SRM Institute of Science and Technology

Faculty of Engineering and Technology

Department of Mathematics

Question Bank- Fourier Transform(Unit-4)

1. If $f(x)$ is piece-wise continuously differentiable and absolutely integrable in $(-\infty, \infty)$ then

   (A) $f(x) = \frac{1}{2\pi} \int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} f(t) e^{i(x-t)s} dt ds$

   (B) $f(x) = \frac{1}{\pi} \int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} f(t) e^{i(x-t)s} dt ds$

   (C) $f(x) = \frac{1}{2\pi} \int\limits_{0}^{\infty} \int\limits_{0}^{\infty} f(t) e^{i(x-t)s} dt ds$

   (D) $f(x) = \frac{1}{2\pi} \int\limits_{-\infty}^{\infty} \int\limits_{0}^{\infty} f(t) e^{i(x-t)s} dt ds$

   Answer: (A)

2. If $f(x)$ is piece-wise continuously differentiable and absolutely integrable in $(-\infty, \infty)$ then $f(x) = \frac{1}{2\pi} \int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} f(t) e^{i(x-t)s} dt ds$.

   (A) Fourier integral theorem

   (B) Modulation theorem

   (C) Shifting theorem

   (D) Convolution theorem

   Answer: (A)

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

   (A) $\frac{1}{\sqrt{2\pi}} \int\limits_{-\infty}^{\infty} f(x) e^{ist} dt$

   (B) $\frac{1}{\sqrt{2\pi}} \int\limits_{0}^{\infty} f(x) e^{ist} dt$

   (C) $\frac{1}{\sqrt{\pi}} \int\limits_{-\infty}^{\infty} f(x) e^{isx} dx$

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

   Answer: (D)

4. The inversion formula for infinite Fourier transform is

   (A) $f(x) = \frac{1}{\sqrt{2\pi}} \int\limits_{0}^{\infty} F(s) e^{-isx} ds$

   (B) $f(x) = \frac{1}{\sqrt{2\pi}} \int\limits_{-\infty}^{\infty} F(s) e^{-isx} ds$

   (C) $f(x) = \frac{1}{\sqrt{2\pi}} \int\limits_{-\infty}^{\infty} F(s) e^{isx} ds$

(D) $f(x) = \frac{1}{\sqrt{\pi}} \int\limits_{-\infty}^{\infty} F(s) e^{-isx} ds$

Answer: (B)

5. The infinite Fourier cosine transform is

   (A) $F_c(s) = \frac{1}{\sqrt{\pi}} \int\limits_{0}^{\infty} f(x) \cos sx dx$

   (B) $F_c(s) = \sqrt{\frac{2}{\pi}} \int\limits_{-\infty}^{\infty} f(x) \cos sx dx$

   (C) $F_c(s) = \sqrt{\frac{2}{\pi}} \int\limits_{0}^{\infty} f(x) \cos sx dx$

   (D) $F_c(s) = \frac{2}{\pi} \int\limits_{0}^{\infty} f(x) \cos sx dx$

   Answer: (C)

6. The inversion theorem for infinite Fourier cosine transform is

   (A) $f(x) = \sqrt{\frac{2}{\pi}} \int\limits_{0}^{\infty} F_c(s) \cos sx ds$

   (B) $f(x) = \sqrt{\frac{2}{\pi}} \int\limits_{-\infty}^{\infty} F_c(s) \cos sx ds$

   (C) $f(x) = \frac{2}{\pi} \int\limits_{0}^{\infty} F_c(s) \cos sx ds$

   (D) $f(x) = \frac{2}{\sqrt{\pi}} \int\limits_{0}^{\infty} F_c(s) \cos sx ds$

   Answer: (A)

7. The infinite Fourier sine transform is

   (A) $F_s(s) = \frac{2}{\sqrt{\pi}} \int\limits_{0}^{\infty} f(x) \sin sx dx$

   (B) $F_s(s) = \sqrt{\frac{2}{\pi}} \int\limits_{-\infty}^{\infty} f(x) \sin sx dx$

   (C) $F_s(s) = \sqrt{\frac{2}{\pi}} \int\limits_{0}^{\infty} f(x) \sin sx dx$

   (D) $F_s(s) = \frac{2}{\pi} \int\limits_{0}^{\infty} f(x) \sin sx dx$

   Answer: (C)

8. The inversion theorem for infinite Fourier sine transform is

   (A) $f(x) = \sqrt{\frac{2}{\pi}} \int\limits_{0}^{\infty} F_s(s) \sin sx ds$

   (B) $f(x) = \sqrt{\frac{2}{\pi}} \int\limits_{-\infty}^{\infty} F_s(s) \sin sx ds$

   (C) $f(x) = \frac{2}{\pi} \int\limits_{0}^{\infty} F_s(s) \sin sx ds$

   (D) $f(x) = \frac{2}{\sqrt{\pi}} \int\limits_{0}^{\infty} F_s(s) \sin sx ds$

   Answer: (A)

9. $F[af(x) + bg(x)] =$

(A) $F[f(x)] + bF[g(x)]$

(B) $aF[f(x)] + F[g(x)]$

(C) $aF[f(x)] + bF[g(x)]$

(D) $F[f(x)] + F[g(x)]$

Answer: (C)

10. If $F\{f(x)\} = F(s)$, then $F\{f(x-a)\} =$

(A) $e^{-isa}F(s)$

(B) $e^{iax}F(x)$

(C) $e^{isa}F(a)$

(D) $e^{isa}F(s)$

Answer: (D)

11. If $F\{f(x)\} = F(s)$, then $F\{f(x-a)\} = e^{isa}F(s)$.

(A) Fourier integral theorem

(B) Modulation theorem

(C) Shifting theorem

(D) Convolution theorem

Answer: (C)

12. If $F\{f(x)\} = F(s)$ and $a > 0$, then $F\{f(ax)\} =$

(A) $\frac{1}{a}F(\frac{s}{a})$

(B) $\frac{1}{a}F(\frac{a}{s})$

(C) $\frac{1}{s}F(\frac{s}{a})$

(D) $\frac{1}{s}F(\frac{a}{s})$

Answer: (A)

13. If $F\{f(x)\} = F(s)$, then $F\{f(ax)\} = \frac{1}{|a|}F(\frac{s}{a})$ where $a \neq 0$

(A) Fourier integral theorem

(B) Modulation theorem

(C) Change of scale property

(D) Convolution theorem

Answer: (C)

14. $F\{e^{iax}f(x)\} =$

(A) $F(s-a)$

(B) $F(s+a)$

(C) $F(sa)$

(D) $F(\frac{s}{a})$

Answer: (B)

15. If $F\{f(x)\} = F(s)$, then $F\{f(x)\cos ax\} =$

(A) $\frac{1}{2}[F(s+a) * F(s-a)]$

(B) $\frac{1}{2}[F(s+a) - F(s-a)]$

(C) $\frac{1}{2}[F(s+a) + F(s-a)]$

(D) $\frac{1}{2}[F(sa) + F(s+a)]$

Answer: (C)

16. If $F\{f(x)\} = F(s)$, then $F\{f(x)\cos ax\} = \frac{1}{2}[F(s+a) + F(s-a)]$

(A) Fourier integral theorem

(B) Modulation theorem

(C) Change of scale property

(D) Convolution theorem

Answer: (B)

17. If $F\{f(x)\} = F(s)$, then $F\{x^n f(x)\} =$

(A) $(-i)^n \frac{d^n}{ds^n} F(s)$

(B) $(i)^n \frac{d^n}{ds^n} F(s)$

(C) $(-i) \frac{d^n}{ds^n} F(s)$

(D) $\frac{d^n}{ds^n} F(s)$

Answer: (A)

18. The convolution of two functions $f(x)$ and $g(x)$ is defined as $f * g =$

(A) $\frac{1}{\sqrt{2\pi}} \int\limits_{-\infty}^{\infty} f(t)g(x-t)dt$

(B) $\frac{1}{\sqrt{\pi}} \int\limits_{-\infty}^{\infty} f(t)g(x-t)dt$

(C) $\frac{1}{\sqrt{2\pi}} \int\limits_{0}^{\infty} f(t)g(x-t)dt$

(D) $\frac{1}{\sqrt{2}} \int\limits_{-\infty}^{\infty} f(t)g(x-t)dt$

Answer: (A)

19. $F\{f(x) * g(x)\} =$

(A) $F(s) + G(s)$

(B) $F(s) - G(s)$

(C) $F(s).G(s)$

(D) $F(s)/G(s)$

Answer: (C)

20. If $F(s)$ is the Fourier transform of $f(x)$, then

(A) $\int\limits_0^\infty |f(x)|^2 dx = \int\limits_0^\infty |F(s)|^2 ds$

(B) $\int\limits_{-\infty}^{\infty} |f(x)|^2 dx = \int\limits_{-\infty}^{\infty} |F(s)|^2 ds$

(C) $\int\limits_{-\infty}^{\infty} |f(x)| dx = \int\limits_{-\infty}^{\infty} |F(s)| ds$

(D) $\int\limits_0^\infty |f(x)| dx = \int\limits_0^\infty |F(s)| ds$

Answer: (B)

21. The Fourier transform of $f(x) = e^{-\frac{x^2}{2}}$ is

(A) $\frac{1}{e^{x^2}}$

(B) $e^{\frac{s^2}{2}}$

(C) e^{s^2}

(D) $e^{-\frac{s^2}{2}}$

Answer: (D)

22. $F_c\{af(x) + bg(x)\} =$

(A) $aF_c\{f(x)\} + bF_c\{g(x)\}$

(B) $F_c\{f(x)\} + F_c\{g(x)\}$

(C) $aF_c\{f(x)\} + F_c\{g(x)\}$

(D) $F_c\{f(x)\} + bF_c\{g(x)\}$

Answer: (A)

23. $F_s\{af(x) + bg(x)\} =$

(A) $aF_s\{f(x)\} + bF_s\{g(x)\}$

(B) $F_s\{f(x)\} + F_s\{g(x)\}$

(C) $aF_s\{f(x)\} + F_s\{g(x)\}$

(D) $F_s\{f(x)\} + bF_s\{g(x)\}$

Answer: (A)

24. $F_s[f(x) \sin ax] =$

(A) $\frac{1}{2}[F_c(s-a) + F_c(s+a)]$

(B) $\frac{1}{2}[F_c(s-a) - F_c(s+a)]$

(C) $\frac{1}{2}[F_s(s-a)+F_s(s+a)]$
(D) $\frac{1}{2}[F_s(s-a)-F_s(s+a)]$
Answer: (B)

25. $F_s[f(x)\cos ax] =$
(A) $\frac{1}{2}[F_c(s+a)+F_c(s-a)]$
(B) $\frac{1}{2}[F_c(s+a)-F_c(s-a)]$
(C) $\frac{1}{2}[F_s(s+a)+F_s(s-a)]$
(D) $\frac{1}{2}[F_s(s+a)-F_s(s-a)]$
Answer: (C)

26. $F_c[f(x)\sin ax] =$
(A) $\frac{1}{2}[F_s(a+s)+F_s(a-s)]$
(B) $\frac{1}{2}[F_s(a+s)-F_s(a-s)]$
(C) $\frac{1}{2}[F_c(a+s)+F_c(a-s)]$
(D) $\frac{1}{2}[F_c(a+s)-F_c(a-s)]$
Answer: (A)

27. $F_c[f(x)\cos ax] =$
(A) $\frac{1}{2}[F_s(s+a)+F_s(s-a)]$
(B) $\frac{1}{2}[F_s(s+a)-F_s(s-a)]$
(C) $\frac{1}{2}[F_c(s+a)+F_c(s-a)]$
(D) $\frac{1}{2}[F_c(s+a)-F_c(s-a)]$
Answer: (C)

28. The Fourier cosine transform of $e^{-ax}, a > 0$ is
(A) $\sqrt{\frac{1}{\pi}}\frac{a}{a^2+s^2}$
(B) $\sqrt{\frac{2}{\pi}}\frac{a}{a^2+s^2}$
(C) $\sqrt{\frac{1}{\pi}}\frac{s}{a^2+s^2}$
(D) $\sqrt{\frac{2}{\pi}}\frac{s}{a^2+s^2}$
Answer: (B)

29. The Fourier sine transform of $e^{-ax}, a > 0$ is
(A) $\sqrt{\frac{1}{\pi}}\frac{a}{a^2+s^2}$
(B) $\sqrt{\frac{2}{\pi}}\frac{a}{a^2+s^2}$
(C) $\sqrt{\frac{1}{\pi}}\frac{s}{a^2+s^2}$

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

Answer: (D)

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

(A) cosine function

(B) self-reciprocal function

(C) inverse function

(D) complex function

Answer: (B)

31. Under Fourier sine transform of $f(x) = \frac{1}{\sqrt{x}}$ is

(A) cosine function

(B) self-reciprocal function

(C) inverse function

(D) complex function

Answer: (B)

32. $F_s[xf(x)] =$

(A) $\frac{d}{ds}F_s(s)$

(B) $-\frac{d}{ds}F_s(s)$

(C) $\frac{d}{ds}F_c(s)$

(D) $-\frac{d}{ds}F_c(s)$

Answer: (D)

33. $F_c[xf(x)] =$

(A) $\frac{d}{ds}F_s(s)$

(B) $-\frac{d}{ds}F_s(s)$

(C) $\frac{d}{ds}F_c(s)$

(D) $-\frac{d}{ds}F_c(s)$

Answer: (A)

34. The Fourier sine transform of $\frac{1}{x}$ is

(A) $\sqrt{\frac{2}{\pi}}$

(B) $\sqrt{\frac{1}{\pi}}$

(C) $\sqrt{\frac{\pi}{2}}$

(D) $\sqrt{\frac{\pi}{4}}$

Answer: (C)

35. $F_c\{f(ax)\} =$

(A) $\frac{1}{a}F_c(\frac{s}{a})$

(B) $\frac{1}{s}F_c(\frac{s}{a})$

(C) $\frac{1}{s}F_c(\frac{a}{s})$

(D) $\frac{1}{s}F_c(\frac{1}{a})$

Answer:(A)

36. $F_s\{f(ax)\} =$

(A) $\frac{1}{a}F_s(\frac{s}{a})$

(B) $\frac{1}{s}F_s(\frac{s}{a})$

(C) $\frac{1}{s}F_s(\frac{a}{s})$

(D) $\frac{1}{s}F_s(\frac{1}{a})$

Answer:(A)

37. If $F_c(s), G_c(s)$ are the Fourier cosine transforms of $f(x)$ and $g(x)$ respectively, then $\int\limits_0^\infty f(x)g(x)dx =$

(A) $\int\limits_0^\infty F_c(s)G_c(s)ds$

(B) $\int\limits_{-\infty}^\infty F_c(s)G_c(s)ds$

(C) $\int\limits_0^\infty G_c(s)ds$

(D) $\int\limits_0^\infty F_c(s)ds$

Answer:(A)

38. If $F_s(s), G_s(s)$ are the Fourier cosine transforms of $f(x)$ and $g(x)$ respectively, then $\int\limits_0^\infty f(x)g(x)dx =$

(A) $\int\limits_0^\infty F_s(s)G_s(s)ds$

(B) $\int\limits_{-\infty}^\infty F_s(s)G_s(s)ds$

(C) $\int\limits_0^\infty G_s(s)ds$

(D) $\int\limits_0^\infty F_s(s)ds$

Answer:(A)

39. If $F_c(s)$ is the Fourier cosine transform of $f(x)$, then

(A) $\int\limits_0^\infty |f(x)|^2dx = \int\limits_0^\infty |F_c(s)|^2ds$

(B) $\int\limits_{-\infty}^\infty |f(x)|^2dx = \int\limits_{-\infty}^\infty |F_c(s)|^2ds$

(C) $\int\limits_{-\infty}^{\infty} |f(x)|dx = \int\limits_{-\infty}^{\infty} |F_c(s)|ds$

(D) $\int\limits_{0}^{\infty} |f(x)|dx = \int\limits_{0}^{\infty} |F_c(s)|ds$

Answer: (A)

40. If $F_s(s)$ is the Fourier sine transform of $f(x),$ then

(A) $\int\limits_{0}^{\infty} |f(x)|^2dx = \int\limits_{0}^{\infty} |F_s(s)|^2ds$

(B) $\int\limits_{-\infty}^{\infty} |f(x)|^2dx = \int\limits_{-\infty}^{\infty} |F_s(s)|^2ds$

(C) $\int\limits_{-\infty}^{\infty} |f(x)|dx = \int\limits_{-\infty}^{\infty} |F_s(s)|ds$

(D) $\int\limits_{0}^{\infty} |f(x)|dx = \int\limits_{0}^{\infty} |F_s(s)|ds$

Answer: (A)