(50) Seat No: _____ No. of Printed Pages : 2

Sardar Patel University

M Sc (Physics) - I Semester Examination
PS01CPHY01 Mathematical Physics and Computer Programming
Day and Date: Friday, 21st October 2016

Time: 10:00 to 1:00pm **Max marks: 70**

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

1. The arrows lying in a plane including the arrow of zero length is an example for
   (a) A scalar field (b) linear vector space
   (c) Hilbert space (d) Dual vector space

2. If $\rho(a,b)$ is areal positive number associated with any pair of elements ((a,b) of a metric space then the following is true.
   (a) $\rho(a,b)+\rho(b,c) \geq \rho(a,c)$ (b) $\rho(a,b)+\rho(b,c)=0$
   (c) $\rho(a,b)+\rho(b,c) \leq \rho(a,c)$ (d) $\rho(a,b)-\rho(b,c)=\rho(a,c)$

3. From the list given below pick up the one which is not a tensor quantity.
   (a) A contravariant vector (b) A diadic
   (c) Christoffel symbol (d) covariant derivative of a vector

4. The correspondence between the elements of two group representations is one to one, then the two groups are said to be
   (a) Cyclic (b) Homomorphic
   (c) Symmetric (d) Isomorphic

5. If $Z = r\exp(4i\varphi)$, then $|dZ|$ equals
   (a) r (b) $4rd\varphi$
   (c) dr (d) $4\exp(4id\varphi)$

6. The Fourier inverse transform of the product of Fourier transforms is called
   (a) Convolution (b) Inverse transform
   (c) Parseval's relationship (d) Normalization condition

7. The expression, $\frac{n!}{(s-a)^{n+1}}$ represents the Laplace transform of
   (a) t^n (b) at^{n+1} (c) $e^{at}t^n$ (d) e^{at^n}

8. An out put of a Fortran program which is to be stored in a location specified by unit 2 and is format free can be written as
   (a) printiff (b) write(2,*) (c) write(*,2) (d) print 2

(P.T.O.)

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

1. Define norm and basis in the case of a linear vector space
2. Explain the range and domain of a linear operator.
3. Define a group and show that (1,i,-1,-i) form a group.
4. Give the transformation properties of the components of a contravariant and covariant vectors..
5. Show that Dirac delta function can be expressed as $\delta(t-x)=\frac{1}{2\pi}\int_{-\infty}^{\infty} e^{i\omega(t-x)}d\omega$
6. Obtain the Laplace transform of $\cos(\omega t)$
7. Write Cauchy- Riemann conditions. Define a simply connected region.
8. Write a FORTRAN program to add and multiply two integers.
9. Explain the difference between point groups and continuous groups. Give examples.

III A. State the rules of scalar products of two quantities in a linear vector space and derive the Cauchy-Schwarz inequality condition. (6)

B. Show that all the symmetry operations of an equilateral triangle forms a group. Write down the group multiplication table corresponds to this group and identify the sub groups if any in it. (6)

OR

B. Define Metric tensors and its properties. Define the Christoffel symbols of the first and second kind and show that they do not transform like a tensor. (6)

IV A Obtain the Fourier transform of a Gaussian function and give your comments on their widths. (6)

B. Using Laplace transform find the solution of a damped oscillator problem with an appropriate boundary conditions. (6)

OR

B. State and prove convolution theorem. Then prove that $\int_{-\infty}^{\infty} F(\omega)G^{*}(\omega)d\omega=\int_{-\infty}^{\infty} f(t)g^{*}(t)dt$ (6)

V A If $f(Z)$ is a single valued and analytic through out a simply connected region R and if c is any closed contour interior to R and enclosing z_0, then show that

$$f(z_0)=\frac{1}{2\pi}\oint_c \frac{f(z)}{z-z_0}dz$$ and evaluate $\oint_c \frac{z^2+2z-2}{z-4}dz$ over a contour path $z_0=4$. (6)

B. Show that $\int_0^{2\pi}\frac{d\theta}{(a+b\cos\theta)}=\frac{2\pi}{(a^2-b^2)^{1/2}}$; a>b. (6)

OR

B. Describe the methods of constructing Green's function. Derive the green's function corresponds to the Laplacian operator. (6)

VI A. Give the general structure of Fortran 90. Explain the terms constants and variables using suitable examples. How arrays are represented in FORTRAN? (6)

B. Using the do loop structure in FORTRAN writes a program to compute the sum of odd integers below 10. (6)

OR

B. Write notes on i) Input Output statements ii) Format specifications in FORTRAN (6)

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