Program : M.A./M.Sc. (Mathematics)
M.A./M.Sc. (Previous) Question Bank-2015
Paper Code:MT-03
Section-A (Very Short Answer type Questions)

1. Define efaffian differential Equation.
   (P.N. 26, Art 2.1, M.A./MSC MT-03)
2. Write the monge's subsidiary equation for
   $x^2 r + 2xys + y^2 t = 0$
   (P.N. 54, Ex (3), M.A./MSC MT-03)
3. Find the nature of following PDE
   $$\frac{3\partial^2 z}{\partial x^2} + 2\frac{\partial^2 z}{\partial x \partial y} + 5\frac{\partial^2 z}{\partial y^2} + x\frac{\partial z}{\partial y} = 0$$
   (P.N. 67, Ex (3), M.A./MSC MT-03)
4. Check whether the boundary value problem.
   $y^{11} - \lambda y = 0 \ with \ y(0) = 0 = y(\pi)$
   Is sturm liouscille problem as not.
   (P.N. 110, Ex (1), M.A./MSC MT-03)
5. Test for extremism of the functional
   $F[y(x) =]^b (Cosy - xy^{'} Siny)dx$ With the boundary conditions $y(a)^a = y_0, y(b) = y_1$
   (P.N. 128, Ex (2), M.A./MSC MT-03)
6. Define ordinary and singular points.
   (P.N. 159, Art., 9.2.2(a), M.A./MSC MT-03)
7. Define Bessel's differential Equation.
   (P.N. 248, Art., 13.2.1 , M.A./MSC MT-03)
8. Write Rodrigul's Formula for $L_n(x)$
   (P.N. 290, Art., 15.5, M.A./MSC MT-03)
9. Shown that s $(2x + y^2 + 2xz)dxydy + x^2 dz = 0$ integrable.
   (P.N. 30, Ex(3)., M.A./MSC MT-03)
10. Write the monge's subsidiary equations for equation of the type Rt+Ss+Tt = V
    (P.N. 50, Art 3.4, M.A./MSC MT-03)
11. Determine the nature of following PDF
    $$\frac{\partial^2 z}{\partial x^2} = x^2 \frac{\partial^2 z}{\partial y^2}$$
    (P.N. 67, Ex(1)., M.A./MSC MT-03)
12. Check whether the following boundary value problem.
    $xy^{11} + y^1 + (x^2 + 1 + \lambda)y = 0$
    Y(0) and y'(L) = 0 L is constant such that L>1 is sturm liouville problem or not.

(P.N. 110, Ex(2)., M.A./MSC MT-03)

13. Define linear Functionals.
(P.N. 122, Art 7.22., M.A./MSC MT-03)

14. Define Regular singular point.
(P.N. 160, Art 9.2.2 (b)., M.A./MSC MT-03)

15. Give the expression for $P_n(Cos\theta)$ is term of consine series.
(P.N. 230, Art 9.2.2 (b)., M.A./MSC MT-03)

16. State the addition thearm for Bessel function,
(P.N. 259, Art 13.7., M.A./MSC MT-03)

Section-B (Short Answer type Questions)

17. Shown that there are two values of the constant for which K/x is an integral of $x^2(y_1 + y^2) = 2$ and hence obtain the general solution.
(P.N. 12, Ex(3)., 15.5, M.A./MSC MT-03)

18. Solve
$z(1+q^2)r - 2pqzs(1+p^2)t + z^2(rt+s^2) + 1 + p^2 + q^2 = 0$
(P.N. 62, Ex(5)., 15.5, M.A./MSC MT-03)

19. Find the most general Functions X(x) and T(t), each of one is variable, such that u(x,y)=x(t) satisfies the PDF $\frac{\partial^2 u}{\partial x^2} = \frac{1}{K}\frac{\partial u}{\partial t}$
Also obtain a solution of the above equation for K = 1 and which satisfies the boundary conditions
u = 0 when x =0 or π
$u = Sin 3x \, When \, t = 0 \, and \, 0 < x < \pi$
(P.N. 83, Ex(1)., 15.5, M.A./MSC MT-03)

20. Test for an extramum the functional
$$I = [y(x)] = \int_0^1 (xy + y^2 - 2y^2 y^1)dx, d(0) = 1, y(1) = 2$$
(P.N. 13.8, Ex(13.2), Advanced mathematics (M-IV) N.K.)

21. Find the solid of maximum volume formed by the revolution of a given surface area.
(P.N. 13.12, Ex(13.6), Advanced mathematics (M-IV) N.K.)

22. Show that $n(p_n Q_{n-1} - Q_n P_{n-1}) = 1$
(P.N. 243, Ex(12)., M.A./MSC MT-03)

23. Prove that $J_n(x) = (-2)^n x^n \frac{d^n}{d(x^2)} J_0(x)$
(P.N. 263, Ex(3)., M.A./MSC MT-03)

24. Show that $\sum_{n=0}^{\infty} \frac{H_{n+s}(x)t^n}{Ln} = \exp(2xt - t^2) H_s(x-t)$
(P.N. 282, Ex(4)., M.A./MSC MT-03)

25. Solve the following differential equation.

$$2\sin x\frac{d^2y}{dx^2}+2Cosx\frac{dy}{dx}+2\sin x\frac{dy}{dx}+2yCosx=Cosx$$

(P.N. 3, Ex. (2)., M.A./MSC MT-03)

26. Solve $z(y+z)dx+z(t-x)dy+y(x-t)dz+y(y+z)dt=0$

(P.N. 42, Ex. (2)., M.A./MSC MT-03)

27. Use the method of separation of variables to solve the equation.

$\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}+u$ given that u(x,0)=6x-^{3x}

(P.N. 75, Ex. (4)., M.A./MSC MT-03)

28. Explain the orthogonality of Eigen functions

(P.N. 112, Art 6.5., M.A./MSC MT-03)

29. Find the extremal of the function

$$I(y(x))=\int_0^{\pi/2}[y''^2-y^2+x^2]$$

$y(0)=1, y'(0), y(\pi/2)=-1$

(P.N. 147, Ex. (2)., M.A./MSC MT-03)

30. Prove that $\frac{1+z}{z\sqrt{1-xz+z^2}}-\frac{1}{z}=\sum_{n=1}^{\infty}(p_n+p_{n+1})z^n$

(P.N. 231, Ex. (1)., M.A./MSC MT-03)

31. Prove that $J_{-n}(x)=(-1)J_n(x)$

(P.N. 251, Art 13.4., M.A./MSC MT-03)

32. Prove that if $m<n$

$$\frac{d^m(H_n(x)}{dx^m}=\frac{\alpha^m Ln}{L_{N-m}}H_{n-m}(x)$$

(P.N. 275, Ex. (2)., M.A./MSC MT-03)

Section-C (Long Answer type Questions)

33. Obtain the necessary and sufficient condition for integrability of the total differential equation $pdx+Qdy+Rdz=0$

(P.N. 26, Art 2.2, M.A./MSC MT-03)

34. State and obtain the Euler – logrange Equation

(P.N. 124, Art 7.3.2, M.A./MSC MT-03)

35. Determine the soluation of legendra's equation.

(P.N. 177, Ex(1), M.A./MSC MT-03)

36. Write the Hermite Differential equation and obtan its soluation.

(P.N. 296, Art 14.2, M.A./MSC MT-03)

37. Solve $x^2y\frac{d^2y}{dx^2}+\left(x\frac{dy}{dx}-y\right)^2=0$

(P.N. 6, Ex. (4)., M.A./MSC MT-03)

38. Let λ_m *and* λ_n be two distrinct eigenvalues of the sturm – liouville problem.

$$\frac{d}{dx}\left[P(x)\frac{dy}{dx}\right]+(\lambda q(x)+r(r)]y=0$$

And $y_m(x)$ and $y_n(x)$ be their corresponding eigen functions. Then prove that $y_m(x)$ and $y_n(x)$ are orthogonal with respect to the weight function q(x) on the interval $a \le x \le b$

(P.N. 114, art 6.6.2, M.A./MSC MT-03)

39. if Z is a curve which is dependent on x, y and is twice differentiable in its domain D, and extremize he functional

$$i(z(x,y)=\int_D F(x,y,p,q)\,dx\,dy$$

Then prove that following differential equation must be satisfied.

$$\frac{\partial F}{\partial Z}-\frac{\partial}{\partial x}\frac{(\partial F)}{(\partial P)}-\frac{\partial}{\partial y}(\frac{\partial F}{\partial q})=0 \text{ where } P=\frac{\partial y}{\partial x} and\, q=\frac{\partial z}{\partial y}$$

(P.N. 141, art 8.3, M.A./MSC MT-03)

40. Prove that

$$\int_0^\infty e^{-x}xL_N K(x)L^k{}_m(x)dx=\frac{Ln+k}{Ln}=\delta mn$$

(P.N. 298, art 15.11, M.A./MSC MT-03)