Reg. No.										

MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

DEPARTMENT OF SCIENCES, I SEMESTER M.Sc (PHYSICS)
END SEMESTER EXAMINATIONS, NOVEMBER 2019

MATHEMATICAL METHODS OF PHYSICS [PHY 4101]

(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 15-11-2019 MAX. MARKS: 50

Note: (i) Answer **ALL** questions

(ii) Draw diagrams wherever necessary

1A. Define residue of the function of complex variable. How do you calculate the residue for m^{th} order (m > 1) pole? State and prove residue theorem.

1B. Using residue theorem, evaluate $I = \int_0^{2\pi} \frac{\cos 2\theta \, d\theta}{5-4\cos\theta}$

(5+5)

2A. Find the inverse Laplace transform of the function $g(s) = \frac{1}{(s^2+a^2)(s^2+b^2)}$, $a^2 \neq b^2$

2B. State and prove Fourier integral theorem. What is the value of the integral at points of discontinuity?

(5+5)

3A. Using the generating function, $(1-2xt+t^2)^{-1/2}$, obtain the series form of Legendre's function $P_n(x)$. Show that $P_n(-x) = (-1)^n P_n(x)$.

3B. The generating functions for Bessel function and Hermite function are $e^{\frac{x}{2}\left(t-\frac{1}{t}\right)}$ and e^{2xt-t^2} respectively. Prove the following recurrence relations.

(i) $J_{n-1}(x) + J_{n+1}(x) = \frac{2n}{x} J_n(x)$

(ii) $2nH_{n-1}(x) = H_n'(x)$

(6+4)

4A. Define a permutation group. Obtain the multiplication table. Show that permutation of *n* identical objects form a group (example of a S_3 group).

4B. Show that gradient of a scalar field is a covariant tensor

4C. Define (i) Contravariant tensor of rank one (ii) Covariant tensor of rank one (iii) mixed tensor of rank two.

(5+2+3)

5A. State Gauss' theorem. Obtain an expression for divergence of vector field in curvilinear coordinates.

5B. Find the eigen values and eigen vectors of the following matrix, $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.

(6+4)