(63) Sc

SEAT No._____

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Sardar Patel University
Vallabh Vidyanagar
M Sc (Physics) - I Semester Examination
PS01CPHY01 Mathematical Physics and Computer Programming
Day & Date: Tuesday, 19 March 2019

Time: 2:00 to 5:00pm **Max marks: 70**

I. **Choose the best possible answer from the choices given below the questions** (8x1=8)

1. The norm of arrows lying in a plane is simply the
   (a) direction of the arrow (b) length of the arrow
   (c) plane in which the arrow lies (d) square of its length

2. If the operator X satisfying XA = E, where E is the identity operator then X is called
   (a) right inverse of A (b) left inverse of A
   (c) norm of A (d) dual operator of A

3. The only projection operator which has an inverse is the
   (a) null operator (b) vector operator
   (c) identity operator (d) adjoint operator

4. If there exist correspondence between the elements of the two representations of a group that satisfies the same group multiplication table, then the two representations are said to be
   (a) Cyclic (b) Homomorphic
   (c) Identical (d) Isomorphic

5. If $f(z) = z^2$ and $g(z) = z^*$ then it can be proved that
   (a) both f(z) and g(z) are analytic (b) both f(z) and g(z) are not analytic
   (c) f(z) is analytic g(z) is not (d) f(z) is not analytic g(z) is analytic

6. The Fourier transform of a Gaussian function is
   (a) another Gaussian with different width (b) same Gaussian with same width
   (c) a delta function (d) a polynomial

7. The Laplace transform of cos (kx) is given by

   (a) $s / (s^2+k^2)$ (b) $s^2 / (s^2+k^2)$ (c) $s / (s+k)$ (d) $s / (s^2- k^2)$

8. An input data stored in a location specified by unit 2 and is format free can be read in a Fortran program as

   (a) READ(*,*) 2 (b) READ (2,*) (c) READ(*,2) (d) READ 2

II. Short answer questions (Answer any seven questions given below. 7x2 = 14)

1. State the properties of a linear vector space
2. Define dual vectors with examples
3. What are the defining properties of a group?
4. Show how the components of a contravariant and covariant vectors transform.
5. Write Laurent series. Define analytic function.
6. Obtain the Laplace transform of cosh (kt)
7. Write Cauchy- Riemann conditions. Show that for an analytic function f(z), the derivative of f(z with reference to z^* vanishes.
8. Write a FORTRAN program to add all the odd numbers between 0 and 10.
9. give the general structure of a FORTRAN 90 program.

III A. Define an Eigen value equation. Show that the Eigen values of a Hermitian operator are all real and Eiger vectors corresponding to two different eigen values of a Hermitian operator are orthogonal. (6)

B. What are the reducible and irreducible representations of a group? Explain them with the help of the Group (i, -i, 1,-1).

OR

B. How the covariant and contravariant vectors are defined as per their co-ordinate transformation? Show that the derivatives of a contravariant vector do not transform like a tensor. (6)

IV A. Find the Fourier transform of a finite wave train. Using the result derive the energy time uncertainty relationship. (6)

B. Using Laplace transform solve the LCR circuit. Obtain the resonance frequency of the circuit (6)

OR

B. Using the Fourier transform obtain the expression for the ground state of hydrogen atom given by $\varphi(r) = (\frac{1}{\pi a_0})^{1/2} \exp\left(-\frac{r}{a_0}\right)$ into momentum space. (6)

V A. Derive the residue theorem and obtain an expression for the Cauchy Principal value. Evaluate the definite integral $\int_0^{2\pi} \frac{d\theta}{1+\epsilon cos\theta}$ (6)

B. Using Contour of integration, evaluate $\int_0^{\infty} \frac{sin\, x}{x} dx$ (6)

B. Discuss various applications of Green's function. Derive a closed form of the Green's function corresponds to the Laplacian operator.

OR (6)

VI A. Discuss the various syntax used in Fortran 90. Explain how the constants and arrays in one or more dimensions are represented in Fortran with suitable examples. (6)

B. Using the do loop structure in FORTRAN writes a program to compute the sum of integers from 1 to 100. (6)

B. Discuss the advantages of Function and Suroutine in FORTRAN. Explain them with suitable example in each case.

OR (6)

(6)