

M.Sc. DEGREE EXAMINATION, APRIL 2026
BRANCH III - PHYSICS
SECOND SEMESTER

COURSE : CORE
PAPER : MATHEMATICAL PHYSICS II
SUBJECT CODE : 23PH/PC/MP24
TIME : 3 HOURS **MAX. MARKS: 100**

Q. No.	SECTION A	CO	KL
	ANSWER ALL QUESTIONS (10 x 3=30 marks)		
1	State the definition of Fourier Sine Transform.	1	1
2	List two properties of Laplace Transform.	1	1
3	Classify $u_{tt} = c^2 u_{xx}$ as elliptic/parabolic/hyperbolic.	1	1
4	What is D'Alembert's method used for?	2	2
5	Write Bessel's differential equation.	2	2
6	State the generating function for Hermite polynomials.	2	2
7	Define an Abelian group.	2	2
8	What is a normal subgroup?	3	3
9	Define sample space and mutually exclusive events.	3	3
10	State the mean of a binomial distribution.	3	3
Q. No.	SECTION - B	CO	KL
	Part A		
	ANSWER ANY TWO QUESTIONS (2x 5 = 10 marks)		
11	State and Prove the Convolution theorem of Fourier Transform.	3	3
12	Determine the steady state temperature distribution of a thin rectangular plate bounded by the lines $x=0, x=l, y=0, y=b$, assuming that the edges $x=0, x=l, y=0$ are maintained at zero temperature and the edge $y=b$ is maintained at steady state temperature $F(x)$.	3	3
13	State the Rearrangement theorem and find the generators of cyclic group \mathbb{Z}_6 .	3	3
	Part B		
	ANSWER ANY FOUR QUESTIONS (4x 5 = 20 marks)		
14	Find the inverse Laplace transform of i) $\left\{ \frac{6}{2s-3} - \frac{3+4s}{9s^2-16} + \frac{8-6s}{16s^2+9} \right\}$ and ii) $\left\{ \frac{2s-5}{9s^2-25} \right\}$.	4	4
15	Define the key concepts of normal subgroups, factor groups, isomorphism, and homomorphism in finite groups.	4	4
16	Deduce the Rodrigue's formula for Hermite polynomials.	4	4
17	The number of arrivals of customers during any day follows Poisson distribution with a mean of 5. What is the probability that the total number of customers on two days selected at random is less than 2?	4	4

18	An experiment succeeds twice as often as it fails. Find the chance that in the next 6 trials there will be at least 4 successes.	4	4												
Q. No.	SECTION C ANSWER ALL THE QUESTIONS (2 x20=40 marks)	CO	KL												
19	(i)a. Develop the Fourier cosine transform of $\frac{1}{1+x^2}$ and hence find the Fourier sine transform of $\frac{x}{1+x^2}$.	5	5												
	b. Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ with boundary condition $u(x, 0) = 3\sin n\pi x$, $u(0, t), u(l, t) = 0$ where $0 < x < l$.	5	6												
(OR)															
	(ii) a. Develop the Orthogonality property of the Laguerre polynomial.	5	5												
	b. Convert the following polynomial into Hermite polynomial $64x^4 + 8x^3 + -32x^2 + 40x + 10$.	5	6												
20.	(i)a. Prove that every subgroup of an Abelian group is normal. Define factor group G/N for normal N and show it forms a group. Construct the Cayley table for the symmetry group of an equilateral triangle and identify its conjugacy classes.	5	5												
	b. Find the Laplace transform of $f(t) = \begin{cases} t^2, & 0 < t < 2 \\ t - 1, & 2 < t < 3 \\ 7, & t > 3 \end{cases}$	5	6												
(OR)															
	(ii) a. From the following frequency distribution, compute the standard deviation of 100 students :	5	5												
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 5px;">Mass in kg</td> <td style="padding: 5px;">60-62</td> <td style="padding: 5px;">63-65</td> <td style="padding: 5px;">66-68</td> <td style="padding: 5px;">69-71</td> <td style="padding: 5px;">72-74</td> </tr> <tr> <td style="padding: 5px;">Number of students</td> <td style="padding: 5px;">5</td> <td style="padding: 5px;">18</td> <td style="padding: 5px;">42</td> <td style="padding: 5px;">27</td> <td style="padding: 5px;">8</td> </tr> </table>				Mass in kg	60-62	63-65	66-68	69-71	72-74	Number of students	5	18	42	27	8
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	b. The overall percentage of failures in a certain examination is 20. If six candidates appear in the examination, what is the probability that at least five pass the examination?	5	6												