Enrollment No: _____________________ **Exam Seat No:**_____________________

C.U.SHAH UNIVERSITY

Winter Examination-2018

Subject Name : Mathematical Physics

Subject Code :5SC01MTP1 **Branch: M.Sc. (Physics)**

Semester :1 **Date :26/11/2018** **Time : 02:30 To 05:30** **Marks : 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the Following questions .** **(07)**

a. What is the basic difference between scalars, vectors and tensors? 01
b. Define: Rank or Order of Tensors 01
c. When, where, why and how are the subscript and superscript used in tensors? 01
d. Name different types groups. 01
e. What are the subgroups? 01
f. Show that $\{\pm 1, \pm i\}$ is a group under complex multiplication. 01
g. Name different types of group representations. 01

Q-2 **Attempt all questions.** **(14)**

(A) Write a detailed note on Kronecker-Delta giving definition, explanation, examples and its properties. 07
(B) Discuss Symmetric tensors and Anti (Skew) symmetric tensors. 07

OR

Q-2 **Attempt all questions.** **(14)**

(A) Describe properties and characteristics of tensors. 07
(B) Describe Applications of tensors. 07

Q-3 **Attempt all questions.** **(14)**

(A) Distinguish: Isomorphism and Homomorphism. Discuss any one. 07
(B) Discuss Coordinate transformation giving proper example. 07

OR

Q-3 **Attempt all Questions.** **(14)**

(A) Describe properties of Group Theory. 07

(B) Describe Applications of Group Theory. 07

SECTION – II

Q-4 **Attempt the Following questions.** **(07)**

a. Define complex numbers and identify each of its parts. 01

b. What is $\boldsymbol{i}$in the complex numbers? Why it is important in physics? 01

c. Define an analytic function. 01

d. Define a continuous function. 01

e. What is the differentiability of a complex function? 01

f. Define: Differential Equation. Name different types of differential equations. 01

g. What are 'degree' and 'order' of a differential equation? Give example of each. 01

Q-5 **Attempt all Questions.** **(14)**

(A) State Cauchy Riemann theorem. Discuss the Cauchy-Riemann theorem by deriving the *Necessary* Cauchy-Riemann conditions$\left\{\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} \;\; ; -\frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}\right\}$for a function to be analytic. 08

(B) State and Discuss the Cauchy-Riemann theorem by deriving the *Sufficient* Cauchy-Riemann conditions$\left\{\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} \;\; ; \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}\right\}$for a function to be analytic. 06

OR

Q-5 **Attempt all Questions.** **(14)**

(A) If the function $f(z)$is analytic within and on a closed contour c and if z_0 is any point within c , then prove *Cauchy's integral formula*$f(\, z_0\,) = \frac{1}{2\pi i}\int \frac{f(z)}{z - z_0}\, dz.$ 10

(B) Develop Cauchy's integral formula for the derivative of an analytic function by deriving $f^{'\,n}(z_0) = \left(\frac{2!}{2\pi i}\right)\int \frac{f(z)}{(z-z_0)^{n+1}}\, dz.$ 04

Q-6 State and prove *Laurent's theorem* for the function$f(z)$ by deriving Laurent's series as **(14)**

$$f(z) = \left(\frac{1}{2\pi i}\right)\sum_{n=1}^{\infty}\left\{(z - z_0)^n \int_c \frac{f(w)dw}{(w - z_0)^{n+1}} + (z - z_0)^{-n} \int_c \frac{f(w)dw}{(w - z_0)^{-n+1}}\right\}$$

OR

Q-6 Derive the solution of *Legendre's differential equation* $(1 - x^2)y^{''} - 2x\, y^{'} + n(n+1)y = 0$ by the Ascending or Descending Mode. **(14)**