SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF MATHEMATICS

18MAB201T/Transforms and Boundary value problems

UNIT IV-FOURIER TRANSFORMS
TUTORIAL SHEET -1

PART-B QUESTIONS

1. **If** $F\{f(x)\} = F(s)$, **then** $F\{f(ax)\} = \frac{1}{|a|}F\left(\frac{s}{a}\right)$.
2. **State and Prove Modulation theorem.**
3. **If** $F\{f(x)\} = F(s)$, **then** $F\{x^n f(x)\} = (-i)^n \frac{d^n}{ds^n}F(s)$.
4. **Find the complex Fourier transform of** $f(x) = \begin{cases} x, & \text{for} |x| \le a \\ 0, & \text{for} |x| > a \end{cases}$

PART-C QUESTIONS

5. **Show that the Fourier transform of** $f(x) = \begin{cases} a^2 - x^2, & |x| < a \\ 0, & |x| > a > 0 \end{cases}$ **is** $2\sqrt{\frac{2}{\pi}}\left(\frac{\sin as - as\cos as}{s^3}\right)$. **Hence deduce that** $\int_0^\infty \frac{\sin t - t\cos t}{t^3}dt = \frac{\pi}{4}$. **Using Parseval's identity show that** $\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)^2 dt = \frac{\pi}{15}$.
6. **Find the Fourier transform of** $f(x) = \begin{cases} 1 - x^2, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$ **and hence evaluate** $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3}\right)\cos\frac{x}{2}dx$
7. **Find the Fourier transform of** $f(x)$ **given by** $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a > 0 \end{cases}$ **and hence evaluate** $\int_0^\infty \frac{\sin x}{x}dx$ **and** $\int_{-\infty}^\infty \frac{\sin as\cos sx}{s}ds$.
8. **Find the Fourier transform of** $f(x)$ **given by** $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a > 0 \end{cases}$ **and using Parseval's identity, prove** $\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$.
9. **Show that the transform of** $e^{\left(\frac{-x^2}{2}\right)}$ **is** $e^{\left(\frac{-s^2}{2}\right)}$ **by finding the Fourier transform of** $e^{-a^2x^2}, a > 0$.
10. **Find the Fourier transform of** $f(x)$ **given by** $f(x) = \begin{cases} 1 - |x|, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$ **and hence find the value of** $\int_0^\infty \frac{\sin^4 t}{t^4}dt$.

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