STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2019 – 2020 and thereafter)

SUBJECT CODE : 19PH/PC/MP14

M.Sc., DEGREE EXAMINATION NOVEMBER 2022
PHYSICS
FIRST SEMESTER

COURSE	**:**	**MAJOR CORE**	
PAPER	**:**	**MATHEMATICAL PHYSICS - I**	
TIME	**:**	**3 HOURS**	**MAX. MARKS : 100**

SECTION - A

ANSWER ALL QUESTIONS: (10x3=30)

1. What do you mean by interpolation and extrapolation?
2. Find y(0.1) for $y' = \frac{x-y}{2}$, y(0) = 1 with step length 0.1 using Runge –Kutta method of second order.
3. Verify Cauchy – Riemann equations for the following function f(z) = az + b.
4. Find the pole of the following function $\frac{z}{(z-1)(z-2)^2}$
5. What is unitary space? Give example.
6. Define isomorphism of vector space.
7. What is Einstein's summation convention?
8. If A_{ij} is antisymmetric tensor, find the component A_{11}.
9. Define Beta function.
10. What is Hankel function?

SECTION – B

ANSWER ANY FIVE QUESTIONS: (5x5=25)

11. Using Newton Raphson method, obtain a root of $x^3-3x-5 = 0$ to three decimals
12. Using 4 segment Simpsons 1/3 rule to approximate the distance covered by a rocket in meters from t=8s to t = 30s given by
$$x = \int_8^{30} 2000 \ln\left(\frac{14000}{14000-2100t}\right) - 9.8t.dt$$
13. Prove that the function $u = 2x - x^3 + 3xy^2$ satisfies Laplace equation and determine the imaginary part of the corresponding regular function u+iv.
14. Expand f(z) = Sin z into a Taylor series about z = π/4
15. Derive Fourier's equation of heat flow in solids.
16. Obtain moment of inertia in tensor form.
17. By using Rodrigue's formula, find first four Legendre polynomials.

SECTION – C

ANSWER ANY THREE QUESTIONS: (3x15=45)

18. Find the numerical solution of $\frac{dy}{dx} = x + y$, from x=0 to 0.2 by modified Euler's method for h= 0.05 with the initial condition $x_0 = 0$, $y_0 = 1$.
19. (a) State and prove Cauchy's integral formula. (10 mark)

    (b) Evaluate $\int_C \frac{\sin\pi z^2 + \cos\pi z^2}{(z-1)(z-2)} dz$, where C is the circle $|z| = 3$, using Cauchy's integral formula.

20. Use Gram Schmidt orthogonal process to construct an orthonormalization to the following basis for R^3

$$B = \{(1,1,0),(1,2,0),(0,1,2)\}$$

21. (a) If A^μ and B_μ are any two vectors, one contravariant and the other covariant, then prove that $A^\mu B_\mu$ is invariant.

    (b) A covariant tensor has components xy, $2y - z^2$, xz in rectangular coordinates. Find its covariant components in spherical coordinates

22. Obtain the complete solution for Bessel differential equation.

****