-3e^{x^2}\sin 2x$ **(15 Marks)**

95. Solve the differential equation $y=x-2ap+ap^2$. Find the singular solution and interpret it geometrically **(15 Marks)**

96. Show that $(4x+3y+1)dx+(3x+2y+1)dy=0$ represents a family of hyperbolas with a common axis and tangent at the vertex **(15 Marks)**

97. Solve $x\frac{dy}{dx}-y=(x-1)\left(\frac{d^2y}{dx^2}-x+1\right)$ by the method of parameters **(15 Marks)**

1999

98. Solve the differential equation $\frac{xdx+ydy}{xdy-ydx}=\left(\frac{1-x^2-y^2}{x^2+y^2}\right)^{1/2}$ **(20 Marks)**

99. Solve $\frac{d^3y}{dx^3}-3\frac{d^2y}{dx^2}+4\frac{dy}{dx}-2y=e^x+\cos x$ **(20 Marks)**

100. By the method of variation of parameters solve the differential equation $\frac{d^2y}{dx^2}+a^2y=\sec(ax)$ **(20 Marks)**

1998

101. Solve the differential equation: $xy-\left(\frac{dy}{dx}\right)=y^3e^{-x^2}$ **(20 Marks)**

102. Show that the equation: $(4x+3y+1)dx+(3x+2y+1)dy=0$ represents a family of hyperbolas having as asymptotes the lines $x+y=0,\ 2x+y+1=0$. **(20 Marks)**

103. Solve the differential equation: $y=3px+4p^2$ **(20 Marks)**

104. Solve the differential equation: $\frac{d^2y}{dx^2}-5\frac{dy}{dx}+6y=e^{4x}(x^2+9)$ **(20 Marks)**

105. Solve the differential equation: $\frac{d^2y}{dx^2}+2\frac{dy}{dx}+y=x\sin x$ **(20 Marks)**

106. Solve the differential equation: $x^3\frac{d^3y}{dx^3}+2x^2\frac{d^2y}{dx^2}+2y=10\left(x+\frac{1}{x}\right)$ **(20 Marks)**

1997

107. Solve the initial value problem $\frac{dy}{dx}=\frac{x}{x^2y+y^3}$, $y(0)=0$ **(20 Marks)**

108. Solve $(x^2-y^2+3x-y)dx+(x^2-y^2+x-3y)dy=0$ **(20 Marks)**

109. Assume that a spherical rain drop evaporates at a rate proportional to its surface area. If its radius originally is 3mm, and one hour later has been reduced to 2 mm. find an expression for the radius of the rain drop at any time. **(20 Marks)**

110. Solve $\frac{d^4y}{dx^4}+6\frac{d^3y}{dx^3}+11\frac{d^2y}{dx^2}+6\frac{dy}{dx}=20e^{-2x}\sin x$ **(20 Marks)**

111. Make use of the transformation $y(x)=u(x)\sec x$ to obtain the solution of $y''-2y'\tan x+5y=0,\ \ y(0)=0,\ y'(0)=\sqrt{6}$ **(20 Marks)**

112. Solve $(1+2x)^2\frac{d^2y}{dx^2}-6(1+2x)\frac{dy}{dx}+16y=8(1+2x)^2,\ y(0)=0,\ y'(0)=2$ **(20 Marks)**

1996

113. Find the curves for which the sum of the reciprocals of the radius vector and polar sub tangent is constant. **(20 Marks)**

114. Solve : $x^2(y-px)=yp^2,\ p\equiv\frac{dy}{dx}$ **(20 Marks)**

115. Solve : $y\sin 2x dx-\left(1+y^2+\cos^2 x\right)dy=0$ **(20 Marks)**

116. $\frac{d^2y}{dx^2}+2\frac{dy}{dx}+10y+37\sin 3x=0$. Find the value of y when $x=\frac{\pi}{2}$, if it is given that $y=3$ and $\frac{dy}{dx}=0$ when $x=0$ **(20 Marks)**

117. Solve : $\frac{d^4y}{dx^4}+2\frac{d^3y}{dx^3}-3\frac{d^2y}{dx^2}=x^2+3e^{2x}+4\sin x$ **(20 Marks)**

118. Solve : $x^3\frac{d^3y}{dx^3}+3x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=x+\log x$ **(20 Marks)**

1995

119. Determine a family of curves for which the ratio of the y- intercept of the tangent to the radius vector is a constant. **(20 Marks)**

120. Solve $(2x^2+3y^2-7)xdx+(3x^2+2y^2-8)ydy=0$ **(20 Marks)**

121. Test whether the equation $(x+y)^2dx-(y^2-2xy-x^2)dy=0$ is exact and hence solve it. **(20 Marks)**

122. Solve $x^3\frac{d^3y}{dx^3}+2x^2\frac{d^2y}{dx^2}+2y=10\left(x+\frac{1}{x}\right)$ **(20 Marks)**

123. Determine all real valued solutions of the equations $y'''-iy''+y'-iy=0,\ y'=\frac{dy}{dx}$ **(20 Marks)**

124. Find the solution of the equation $\frac{d^2y}{dx^2}+4y=8\cos 2x,$ given that $y=0$ and $y'=2$ when $x=0$

(20 Marks)

1994

125. Solve: $\frac{dy}{dx}+x\sin 2y=x^3\cos^2 y$ **(20 Marks)**

126. Show that if $\frac{1}{Q}\left(\frac{\partial P}{\partial y}-\frac{\partial Q}{\partial x}\right)$ is a function of x only, say , $f(x),$ then $F(x)=e^{\int f(x)dx}$ is an integration factor of $Pdx+Qdy=0$ **(20 Marks)**

127. Find the family of curves whose tangent from an angel $\frac{\pi}{4}$ with the hyperbola $xy=c$ **(20 Marks)**

128. Transform the differential equation $\frac{d^2y}{dx^2}\cos x+\frac{dy}{dx}\sin x-2y\cos^3 x=2\cos^5 x$ into one having z as independent variable where $z=\sin x$ and solve it. **(20 Marks)**

129. If $\frac{d^2x}{dt^2}+\frac{g}{b}(x-a)=0$ (a,b and g being positive constants) and $x=a'$ and $\frac{dx}{dt}=0$ when $t=0,$

show that $x=a+(a'-a)\cos t\sqrt{\frac{g}{b}}t$ **(20 Marks)**

130. Solve $(D^2-4D+4)y=8x^2e^{2x}\sin 2x$ where $D\equiv\frac{dy}{dx}$ **(20 Marks)**

1993

131. Determine the curvature for which the radius of curvature is proportional to the slope of the tangent. **(20 Marks)**

132. Show that the system of co focal conics $\frac{x^2}{a^2+\lambda}+\frac{y^2}{b^2+\lambda}=1$ is self orthogonal. **(20 Marks)**

133. Solve $\left\{y\left(1+\frac{1}{x}\right)+\cos y\right\}dx+\left(x+\log x-x\sin y\right)dy=0$ **(20 Marks)**

134. Solve $y\frac{d^2y}{dx^2}-2\left(\frac{dy}{dx}\right)^2=y^2$ **(20 Marks)**

135. Solve $\frac{d^2y}{dx^2}+{\omega_0}^2y=a\cos\omega t$ and discuss the nature of solution as $\omega\xrightarrow{dt^2}\omega_0$ **(20 Marks)**

136. Solve $(D^4+D^2+1)y=e^{-x/2}\cos\left(x\frac{\sqrt{3}}{2}\right)$ **(20 Marks)**

1992

137. By eliminating the constants a, b obtain the differential equation for which $xy = ae^x + be^{-x} + x^2$ is a solution **(20 Marks)**

138. Find the orthogonal trajectory of the family of semi cubical parabolas $ay^2 = x^3$, where a is a variable parameter. **(20 Marks)**

139. Show that $(4x+3y+1)dx+(3x+2y+1)dy=0$ represents hyperbolas having the following lines as asymptotes $x+y=0,\ 2x+y+1=0$ **(20 Marks)**

140. Solve the following differential equation $y(1+xy)dx + x(1-xy)dy = 0$ **(20 Marks)**

141. Find the curves for which the portion of y- axis cut off between the origin and the tangent varies as the cube of the abscissa of the point of contact. **(20 Marks)**

142. Solve the following differential equation: $(D^2+4)y = \sin 2x,$ given that when $x=0,$ then $y=0$ and $\frac{dy}{dx}=2$ **(20 Marks)**

143. Solve : $(D^3-1)y = xe^x + \cos^2 x$ **(20 Marks)**

144. Solve : $(x^2D^2 + xD - 4)y = x^2$ **(20 Marks)**