YMCA UNIVERSITY OF SCIENCE & TECHNOLOGY, FARIDABAD

M.Sc. PHYSICS 1st SEMESTER (UNDER CBS)

MATHEMATICAL PHYSICS (PH-501)

Time: 3 Hours | Max. Marks: 60

Note: 1. *It is compulsory to answer the questions of Part -1. Limit your answers within 20-40 word in this part.*
2. *Answer any four questions from Part -2 in detail.*
3. *Different parts of the same question are to be attempted adjacent to each other.*

PART -1

Q1 (a) Find the modulus and principal argument of $-\sqrt{3}-i$ (2)

(b) State the Cauchy Riemann conditions. (2)

(c) What is a harmonic function? (2)

(d) Find the Laplace transform of $t\cos at$. (2)

(e) Prove that $L\{e^{at}\} = \frac{1}{s-a}$ (2)

(f) What is the kernel in Fourier Transform? (2)

(g) What is the shifting property of Fourier transform? (2)

(h) Define a multiply connected region. (2)

(i) What do you understand by the term singularity? (2)

(j) Is *sinz* analytic everywhere? Give reasons. (2)

PART -2

Q2 (a) State and prove Cauchy's Integral formula for the function of a complex variable. (5)

(b) Derive the Laurent's series expansion for the function of a complex variable. (5)

Q3 (a) Show that the Fourier sine transform of $\frac{x}{1+x^2}$ is $\sqrt{\frac{\pi}{2}}\ ase^{-as}$ (5)

(b) Find the Fourier sine and cosine transform of xe^{-ax} (5)

Q4 (a) Prove that (5)

$$\frac{2}{\pi}\int_0^{\infty} F_s(s)G_s(s)ds = \int_0^{\infty} f(x)g(x)dx$$

where the symbols have their usual meanings.

(b) Determine the poles and the residue at simple pole of the function (5)

$$f(z) = \frac{z^2}{(z-1)^2(z+2)}$$

Q5 (a) Using Parseval's Identity, prove that (5)

$$\int_0^{\infty} \frac{t^2}{(4+t^2)(9+t^2)} dt = \frac{\pi}{10}$$

(b) Evaluate the following integrals by Laplace Transform: (5)

$$\int_0^{\infty} \left(\frac{e^{-2t}-e^{-3t}}{t}\right) dt$$

Q6 (a) What do understand by convolution of two functions f(x)*g(x)? Hence derive the convolution theorem for Fourier Transform. (5)

(b) State and prove any two properties of Laplace transform. (5)

Q7 Write short note on: (5x2)

(a) Bessel function

(b) Jordon's Lemma