LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2024**

PPH3ME01 – ADVANCED MATHEMATICAL METHODS

Date: 19-11-2024   Dept. No.   Max. : 100 Marks
Time: 01:00 pm-04:00 pm

SECTION A – K1 (CO1)

	Answer ALL the questions	**(5 x 1 = 5)**
1	**True or False/ Fill in the blanks/MCQs**	
a)	Special functions are only applicable in the field of mathematics and have no real-world significance. (True/False)	
b)	The primary application of Bessel functions is to solve physics problems in _____ coordinate systems.	
c)	The Laplace transform of a square wave input is (i) 1/s (ii) 1/(s + 1) (iii) s/(s+1) (iv) s	
d)	Tensors can only exist in three-dimensional space. (True/False)	
e)	Which of the following is a symmetry transformation of a square? (i) Translation (ii) Reflection over a diagonal (iii) Rotation by 90 degrees (iv) Scaling	

SECTION A – K2 (CO1)

	Answer ALL the questions	**(5 x 1 = 5)**
2	**Define/State/Prove/Explain**	
a)	Abstraction	
b)	Find the value of $J_{-1}(x) + J_1(x)$.	
c)	Hammerblow Response	
d)	Tensor Contraction	
e)	Cyclic group	

SECTION B – K3 (CO2)

	Answer any THREE of the following	**(3 x 10 = 30)**
3	Express the first three Laguerre Polynomials and represent the polynomial $x^3 + x^2 - 3x + 2$ in a series of Laguerre Polynomials.	
4	Verify that Bessel's function $J_n(x)$ is an even function when n is even and is odd function when n is odd.	
5	Analyse the response of a damped vibrating system to a unit impulse using Laplace transforms.	
6	Justify that velocity and acceleration are contravariant tensors.	
7	Compare Isomorphism and Homomorphism with suitable examples.	

SECTION C – K4 (CO3)

Answer any TWO of the following (2 x 12.5 = 25)

8 | Prove any two recurrence relations of Laguerre polynomials.

9 | Obtain the series solution of the equation $xy'' + y' + xy = 0$.

10 | Solve $\ddot{x} + \omega^2 x = 0$ with the initial conditions $x(0) = \alpha$ and $\dot{x}(0) = 0$ using Laplace transforms.

11 | Derive the moment of inertia tensor for a system consisting of a number of points executing a rotatory motion.

SECTION D – K5 (CO4)

Answer any ONE of the following (1 x 15 = 15)

12 | State and prove the orthogonality property of Laguerre Polynomials.

13 | State and demonstrate the orthogonality theorem of representation of finite groups.

SECTION E – K6 (CO5)

Answer any ONE of the following (1 x 20 = 20)

14 | Formulate any four recurrence relations of Bessel Polynomials for solving physics problems.

15 | Develop a model of two identical masses connected by a spring and find its solutions using Laplace transforms.

$$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$$$