SRM Institute of Science and Technology

DEPARTMENT OF MATHEMATICS

# Transforms and Boundary Value Problems

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1. The order and degree of the PDE $\frac{\partial^2 z}{\partial x^2} + 2xy(\frac{\partial z}{\partial x})^2 + \frac{\partial z}{\partial y} = 5,$ respectively

   (A) $2, 1$ (B) $1, 2$ (C) $1, 1$ (D) $2, 2$

   **ANSWER: A**

2. The Partial Differential Equation corresponding to $Z = (x + a)(y + b)$ is

   (A) $p^2 + q^2 = z$ (B) $pq = z$ (C) $p^2 - q^2 = z$ (D) $z = p^2q^2$

   **ANSWER: B**

3. The complete solution of $\sqrt{p} + \sqrt{q} = 1$ is

   (A) $z = ax + (1 + \sqrt{a})^2 y + c$ (B) $z = ax + (1 - \sqrt{a})^2 y$

   (C) $z = ax + (1 - \sqrt{a})^2 y + c$ (D) $z = ax - (1 - \sqrt{a})^2 y + c$

   **ANSWER: C**

4. The general solution of $px + qy = z$ is

   (A) $f(x, y) = 0$ (B) $f(\frac{x}{y}, \frac{y}{z}) = 0$ (C) $f(xy, yz) = 0$ (D) $f(x^2 + y^2) = 0$

   **ANSWER: B**

5. The general solution of $(y - z)p + (z - x)q = x - y$ is

   (A) $f(x + y + z) = x^2 + y^2 + z^2$ (B) $f(xyz) = x^2 + y^2 + z^2$

   (C) $f(x + y + z) = xyz$ (D) $f(x^2 + y^2 + z^2) = x^2y^2z^2$

   **ANSWER: A**

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

   (A) $z = (x + a)(y + b)$ (B) $z = ax + by + c$

   (C) $z = ax + by + c^2 + d^2$ (D) $z = ax + by + a^2 + b^2$

   **ANSWER: D**

7. The solution of the linear PDE $(D^2 + 4DD' - 5D'^2)z = 0$ is

   (A) $z = f_1(y + x) + f_2(y + 5x)$ (B) $z = f_1(y - x) + f_2(y - 5x)$

   (C) $z = f_1(y + x) + f_2(y - 5x)$ (D) $z = f_1(y - x) + f_2(y + 5x)$

   **ANSWER: C**

8. The solution of $\frac{\partial^3 z}{\partial x^3} = 0$ is

   (A) $z = (1 + x + x^2)f(y)$ (B) $z = (1 + y + y^2)f(x)$

   (C) $z = f_1(y) + xf_2(y) + x^2f_3(y)$ (D) $z = f_1(x) + yf_2(x) + y^2f_3(x)$

   **ANSWER: C**

9. The solution of $p+q=z$ is

(A) $f(x+y, y+logz)$ (B) $f(xy, ylogz)$

(C) $f(x-y, y-logz)$ (D) $f(xy, y-logz)$

**ANSWER: C**

10. The particular solution of $(D^2-2DD'+D'^2)z=sinx$

(A) $-sinx$ (B) $sinx$ (C) $cosx$ (D) $-cosx$

**ANSWER: A**

11. The period of $sin5x$ is

(A) $\frac{8\pi}{5}$ (B) $\frac{6\pi}{5}$ (C) $\frac{4\pi}{5}$ (D) $\frac{2\pi}{5}$

**ANSWER: D**

12. If $f(x)=xsinx$ in $(-\pi,\pi)$ then the value of $b_n$ in Fourier series expansion is

(A) 0 (B) 1 (C) 2 (D) 3

**ANSWER: A**

13. Fourier coefficient $a_0$ in the Fourier series expansion of a function represents the

(A) maximum value of the function (B) 2 mean value of the function

(C) minimum value of the function (D) mean value of the function

**ANSWER: B**

14. If the Fourier series of the function $f(x)$ in $(-\ell,\ell)$ has only cosine terms then $f(x)$ must be

(A) odd function (B) even function

(C) neither even nor odd function (D) multi-valued function

**ANSWER: B**

15. If $f(x)=x^2+x$ in $(0,\ell)$ then the even extension in $(-\ell,0)$ is

(A) $-x^2-x$ (B) $-x^2+x$ (C) $x^2+x$ (D) $x^2-x$

**ANSWER: D**

16. Compute the constant term $\frac{a_0}{2}$ of the Fourier series of $f(x)$ given by the following data:

| $x$ | 0 | $\frac{\pi}{3}$ | $\frac{2\pi}{3}$ | $\pi$ | $\frac{4\pi}{3}$ | $\frac{5\pi}{3}$ | $2\pi$ |
|---|---|---|---|---|---|---|---|
| **f(x)** | 1.0 | 1.4 | 1.9 | 1.7 | 1.5 | 1.2 | 1.0 |

(A) 8.7 (B) 9.7 (C) 2.9 (D) 1.45

**ANSWER: A**

| $x$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **f(x)** | 9 | 18 | 24 | 28 | 26 | 20 |

17. Compute $a_1$ of the Fourier series of $f(x)$ given by the table:

    (A) -8.33 (B) -25 (C) -1.155 (D) 0.519

    **ANSWER: A**

18. The root mean square value of the function $f(x)$ over the interval $(a, b)$ then $\bar{y} =$

    (A) $\sqrt{\int_a^b \mid f(x) \mid^2 dx}$ (B) $\sqrt{\frac{1}{b-a}\int_a^b \mid f(x) \mid^2 dx}$

    (C) $\sqrt{\frac{1}{a-b}\int_a^b \mid f(x) \mid^2 dx}$ (D) $\sqrt{\frac{1}{b-a}\int_a^b \mid f(x) \mid dx}$

    **ANSWER: B**

19. The period of $tan2x$ is

    (A) $\frac{2\pi}{n}$ (B) $\frac{\pi}{n}$ (C) $\frac{\pi}{2}$ (D) $\frac{2}{\pi}$

    **ANSWER: C**

20. The Fourier cosine series of the function $f(t) = sin(\frac{\pi t}{\ell})$, $0 < t < \ell$ then the value of $a_0$ is

    (A) $\frac{1}{\pi}$ (B) $\frac{2}{\pi}$ (C) $\frac{3}{\pi}$ (D) $\frac{4}{\pi}$

    **ANSWER: D**

21. In one dimensional wave equation $\frac{\partial^2 y}{\partial t^2} = a^2 \frac{\partial^2 y}{\partial x^2}$, $a^2$ stands for

    (A) $\frac{T}{m}$ (B) $\frac{k}{c}$ (C) $\frac{m}{T}$ (D) $\frac{k}{m}$

    **ANSWER: A**

22. One dimensional wave equation is used to find the

    (A) time (B) displacement (C) heat flow (D) mass

    **ANSWER: B**

23. Heat flows from

    (A) higher to lower temperature (B) lower to higher temperature

    (C) constant temperature (D) uniform temperature

    **ANSWER: A**

24. The steady state temperature of the rod of length $20cm$ whose ends are kept at $30C$ and $80C$ is

    (A) $30 - \frac{5}{2}x$ (B) $30 + \frac{2}{5}x$ (C) $10 + \frac{5}{2}x$ (D) $30 + \frac{5}{2}x$

    **ANSWER: D**

25. The tension T caused by stretching the string before fixing it at the end points is

(A) decreasing (B) increasing (C) zero (D) constant

**ANSWER: D**

26. The amount of heat required to produce a given temperature change in a body is proportional to the

(A) mass of the body (B) weight of the body

(C) density of the body (D) Tension of the body

**ANSWER: A**

27. The one dimensional heat equation is of the form

(A) $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$ (B) $\frac{\partial u}{\partial t} = \alpha^2 \frac{\partial^2 u}{\partial x^2}$

(C) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ (D) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(x, y)$

**ANSWER: B**

28. The proper solution of one dimensional heat flow equation is $u(x, t)$

(A) $Ax + B$ (B) $(Ae^{\lambda x} + Be^{-\lambda x})e^{\alpha^2 \lambda^2 t}$

(C) $(A \cos px + B \sin px)e^{-\alpha^2 \lambda^2 t}$ (D) $(Ae^{\lambda x} + Be^{-\lambda x})(Ce^{\lambda at} + De^{-\lambda at})$

**ANSWER: C**

29. The slope of the deflection curve in vibrating string is assumed to be

(A) small at all points and at all times

(B) large at all points and at all times

(C) small at all points but not at all times

(D) large at all points but not at all times

**ANSWER: A**

30. How many initial and boundary conditions are required to solve the equation $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$

(A) 1 (B) 2 (C) 3 (D) 4

**ANSWER: D**

31. If $F[f(x)] = F(s)$, then $F[f(x - a)] =$

(A) $e^{isa}F(s)$ (B) $e^{-isa}F(s)$ (C) $e^{isx}F(s)$ (D) $e^{is(x-a)}F(s)$

**ANSWER: A**

32. If $F[f(x)] = F(s)$, then $F[f(ax)] =$

(A) $F(\frac{s}{a})$ (B) $F(\frac{a}{s})$ (C) $\frac{1}{|a|}F(\frac{a}{s})$ (D) $\frac{1}{|a|}F(\frac{s}{a})$

**ANSWER: D**

33. If $F[f(x)] = F(s)$, then $F[e^{iax}f(x)] =$

(A) $F(s-a)$ (B) F(s+a) (C) $e^{isa}F(s)$ (D) $e^{-isa}F(s)$

**ANSWER: B**

34. If $f(x) = e^{-ax}$, then Fourier sine transform of $f(x)$ is

(A) $\sqrt{\frac{2}{\pi}}\frac{a}{s^2+a^2}$ (B) $\sqrt{\frac{2}{\pi}}\frac{s}{s^2+a^2}$ (C) $\sqrt{\frac{\pi}{2}}\frac{a}{s^2+a^2}$ (D) $\sqrt{\frac{\pi}{2}}\frac{s}{s^2+a^2}$

**ANSWER: B**

35. If $f(x) = e^{-ax}$, then Fourier cosine transform of $f(x)$ is

(A) $\sqrt{\frac{2}{\pi}}\frac{a}{s^2+a^2}$ (B) $\sqrt{\frac{2}{\pi}}\frac{s}{s^2+a^2}$ (C) $\sqrt{\frac{\pi}{2}}\frac{a}{s^2+a^2}$ (D) $\sqrt{\frac{\pi}{2}}\frac{s}{s^2+a^2}$

**ANSWER: A**

36. If $f(x) = \frac{1}{x}$, then Fourier sine transform of $f(x)$ is

(A) $\sqrt{\frac{\pi}{2}}$ (B) $\sqrt{\frac{2}{\pi}}$ (C) $\frac{\pi}{2}$ (D) $\frac{2}{\pi}$

**ANSWER: A**

37. Under Fourier cosine transform $f(x) = \frac{1}{\sqrt{x}}$ is

(A) cosine function (B) sine function

(C) self reciprocal function (D) complex function

**ANSWER: C**

38. If $F[f(x)] = F(s)$, then $\int_{-\infty}^{\infty} \mid f(x) \mid^2 dx =$

(A) $\int_{-\infty}^{\infty} \mid F_s(s) \mid^2 ds$ (B) $\int_{-\infty}^{\infty} \mid F_c(s) \mid^2 ds$

(C) $\int_{0}^{\infty} \mid F(s) \mid^2 ds$ (D) $\int_{-\infty}^{\infty} \mid F(s) \mid^2 ds$

**ANSWER: D**

39. The Fourier transform of a function $f(x)$ is

(A) $\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}dx$ (B) $\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} F(s)e^{-isx}ds$

(C) $\frac{1}{\sqrt{\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}dx$ (D) $\frac{1}{\sqrt{2\pi}}\int_{0}^{\infty} f(x)e^{isx}dx$

**ANSWER: A**

40. The Fourier cosine transform of $5e^{-2x}$ is

(A) $\sqrt{\frac{2}{\pi}}\frac{10}{s^2+4}$ (B) $\sqrt{\frac{2}{\pi}}\frac{2}{s^2+4}$ (C) $\sqrt{\frac{2}{\pi}}\frac{s}{s^2+4}$ (D) $\sqrt{\frac{2}{\pi}}\frac{5s}{s^2+4}$

**ANSWER: A**

41. If $Z[f(n)] = F(z)$, then $Z(\frac{1}{3^n}) =$

(A) $\frac{z}{z-1}$ (B) $\frac{3z}{3z-1}$ (C) $\frac{z}{z-3}$ (D) $\frac{z}{z-3^n}$

**ANSWER: B**

42. If $Z[f(n)] = F(z)$, then $Z(3^n \sin \frac{n\pi}{2}) =$

(A) $\frac{z^2}{z^2+9}$ (B) $\frac{z}{z^2+9}$ (C) $\frac{\frac{z}{3}}{(\frac{z}{3})^2+1}$ (D) $\frac{z}{z-3^n}$

**ANSWER: C**

43. If $Z[f(n)] = F(z)$, then $Z[a^n n] =$

(A) $\frac{z}{(z-a)^2}$ (B) $\frac{az^2+a^2z}{(z-a)^3}$ (C) $\frac{az}{(z-a)^2}$ (D) $\frac{z^2+z}{(z-1)^3}$

**ANSWER: C**

44. If $Z[f(n)] = F(z)$, then $Z^{-1}[\frac{z}{(z-1)(z-2)}] =$

(A) $1 - 2^n$ (B) $2^n + 1$ (C) $-2^n - 1$ (D) $2^n - 1$

**ANSWER: D**

45. If $Z[f(n)] = F(z)$, then $Z^{-1}[\frac{z}{z-a}] =$

(A) $a^n$ (B) $na^n$ (C) $n^2a^n$ (D) $(-a)^n$

**ANSWER: A**

46. If $Z[f(n)] = F(z)$, then the poles of $F(z) = \frac{z}{(z-1)(z-2)}$ are

(A) $z = -1,\ z = 2$ (B) $z = 1,\ z = 2$

(C) $z = 1,\ z = -2$ (D) $z = -1,\ z = -2$

**ANSWER: B**

47. If $F(z)z^{n-1} = \frac{z^n}{(z-1)(z-2)}$, then the residue of $F(z)z^{n-1}$ at each pole, respectively

(A) $1,\ 2^n$ (B) $-1,\ 2^n$ (C) $1,\ (-2)^n$ (D) $-1,\ -2$

**ANSWER: B**

48. If $Z[f(n)] = F(z)$, then $Z[(-3)^n] =$

(A) $\frac{z}{(z-3)^2}$ (B) $\frac{z}{z+3}$ (C) $\frac{z}{(z+3)^2}$ (D) $\frac{z}{z-3}$

**ANSWER: B**

49. If $Z[f(n)] = F(z)$, then $Z[K] =$

(A) $\frac{Kz}{z-1}$ (B) $\frac{Kz}{z+1}$ (C) $\frac{z}{z+1}$ (D) $\frac{z}{z-1}$

**ANSWER:A**

50. If $Z[f(n)] = F(z)$, then $Z[e^{-5n}] =$

(A) $\frac{z}{z+e^{-5}}$ (B) $\frac{z}{z-e^5}$ (C) $\frac{z}{z-e^{-5}}$ (D) $\frac{z}{z+e^5}$

**ANSWER:C**

51. If $Z[f(n)] = F(z)$, then $Z[\frac{1}{n!}] =$

(A) $e^{-\frac{1}{z}}$ (B) $e^z$ (C) $e^{\frac{1}{z}}$ (D) $e^{-z}$

**ANSWER: C**

52. If $Z[f(n)] = F(z)$, then $Z^{-1}[\frac{z^2}{(z-a)^2}] =$

(A) $(n+1)(-a)^n$ (B) $(n-1)(-a)^n$ (C) $(n+1)(a)^n$ (D) $(n-1)(a)^n$

**ANSWER: C**

53. If $Z[f(n)] = F(z)$, then $Z[a^n \cos\frac{n\pi}{2}] =$

(A) $\frac{az^2}{z^2+a^2}$ (B) $\frac{z^2}{z^2+a^2}$ (C) $\frac{az^2}{z^2-a^2}$ (D) $\frac{az}{z^2+a^2}$

**ANSWER: B**