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

Reg. No.										

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

MATHEMATICAL METHODS OF PHYSICS [PHY 4101]

(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 20-12-2019 MAX. MARKS: 50

Note: (i) Answer **ALL** questions
(ii) Draw diagrams wherever necessary

1A. Evaluate the following integral using residues. $\int_0^{2\pi} \frac{d\theta}{5+4cos\theta}$ **5**

1B. State and prove the theorem that goes by the name "Cauchy's integral formula" **5**

2A. The generating function for Legendre polynomial is $g(x) = (1 - 2xt + t^2)^{-1/2} = \sum P_n(x)t^n$. Using this, explain potential due to an electric dipole. Show that $P_n(1) = 1$. **5**

2B. Using Stokes' theorem, obtain an expression for curl in curvilinear coordinates. **5**

3A. Show that eigen values of real symmetric matrix are real and eigen values corresponding to distinct eigen values are orthogonal. **5**

3B. (i) Explain (a) a normal matrix (b) eigen values and eigen vectors.
(ii) Solve the following system of linear equations using Cramer's rule.

$$x_1 + 2x_2 + x_3 = 6$$
$$-2x_1 + x_3 = 3$$
$$3x_1 - 3x_2 + x_3 = 2$$

5

4A. Find the Fourier transform of the function $f(x) = Ae^{-\alpha x^2}$ where A and α are constants. **5**

4B. Find the inverse Laplace transform of the function, $g(s) = \frac{1}{(s+a)(s+b)}$, $a \neq b$ **5**

5A. Perform the symmetry transformation of an equilateral triangle, and, with the help of multiplication table, show that the set of all symmetry transformation which leaves the system invariant forms a group. **5**

5B. (a) Show that velocity is a contravariant vectors.
(b) Obtain the metric for two dimensional plane in terms of polar coordinates.
(c) The generating function of Hermite polynomial $H_n(x)$ is $g(x,t) = e^{(2tx-t^2)}$ and is equal to $\sum_{n=0}^{\infty} H_n(x)\frac{t^n}{n!}$. Show that $2xH_n(x) - 2nH_{n-1}(x) = H_{n+1}(x)$. **5**