

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(MID SEMESTER EXAMINATION SP/2025)

CLASS: BTECH/IMSC  
BRANCH: ALL

SEMESTER : II/ADD  
SESSION : SP/2025

SUBJECT: MA24103 / MA107 MATHEMATICS-II

TIME: 02 Hours

FULL MARKS: 25

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates
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Q.1(a) Find the Wronskian of the solutions of the equation  $y'' + w^2y = 0$ , where  $w$  is a non-zero constant. [2]

Q.1(b) Find a general solution of the following equation using operator method [3]  
 $(D^2 + 4D + 5)y = e^{-t} \cos t$ , where  $D \equiv \frac{d}{dt}$ .

Q.2(a) Solve  $x^2y'' - 2xy' + 2y = 0$ . [2]

Q.2(b) Use the method of variation of parameters to find a general solution of [3]  
 $y'' + 4y = \cos 2x$ .

Q.3(a) Check whether  $x = 0$  is a singular point or not for the equation [5]  
 $xy'' + (\sin x)y' + xy = 0$ . If it is so, then whether it is regular or not.

Q.3(b) Find a power series solution of the equation  $y'' + y = 0$ .

Q.4(a) Prove that  $J_{-n}(x) = (-1)^n J_n(x)$ , where  $n$  is a positive integer. [2]

Q.4(b) Express the following polynomial in terms of Legendre's polynomial  $P_n(x)$  [3]  
 $f(x) = 4x^3 + 6x^2 + 7x + 2$ .

Q.5(a) Obtain a Fourier series to represent  $f(x) = x - x^2$  in the interval  $(-\pi, \pi)$ . [5]  
Hence deduce that  $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$ .

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