

[113/A21]

SEAT No. \_\_\_\_\_

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SARDAR PATEL UNIVERSITY

M. Sc. (Physics) 1<sup>st</sup> Semester Examination

Monday, 22<sup>nd</sup> October, 2018

Time: 10:00 am to 01:00 pm

Subject: PS01CPHY01 [Mathematical Physics & Computer Programming]-Old Course

Total Marks: 70

Note: (1) Figures to the right indicate marks.  
(2) Symbols have their traditional meaning.

Q:1 Attempt all of the following Multiple choice type questions. [ 01 mark each ] [08]

- (1) A tensor of rank  $n$  has \_\_\_\_\_ components.
- (a)  $3n$  (c)  $3^{n-1}$   
(b)  $n^3$  (d)  $3^n$
- (2) The eigen values of matrix  $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$  are
- (a) 1,2 (c) 1,1  
(b) 0,2 (d) 1,0
- (3) While mapping from  $z$ -plane to  $w$ -plane,  $1/z$  corresponds to
- (a) translation (c) inversion  
(b) Roto-inversion (d) rotation
- (4) If  $u = x^2 - y^2$ , then corresponding analytic function is
- (a)  $z^3 + c$  (c)  $z^2 + c$   
(b)  $z^4 + c$  (d)  $z + c$
- (5) The Laplace transform of  $t^3$  is given by
- (a)  $s-3$  (c)  $6/s^4$   
(b)  $1/s^3$  (d)  $6/s^3$
- (6) The number of generators of  $SU(x)$  is
- (a)  $2^{n+1}$  (c)  $n^2 + 1$   
(b)  $2^n$  (d)  $n^2 - 1$
- (7) Which of the following is a valid real constant
- (a) 67,200.98 (c) -0.567  
(b) 1 (d) -1/2
- (8) The correct answer for the following expression is,  
REAL:: a=2.5,b=2.5  
 $a/2.5/b$
- (a) 1.0 (c) 0  
(b) 0.25 (d) 0.4

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(P.T.O.)

Q:2 Answer any 7 of the following 9 questions briefly. [ 02 marks each ] [14]

- 1 Explain outer product and contraction of tensors.
- 2 Show that Eigen values of a Hermitian operator are real.
- 3 What are linearly independent vectors and unitary operators?
- 4 Define complex number and give its geometrical representation.
- 5 Define analytic function. Write Cauchy-Riemann conditions.
- 6 Explain group multiplication table.
- 7 Explain homomorphism and isomorphism.
- 8 What are input output statements?
- 9 Define array with the help of an example.

Q:3 (a) Define linear vector space. Explain scalar product and triangle inequality. [6]

(b) Prove that  $\begin{pmatrix} -xy & x^2 \\ y^2 & xy \end{pmatrix}$  is a tensor. [6]

OR

(b) Write a note on dual vectors and Cauchy-Schwarz inequality. [6]

Q:4 (a) Using Cauchy's second integral theorem show that the nth order derivative of an analytic function is given as  $f^{(n)}(z_0) = \frac{n!}{2\pi i} \oint_c \frac{f(z)}{(z-z_0)^{n+1}} dz$ . [6]

(b) Evaluate  $\int_0^{\infty} \frac{dx}{(1+x^2)^2}$ . [6]

OR

(b) Explain how Green's function can be obtained for a one dimensional problem. Obtain Green's function for  $\frac{d^2 y}{dx^2} + \omega^2 y = 0$  where  $f(x)$  is known function and  $y(0) = 0$  and  $y(L) = 0$ . [6]

Q:5 (a) Obtain the solution of a damped oscillator using Laplace transform, given by equation  $mx''(t) + bx'(t) + kx(t) = 0$  with initial conditions  $x(0) = x_0$ ,  $x'(0) = 0$ . [6]

(b) Obtain the Fourier transform of a finite wave train. Using the result derive the energy-time uncertainty relation. [6]

OR

(b) Write notes on (i) convolution theorem (ii) Fourier transform of derivatives. [6]

- Q:6 (a) Using suitable example, explain in detail the concept of subroutines. [6]
- (b) Explain DO loops. Write a FORTRAN90 program to compute the sum of integers 1 to 20 using a DO loop. [6]

OR

- (b) Using suitable illustration, explain in detail the IF-ELSEIF construct. [6]

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