BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH/IMSC **SEMESTER : II/ADD**
BRANCH: ALL/PHYSICS **SESSION : SP/2025**

SUBJECT: MA24103/ MA107 MATHEMATICS-II

TIME: 3 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.

			CO	BL
Q.1(a)	Solve: $x^2y'' + xy' + y = \sin(\log x^2)$.	[5]	CO1	2
Q.1(b)	Solve the following equation using the method of variation of parameters $y'' - y = \frac{2}{1+e^x}$.	[5]	CO1	3
Q.2(a)	Find the power series solution of $(x^2+1)y'' + xy' - xy = 0$ in the power of x.	[5]	CO2	2
Q.2(b)	Use the definition of $J_n(x)$ $to\ ptove$ $\frac{d}{dx}(x^{-n}J_n(x)) = -x^{-n}J_{n+1}(x)$.	[5]	CO2	3
Q.3(a)	Find the Fourier series expansion of the following periodic function with period 2π: $f(x) = x^2, \quad -\pi \le x \le \pi.$ Hence, find the sum of the series $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^4} + \ldots$	[5]	CO3	2
Q.3(b)	Use the method of separation of variables to solve the wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the conditions (i) $u = 0$ when $x = 0$ and $x = \pi$, $(ii)\ \frac{\partial u}{\partial t} = 0$ when $t = 0$ and (iii) $u(x,0) = x,\ 0 < x < \pi$.	[5]	CO3	3
Q.4(a)	Expand the function $f(z) = \frac{1}{(z-1)(z-2)}$ for $1 < \|z\| < 2$ as a Laurent series expansion.	[5]	CO4	2
Q.4(b)	Evaluate the integral $I = \oint_C \frac{dz}{z^2+z^3}, C: \|z\| = 2$ using Cauchy Residue theorem.	[5]	CO4	3
Q.5(a)	If the probability density function is defined by $f(x) = \begin{cases} k\,x^3, & 0 \le x \le 3 \\ 0, & otherwise \end{cases}$, then (i) find the value of k, (ii) find the probability between $x = 1/2$ and $x = 3/2$.	[5]	CO5	3
Q.5(b)	A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day is distributed as a poisson distribution with mean 1.5. Calculate the proportion, of days on which (i) neither car is used (ii) some demand is refused.	[5]	CO5	3

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