Online Examinations (Even Sem/Part-I/Part-II Examinations 2020 - 2021

Course Name - –Partial Differential Equations
Course Code - MSCMC203

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Answer all the questions. Each question carry one mark.

9. 1.

The general solution of $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ is of the form

Mark only one oval.

$u=f(x+iy)+g(x-iy)$

Option 1

$u=f(x+y)+g(x-y)$

Option 2

$u=cf(x-iy)$

Option 3

$u=g(x+y)$

Option 4

10. 2.

Let $u(x,y)$ be the solution of the Cauchy problem $xu_x + u_y = 1,\ u(x,0) = 2\ln x,\ x > 1$,
then $u(e,1) =$

Mark only one oval.

- -1
- 0
- 1
- e

11. 3.

In the region $x>0, y>0$, the partial differential equation

$$\left(x^2 - y^2\right)\frac{\partial^2 u}{\partial x^2} + 2\left(x^2 + y^2\right)\frac{\partial^2 u}{\partial x \partial y} + \left(x^2 - y^2\right)\frac{\partial^2 u}{\partial y^2} = 0$$

Mark only one oval.

- changes type
- is elliptic
- is parabolic
- is hyperbolic

12. 4.

The complete integral of $p^2x^2 + q^2y^2 = z^2$ is

Mark only one oval.

$z^2 = cx^2y\sqrt{1-a^2}$

- [ ] Option 1

$z = cx^2y\sqrt{1-a^2}$

- [ ] Option 2

$z = c\left(xy\right)^a$

- [ ] Option 3

$z = c\left(x+y\right)^a$

- [ ] Option 4

13. 5.

The variables ξ and η which reduce the differential equation $\frac{\partial^2 u}{\partial x^2} - x^2 \frac{\partial^2 u}{\partial y^2} = 0$ to the canonical form, are

Mark only one oval.

$\xi = y^2 + \frac{1}{2}x, \eta = y^2 - \frac{1}{2}x$

- Option 1

$\xi = y + \frac{1}{2}x^2, \eta = y - \frac{1}{2}x^2$

- Option 2

$\xi = y + x^2, \eta = y - x^2$

- Option 3

$\xi = y^2 + x, \eta = y^2 - x$

- Option 4

14. 6.

The solution of the differential equation $r+5s+6t=(y-2x)^{-1}$ is

Mark only one oval.

$\phi_1(y+2x)+\phi_2(y+3x)+\log(y+2x)$

Option 1

$\phi_1(y-2x)+\phi_2(y+3x)+x\log(y-2x)$

Option 2

$\phi_1(y-2x)+\phi_2(y-3x)+x\log(y+2x)$

Option 3

$\phi_1(y-2x)+\phi_2(y-3x)+x\log(y-2x)$

Option 4

15. 7.

Pick the region in which the following differential equation is hyperbolic.

$yu_{xx} + 2xyu_{xy} + xu_{yy} = u_x + u_y$

Mark only one oval.

$xy \neq 1$

Option 1

$xy \neq 0$

Option 2

$xy > 1$

Option 3

$xy > 0$

Option 4

16. 8. Which of the following is elliptic?

Mark only one oval.

- Laplace equation
- Wave equation

$$u_{xx} + 2u_{xy} - 4u_{yy} = 0$$

- Heat equation
- Option 4

17. 9. Which of these is a quasi-linear partial differential equation?

Mark only one oval.

$$\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$$

Option 1

$$\frac{\partial^2 u}{\partial x^2}+a\left(x,y\right)\frac{\partial^2 u}{\partial y^2}=0$$

Option 2

$$\frac{\partial u}{\partial x}\frac{\partial^2 u}{\partial x^2}+\frac{\partial u}{\partial y}\frac{\partial^2 u}{\partial y^2}=0$$

Option 3

$$\left(\frac{\partial^2 u}{\partial x^2}\right)^2+\frac{\partial^2 u}{\partial y^2}=0$$

Option 4

18. 10.

The solution of the given differential equation $\frac{\partial^4 z}{\partial x^4} - \frac{\partial^4 z}{\partial y^4} = 0$, is

Mark only one oval.

$f_1(y+x) + f_2(y-x) + f_3(y+ix) + f_4(y-ix)$

Option 1

$f_1(y+x) + f_2(y-x)$

Option 2

$f_1(y+ix) + f_2(y-ix)$

Option 3

None of these

19. 11. A partial differential equation has

Mark only one oval.

- one independent variable
- two or more independent variables
- more than one dependent variable
- equal number of dependent and independent variables

20. 12.

A solution to the partial differential equation.

$$\frac{\partial^2 u}{\partial x^2} = 9\frac{\partial^2 u}{\partial y^2}$$

Mark only one oval.

$\cos(3x - y)$

Option 1

x^2+y^2

Option 2

$\sin(3x - y)$

Option 3

$e^{-3\pi x}\sin(\pi y)$

Option 4

21. 13.

The equation $u_t = c^2 u_{xx}$ is classified as

Mark only one oval.

- Elliptic
- Hyperbolic
- Parabolic
- None of these

22. 14.

Classify the heat equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}=\frac{1}{c^2}\cdot\frac{\partial u}{\partial t}$

Mark only one oval.

- Elliptic
- Hyperbolic
- Parabolic
- None of these

23. 15.

Classify the equation $\frac{\partial^2 u}{\partial x^2}-\frac{\partial^2 u}{\partial x \partial t}+4\frac{\partial^2 u}{\partial x^2}=0$

Mark only one oval.

- Elliptic
- Hyperbolic
- Parabolic
- None of these

24. 16. Monge's method is used to solve a partial differential equation of

Mark only one oval.

- nth order
- 1st order
- 2nd order
- None of these

25. 17.

Solution of the equation $(y^2+z^2)p-xyq=-3x$, is

Mark only one oval.

$x\cos(x+y)$

- Option 1

$\phi(y/z, x^2-y^2+z^2)=0$

- Option 2

$\phi(x/y, x^2+y^2+z^2)=0$

- Option 4

$\phi(y/z, x^2-y^2+z^2)=0$

- Option 3

26. 18.

The solution of $\frac{\partial^2 z}{\partial x^2} - 5\frac{\partial^2 z}{\partial x \partial y} + 4\frac{\partial^2 z}{\partial y^2} = \sin(4x+y)$ is

Mark only one oval.

$$z = \frac{1}{3}x\cos(4x+y)$$

Option 1

$$z = f_1(y+x) + f_2(y+4x)$$

Option 2

$$z = f(y+x) - \frac{1}{3}x\cos(4x+y)$$

Option 3

$$z = f_1(y+x) + f_2(y+4x) - \frac{1}{3}x\cos(4x+3y)$$

Option 4

27. 19.

The complete solution of $z = px + qy + p^2 + q^2$ is

Mark only one oval.

$z = ax + by + a^2 + b^2$

Option 1

$z = ax + by$

Option 2

$z = a^2x^2 + b^2y^2$

Option 3

None of these

28. 20.

A surface passing through the two lines $z = x = 0,\ z - 1 = x - y = 0$, satisfying $r - 4s + 4t = 0$, is

Mark only one oval.

$$z = \frac{2x}{3x+y}$$

Option 1

$$z = \frac{3x}{2x+y}$$

Option 2

$$z = \frac{x+y}{3x-y}$$

Option 3

$$z = \frac{2x}{3x+2y}$$

Option 4

29. 21.

The characteristic curves of the PDE $\left(1-x^2\right)u_{xx}-u_{yy}=0$ in the hyperbola case are

Mark only one oval.

$\xi = y+\sin x,\ \eta = y-\sin x$

( ) rectangular hyperbola

( ) Option 2

$\xi = y-\sin^{-1}x,\ \eta = y+\sin^{-1}x$

$\xi = y+\cos x,\ \eta = y-\cos x$

( ) Option 3

( ) Option 4

30. 22.

For the PDE $\frac{\partial z}{\partial x}+2xy^3\frac{\partial z}{\partial y}=z^3$, the general solution can be expressed in the form $F(u,v)=0$ where u and v are

Mark only one oval.

$$u(x,y,z)=x^2+y^{-2}$$
$$v(x,y,z)=x-\frac{1}{2}z^{-2}$$

Option 1

$$u(x,y,z)=x^2-y^2$$
$$v(x,y,z)=x-z^{-2}$$

Option 2

$$u(x,y,z)=x^2-\frac{1}{2}y^2$$
$$v(x,y,z)=x-\frac{1}{2}z^{-2}$$

Option 3

$$u(x,y,z)=x^2+\frac{1}{2}y^{-2}$$
$$v(x,y,z)=x+\frac{1}{2}z^{-2}$$

Option 4

31. 23.

Let $u = f(x+iy) + g(x+iy)$, where f and g are arbitrary functions differentiable any order. Then the partial differential equation of minimum order satisfied by u is

Mark only one oval.

$$u_{xx} + 2u_{xy} + u_{yy} = 0$$

Option 1

$$u_{xx} + u_{yy} = 0$$

Option 2

$$\frac{u_{xx}}{x} + \frac{u_{yy}}{y} = 0$$

Option 3

$$yu_{xx} + xu_{yy} = 0$$

Option 4

32. 24. Laplace's equation is

Mark only one oval.

$$u_{xx} + u_{yy} - u_z = 0$$

Option 1

$$u_{xx} + u_{yy} + u_z{}^2 = 0$$

Option 2

$$u_{xx} + u_{yy} - u_{zz} = 0$$

Option 3

$$u_{xx} + u_{yy} + u_{zz} = 0$$

Option 4

33. 25.

Suppose $u(x, y)$ satisfies Laplace's equation $\nabla^2 u = 0$ in $\mathbb{R}^2$ and $u = x$ on the unit circle. Then at the origin

Mark only one oval.

- u tends to infinity.
- u attains a finite minimum
- u attains a finite maximum.
- u is equal to 0.

34. 26.

Consider the boundary value problem: $u_{xx} + u_{yy} = 0$ in $\Omega = \{(x, y) : x^2 + y^2 < 1\}$

with $\frac{\partial u}{\partial n} = x^2 + y^2$ on the boundary of Ω ($\frac{\partial u}{\partial n}$ denotes the normal derivative of u).

Then its solution $u(x, y)$

Mark only one oval.

- is unique and is identically zero.
- is unique up to a constant.
- does not exist.
- is unique and non-zero.

35. 27. The Laplace equation can be written as

Mark only one oval.

$\nabla^2 u = \text{Constant}$

- Option 1

$\nabla^2 u = 0$

- Option 2

$\nabla u = 0$

- Option 3

$\nabla^2 u = f(x)$

- Option 4

36. 28. Laplace equation in cylindrical coordinates is

Mark only one oval.

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(S\frac{\partial u}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2 u}{\partial\phi^2}+\frac{\partial^2 u}{\partial z^2}=0$$

Option 1

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\frac{\partial u}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2 u}{\partial\phi^2}+\frac{\partial^2 u}{\partial z^2}=0$$

Option 2

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(S\frac{\partial u}{\partial\rho}\right)+\frac{\partial^2 u}{\partial\phi^2}+\frac{\partial^2 u}{\partial z^2}=0$$

Option 3

Other

37. 29. The solution of Laplace equation in spherical polar coordinates when it is axially symmetric about Z-axis involves

Mark only one oval.

- Associated Legendre's function
- Legendre's polynomial
- Bessel's function
- Trigonometric function

38. 30.Which of the following concerning the solution of the Dirichlet problem for a smooth bounded region is true?

Mark only one oval.

- Solution is unique
- Solution is unique upto an additive constant
- Solution is unique up to a multiplicative constant.
- No conclusion can be made about uniqueness.

39. 31.Which of the following is elliptic?

Mark only one oval.

- Laplace equation
- Wave equation

$$u_{xx} + 2u_{xy} - 4u_{yy} = 0$$

- Heat equation
- Option 4

40. 32.

Consider the BVP $u_{xx}+u_{yy}=0$, $x\in(0,\pi)$, $y\in(0,\pi)$,
$u(x,0)=u(x,\pi)=u(0,y)=0$.
Any solution of this BVP is of the form

Mark only one oval.

$$\sum_{n=1}^{\infty} a_n \sinh nx \sin ny$$

Option 1

$$\sum_{n=1}^{\infty} a_n \cosh nx \sin ny$$

Option 2

$$\sum_{n=1}^{\infty} a_n \sinh nx \cos ny$$

Option 3

$$\sum_{n=1}^{\infty} a_n \cosh nx \cos ny$$

Option 4

41. 33.While solving a partial differential equation using a variable separable method, we equate the ratio to a constant which

Mark only one oval.

- can be positive or negative integer
- can be positive or negative integer or zero
- must be a positive integer
- must be a negative integer

42. 34.

Solution of $\frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}=0$ by method of separation of variables, given $z\left(x,\frac{\pi}{2}\right)=0,\ z(x,0)=4e^{-3x}$

Mark only one oval.

$3e^{-4x}\cos 4y$

Option 1

$4e^{-3x}\cos 3y$

Option 2

$3e^{-3x}\cos 4y$

Option 3

$4e^{-4x}\cos 3y$

Option 4

43. 35. D’Alembert’s solution of the wave equation is

Mark only one oval.

$$u(x,t) = \phi(x+ct) - \psi(x-ct)$$

Option 1

$$u(x,t) = \phi(x+ct) + \psi(x-ct)$$

Option 2

$$u(x,t) = \phi'(x+ct) - \psi'(x-ct)$$

Option 3

$$u(x,t) = \phi(x-ct) + \psi(x+ct)$$

Option 4

44. 36.Solution of one dimensional wave equation is

Mark only one oval.

$$u_n(x,t)=\left(C_n\cos\frac{n\pi ct}{l}+D_n\sin\frac{n\pi ct}{l}\right)\sin\frac{n\pi x}{l}$$

- Option 1

$$u_n(x,t)=\left(C_n\cos^2\frac{n\pi ct}{l}+D_n\sin^2\frac{n\pi ct}{l}\right)\cos\frac{n\pi x}{l}$$

- Option 2

$$u_n(x,t)=\left(C_n\cos\frac{n\pi ct}{l}-D_n\sin\frac{n\pi ct}{l}\right)\sin\frac{n\pi x}{l}$$

- Option 3
- None of these

45. 37. One dimensional wave equation is

Mark only one oval.

$$\frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2} \cdot \frac{\partial^2 u}{\partial x^2}$$

Option 1

$$\frac{\partial^2 u}{\partial t^2} = \frac{1}{c^2} \cdot \frac{\partial^2 u}{\partial x^2}$$

Option 2

$$\frac{\partial^2 u}{\partial t^2} = c^2 \cdot \frac{\partial^2 u}{\partial x^2}$$

Option 3

$$\frac{\partial^2 u}{\partial x^2} = \frac{1}{c^2} \cdot \frac{\partial^2 u}{\partial t^2}$$

Option 4

46. 38. The partial differential equation of the transverse vibration of a string is

Mark only one oval.

$$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$$

Option 1

$$\frac{\partial^2 y}{\partial t^2} = c \frac{\partial y}{\partial x}$$

Option 2

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{c^4} \frac{\partial^2 y}{\partial t^2}$$

Option 3

None of these

47. 39.

The solution of the IVP $u_{tt} = 4u_{xx},\ t > 0,\ -\infty < x < \infty$ satisfying the conditions $u(x,0) = x,\ u_t(x,0) = 0$ is

Mark only one oval.

x

- Option 1
- 2x

$\frac{1}{2}x^2$

$2t$

- Option 3
- Option 4

48. 40. Y=xf(y')+g(y') is

Mark only one oval.

- d'Alembert's equation
- Binomial equation
- Miller equation
- Polynomial equation

49. 41.

Let $u(x,y)$ be a solution of the IVP $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0$, $u(x,0) = x^2$, $u_t(x,0) = 0$

then $u(0,1) =$

Mark only one oval.

- 1
- 0
- 2
- 1/2

50. 42.

The solution of the IVP $u_{tt} = 4u_{xx}$, t>0, $-\infty < x < \infty$ satisfies the condition $u(x,0) = x,\ u_t(x,0) = 0$ is

Mark only one oval.

- x
- 2x

$$\frac{1}{2}x^2$$

- Option 3
- 2t

51. 43.

Solution of $\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}$, $u(0,t) = u(5,t) = u(x,0) = 0$ *and* $u_t(x,0) = 5\sin \pi x$ is

Mark only one oval.

$$u = \frac{2}{5\pi}\sin \pi x \sin 2\pi t$$

Option 1

$$u = \frac{2}{5\pi}\sin 2\pi x \sin 2\pi t$$

Option 2

$$u = \frac{5}{2\pi}\sin \pi x \sin 2\pi t$$

Option 3

All of these

52. 44.

Solution of $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$, $u(0,t) = u(l,t) = 0$, $u(x,0) = A\sin \pi x$ *and* $u_t(x,0) = 0$ is

Mark only one oval.

$u = A\cos(\pi ct)\sin(\pi x)$

Option 1

$u = A\sin(\pi ct)\cos(\pi x)$

Option 2

$u = A\sin(\pi ct)\sin(\pi x)$

All of these

$u = A\cos(\pi ct)\cos(\pi x)$

Option 4

53. 45.

Solution of $u_{tt} = 9u_{xx}$ where $u(0,t) = u(2,t) = 0$, $u(x,0) = 20\sin 2\pi x$ and $u_t(x,0) = 0$ is

Mark only one oval.

$20\cos 2\pi x \sin 6\pi t$

Option 1

$20\cos 6\pi x \sin 2\pi t$

Option 2

$20\sin 2\pi x \cos 6\pi t$

Option 3

$20\sin 6\pi x \cos 2\pi t$

Option 4

54. 46.

Solution of $u_{tt} = 4u_{xx}$ where $u(0,t) = u(5,t) = 0$, $u(x,0) = 0$ and $u_t(x,0) = 5\sin\pi x$ is

Mark only one oval.

$\frac{5}{\pi}\sin 2\pi x \sin \pi t$

Option 1

$\frac{5}{\pi}\cos \pi x \cos 2\pi t$

Option 2

$\frac{5}{\pi}\cos 2\pi x \cos \pi t$

Option 3

$\frac{5}{\pi}\sin \pi x \sin 2\pi t$

Option 4

55. 47.

Solution of $pt - qs = q^3$ is

Mark only one oval.

$y = xz + f(z) + g(z)$

Option 1

$y = xz + f(x) + g(z)$

Option 2

$y = xz + f(x) + g(x)$

Option 3

None of these

56. 48. Number of arbitrary constants in singular solution of an equation of degree n are

Mark only one oval.

- n
- n-1
- 0
- 1

57. 49. Out of the following four PDEs which equation is linear?

Mark only one oval.

$$\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^2 z}{\partial x^2}\frac{\partial z}{\partial y} + 8\frac{\partial^2 z}{\partial y^2} = \sin x$$

Option 1

$$\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^2 z}{\partial x^2}\frac{\partial z}{\partial y} + 8\frac{\partial z}{\partial x}\frac{\partial^2 z}{\partial y^2} = \sin x$$

Option 2

$$\frac{\partial^2 z}{\partial x^2} + 5\frac{\partial^2 z}{\partial y^2} = 0$$

Option 3

None of these

58. 50. When solving a 1-Dimensional wave equation using variable separable method, we get the solution if

Mark only one oval.

- k is positive
- k is negative
- k is 0
- k can be anything

59. 51.

In order to find the solution of $Pp + Qq = R$, the auxiliary equations are

Mark only one oval.

$$\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$$

Option 1

$$\frac{dx}{Q+R} = \frac{dy}{R+P} = \frac{dz}{P+Q}$$

Option 2

$$\frac{dx}{Q-R} = \frac{dy}{R-P} = \frac{dz}{P-Q}$$

Option 3

none of these

60. 52.

Solution of the equation $z = px + qy + f(p,q)$ is

Mark only one oval.

$z = f(ax, by)$

Option 1

$z = f(ax/by)$

Option 2

$z = ax + by + f(a, b)$

Option 3

None of these

61. 53.

For the equation $z = pq$, Charpit's auxiliary equations are

Mark only one oval.

$$\frac{dp}{p} = \frac{dq}{q} = \frac{dz}{2pq} = \frac{dx}{q} = \frac{dy}{p}$$

Option 1

$$\frac{dp}{q} = \frac{dq}{p} = \frac{dz}{pq} = \frac{dx}{p} = \frac{dy}{q}$$

Option 2

$$\frac{dp}{p} = \frac{dq}{q} = \frac{dz}{pq} = \frac{dx}{p} = \frac{dy}{q}$$

Option 3

None of these

62. 54.

Lagrange's subsidiary equations for $y^2zp + zx^2q = xy^2$ are

Mark only one oval.

$$\frac{dx}{y^2z} = \frac{dy}{zx^2} = \frac{dz}{y^2}$$

Option 1

$$\frac{dx}{x^2} = \frac{dy}{y^2} = \frac{dz}{zx}$$

Option 2

$$\frac{dx}{1/x^2} = \frac{dy}{1/y^2} = \frac{dz}{1/zx}$$

Option 3

None of these

63. 55.

The complete integral of $f(p,q)=0$ is

Mark only one oval.

$z = ax + b$

Option 1

$z = ax + F(a)y + b$

Option 2

$z = ax + by + c$

Option 3

None of these

64. 56.

The solution of $xu_x + yu_y = 0$ is of the form

Mark only one oval.

$f\left(\frac{y}{x}\right)$

Option 1

$f(y+x)$

Option 2

$f(x-y)$

Option 3

$f(xy)$

Option 4

65. 57.

If the partial differential $(x-1)^2 u_{xx} - (y-2)^2 u_{yy} + 2xu_x + 2yu_y + 2xyu = 0$ is parabolic in $S \subseteq \mathbb{R}^2$ but not in $\mathbb{R}^2 / S$, then S is

Mark only one oval.

$\{(x,y) \in \mathbb{R}^2 : x = 0 \ or \ y = 2\}$

Option 1

$\{(x,y) \in \mathbb{R}^2 : x = 1 \ or \ y = 2\}$

Option 2

$\{(x,y) \in \mathbb{R}^2 : x = 1\}$

Option 3

$\{(x,y) \in \mathbb{R}^2 : y = 2\}$

Option 4

66. 58.

The auxiliary equations of $p+q+1=0$ are

Mark only one oval.

$dx = dy = dz$

Option 1

$dx = dy = -dz$

Option 2

$\frac{dx}{p} = \frac{dy}{q} = dz$

Option 3

$\frac{dx}{p} = \frac{dy}{q} = -dz$

Option 4

67. 59. Heat equation is

Mark only one oval.

$$\frac{\partial u}{\partial x} = c^2 \nabla^2 x^2$$

Option 1

$$\frac{\partial u}{\partial y} = \frac{1}{c^2} \nabla^2 t^2$$

Option 2

$$\frac{\partial u}{\partial t} = c^2 \nabla^2 u$$

Option 3

$$\frac{\partial u}{\partial t} = c^2 \nabla^2 y^2$$

Option 4

68. 60. While solving a partial differential equation using a variable separable method, we equate the ratio to a constant which?

Mark only one oval.

- can be positive or negative integer or zero
- can be positive or negative rational number or zero
- must be a positive integer
- must be a negative integer