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B.E / B.TECH DEGREE EXAMINATIONS: JUNE 2015

(Regulation 2009)

Third Semester

MAT105: TRANSFORM METHODS IN ENGINEERING

(Common to CSE/IT)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. If f (x + P) = f (x) then f (x) is

a) periodic function b) unit step function

c) multiple valued function d) double valued function

2. The value to which the Fourier series $f(x)=\begin{cases}\pi+x, -\pi\le x\le 0\\ 0, \quad 0\le x<\pi\end{cases}$ converges at x = 0 is

a) a) π b) $\pi/2$

c) 2π d) 0

3. . The Laplace transform of t^2e^{3t} is

a) $\frac{2}{s^3}$ b) $-\frac{2}{(s+3)^3}$

c) $\frac{2}{(s-3)^3}$ d) $-\frac{2}{s^3}$

4. If $L[f(t)]=F(s)$, then $L(f(at))=\frac{1}{a}F(\frac{s}{a})$ this property is called

a) Final value theorem b) Second shifting theorem

c) Change of scale d) Initial value theorem

5. $L^{-1}\left(\frac{1}{(s+a)^n}\right)$ =

a) $\frac{e^{-at}t^{n-1}}{(n-1)!}$ b) $\frac{e^{-at}t^{n-1}}{n!}$

c) $\frac{e^{-at}t^{n}}{n!}$ d) $\frac{e^{-at}t^{n}}{(n-1)!}$

6. $L^{-1}[\phi(s+a)]$ is

a) $e^{at}L^{-1}[\phi(s)]$

b) $e^{-at}L^{-1}[\phi(s/a)]$

c) $e^{-at}L^{-1}[\phi(as)]$

d) $e^{-at}L^{-1}[\phi(s)]$

7. If $F(f(x))=F(s)$, then $F(f(2x))=$

a) $\frac{1}{2}F\left(\frac{s}{2}\right)$

b) $2F(s)$

c) $\frac{1}{2}F(s)$

d) $2F\left(\frac{s}{2}\right)$

8. $F\left[e^{-|x|}\right]=$

a) does not exist

b) $\sqrt{\frac{2}{\pi}}\left[\frac{2}{1+x^2}\right]$

c) $\sqrt{\frac{2}{\pi}}.\frac{1}{1+s^2}$

d) $\sqrt{\frac{2}{\pi}}.\frac{s}{1+s^2}$

9. If $Z\{f(n)\}=F(z)$ then $Z\{a^n f(n)\}$ is

a) $F\left(\frac{a}{z}\right)$

b) $F(az)$

c) $F\left(\frac{z}{a}\right)$

d) $F(-z)$

10. The Z – Transform of the function $(-1)^n$ is

a) $\frac{z}{z-1}$

b) $\frac{1}{z+1}$

c) $\frac{1}{z-1}$

d) $\frac{z}{z+1}$

PART B (10 x 2 = 20 Marks)

11. State Dirichlet's conditions for Fourier series.

12. Find the mean square value of $f(x)=x$ in the interval (0, 2).

13. If $L[f(t)]=\frac{1}{s}e^{-1/s}$ prove that $L\left[e^{-t}f(3t)\right]=\frac{e^{-3/s+1}}{s+1}$.

14. If $f(t)=e^{2t}\sin 2t$, find $L[f'(t)]$.

15. Determine $L^{-1}\left(\frac{1}{s^2+4s+8}\right)$.

16. Find $L^{-1}\left[\frac{e^{-as}}{s^2}\right]$.

17. Define infinite Fourier transform pair.

18. If $F_s(s)$ is the Fourier sine transform of f(x), show that

$$F_S\left[f(x)\cos ax\right]=\frac{1}{2}\left[F_S(s+a)+F_S(s-a)\right].$$

19. If $z\left[f(n)\right]=F(z)$ show that $z\left[f(-n)\right]=F\left(\frac{1}{z}\right)$

20. Find $z\left[e^{-iat}\right]$ using z – transform.

PART C (5 x 14 = 70 Marks)

21. a) i) Obtain the Fourier series expansion of $f(x)=x\cos x$ for $-\pi<x<\pi$. (7)

ii) Obtain the Half – range cosine series of f(x) = x^2 in (0,2l). (7)

(OR)

b) i) Find the Fourier series for the function (7)

$$f(x)=\begin{cases}-K\ , & -\pi<x<0\\ K\ , & 0<x<\pi\end{cases} \text{ and } \quad f(x+2\pi)=f(x).$$

ii) Expand f (x) in a Fourier series upto 2nd harmonic using the following table (7)

x	0	1	2	3	4	5	6
$f(x)$	1.0	1.4	1.9	1.7	1.5	1.2	1.0

22. a) i) Find the Laplace transform of i) $te^{-3t}\sin t$ ii) $\frac{1-\cos t}{t}$. (7)

ii) Find the Laplace transform of (i) $e^{2t}\int_0^t \frac{\sin 3t}{t}dt$ (ii) $U_a(t)e^{-3t}$. (7)

(OR)

b) i) Find the Laplace transform of $f(t)=1+e^{-2t}$ and verify initial value theorem. (7)

ii) (v) Find the Laplace Transform of the “triangular wave” function f(t) is defined by (7)

$$f(t)=\begin{cases}t, 0<t<a\\ 2a-t, a<t<2a\end{cases} \text{ where } \quad f(t+2a)=f(t).$$

23. a) i) Find the inverse Laplace transform of i) $\log\left(1+\frac{\omega^2}{s^2}\right)$ ii) $\frac{e^{-2s}}{s^2\left(s^2+1\right)}$. (6)

ii) Solve the initial value problem $y''-2y'+y=e^t, y(0)=2, y'(0)=1$. (8)

(OR)

b) i) Use convolution theorem to find the inverse Laplace transform of $\frac{2}{(s+1)(s^2+4)}$ (7)

ii) Solve the integral equation $y(t)=1+\int_0^t y(u)\sin(t-u)\,du$. (7)

24. a) (i) Prove that $e^{-x^2/2}$ is self-reciprocal with respect to Fourier transforms. (7)

(ii) Find F.C.T and F.S.T of $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 0 < x < 2 \\ 0, & x > 2 \end{cases}$. (7)

(OR)

b) Determine the Fourier transform of $f(x) = \begin{cases} 1-x^2, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$

Hence deduce that $\int_0^\infty \frac{\sin t - t\cos t}{t^3}\,dt = \frac{\pi}{4}$. Using Parseval's identity show that

$\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)^2 dt = \frac{\pi}{15}$.

25. a) i) Find the Z – Transform of i) $a^n \sin n\theta$ ii) $\frac{1}{n(n+1)}$. (7)

ii) Use convolution theorem to find the inverse Z – Transform of $\frac{8z^2}{(2z-1)(4z-1)}$. (7)

(OR)

b) Solve the difference equation $y(n+3) - 3y(n+1) + 2y(n) = 0$, given that $y(0) = 4, y(1) = 0$ and $y(2) = 8$.

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