

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(MID SEMESTER EXAMINATION SP2023)

CLASS: IMSc  
BRANCH: PHYSICS

SEMESTER: IV  
SESSION: SP/2023

SUBJECT: PH207R1 MATHEMATICAL PHYSICS III

TIME: 03 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
- 

- |  |      |         |           |
|--|------|---------|-----------|
| Q.1 Define and give examples of multivalued functions, branch cuts, Singularities and conformal transformations in a complex plane.  | [10] | CO<br>1 | BL<br>1,2 |
| Q.2 By applying the residue theorem around a wedge-shaped contour of angle $2\pi/n$ , with one side along the real axis, prove that the integral $\int_0^{\infty} \frac{dx}{1+x^n}$ , where $n$ is real and $\geq 2$ , has the value $(\pi/n) \operatorname{cosec}(\pi/n)$ .   | [10] | 2       | 3         |
| Q.3 Find the Fourier transform of $\frac{a}{\sqrt{4a^2+w^2}}$ , where $a$ is a positive number.  | [10] | 3       | 3         |
| Q.4 Find the function $f(x)$ whose Laplace transform is $\bar{f}(s) = \frac{s}{s^2-k^2}$ where $k$ is a constant.  | [10] | 4       | 3         |
| Q.5 Show that, in the circuit given below, if the resistance $R$ is chosen as $R = \sqrt{L/C}$ then the amplitude of the current, $I_R$ through it, is independent of the angular frequency $\omega$ of the applied a.c. voltage $V_0 e^{i\omega t}$ . Determine how the phase of $I_R$ , relative to that of the voltage source, varies with the angular frequency $\omega$ . | [10] | 5       | 3,4       |

