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B.Sc. Hons. Math (Semester – 5th)

MATHEMATICAL METHODS

Subject Code: BMAT1-515

Paper ID: [18131222]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a. Find a_0 in Fourier Expansion of $f(x) = |x|$ in $(-2, 2)$
- b. State Dirichlets conditions.
- c. State Convolution theorem for Fourier Transforms.
- d. Write Parseval's identities for Fourier Cosine and Sine transforms.
- e. Find Laplace transform of $t^2 \cos \frac{7t}{5}$
- f. Find Inverse L.T of $\log \frac{s+1}{s-1}$
- g. State relationship between Laplace transform and Fourier transform.
- h. Find inverse Z-transform of $\frac{Z}{(z-1)^2}$
- i. Find $Z[u_{n-k}]$ if $Z[u_n] = U(z)$
- j. State and prove linear property of fourier transform.

Section – B

(5 marks each)

Q2. Find the fourier series of $f(x) = x \sin x$ in $(-\pi, \pi)$

Q3. Find the fourier series of $f(x) = |\cos x|$ in $(-\pi, \pi)$

Q4. Find Laplace transform of $\int_0^t e^{-5t} t^2 \cos t \, dt$

Q5. Find Inverse Laplace transform of $\frac{s}{(s^2+1)(s^2+4)}$

Q6. Solve the D.E using Laplace transform $(D^2 + 5D + 6)x = te^t; x = 2$ and $\frac{dx}{dt} = 1$ at $t = 0$

Section – C

(10 marks each)

Q7. a. Solve the difference equations using Z – transform

$$u_{n+2} + 3u_{n+1} + 2u_n = 0$$

$$\text{where } u_0 = 0 \text{ and } u_1 = 1$$

b. Find the Z – transform of the following sequence

$$u_n = \begin{cases} 2^n & n < 0 \\ \frac{1}{2^n} & n = 0, 2, 4 \\ \frac{1}{3^n} & n = 1, 3, 5 \end{cases}$$

Q8. a. Find the Fourier Cosine transform of

$$f(x) = \begin{cases} \cos x & \text{if } 0 < x < a \\ 0 & \text{if } x \geq a \end{cases}$$

b. Find Fourier transform of

$$f(x) = \begin{cases} a^2 - x^2 & ; |x| < a \\ 0 & ; |x| > a \end{cases}$$

And hence evaluate $\int_0^{\infty} \left(\frac{\sin t - t \cos t}{t^3} \right) dt = \frac{\pi}{4}$

Q9. State and prove convolution theorem for Laplace transform and use it to evaluate $\frac{1}{s(s+1)^2}$