SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar
M. Sc. (Physics) 1st Semester Examination
Tuesday, 5th April, 2016
Time: 10:30 am to 01:30 pm
Subject: PS01CPHY01 [Mathematical Physics & Computer Programming]

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) 3^n (c)   3n
  (b) n^3 (d) 3^{n-1}

(2)   A vector whose sign reverses with reversal of coordinates is known as
  (a)   axial vector   (c)   polar vector
  (b)   tensor   (d)   negative vector

(3) $\oint_c \frac{z^2}{z-3}$ where c is $|z|=2$ is

  (a)   0   (c) πi
  (b) $2\pi i$ (d) $4\pi i$

(4)   While mapping from z-plane to w-plane, 1/z corresponds to
  (a)   Inversion   (c)   translation
  (b)   roto inversion   (d)   rotation

(5)   The Laplace transform of 1 i.e. £{1} is
  (a) s^2 (c)   1/s
  (b)   1   (d)   s

(6)   Integral transform based on the kernel $e^{i\omega t}$ if known as
  (a)   Laplace transform   (c)   Mellin transform
  (b)   Henkel transform   (d)   Fourier transform

(7)   Which of the following operator has the first precedence?
  (a)   *, /   (c)   unary -
  (b)   +, -   (d)   **

(8)   Which edit descriptor should be used to read or write a REAL number in the next
      w columns with d digits following the decimal points
  (a)   Ew.d   (c)   Iw.d
  (b)   Fw.d   (d)   Fw

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

1   Define (i) contraction (ii) direct product
2   Define linear vector space and linear operator.
3   What is complex conjugation? Show that $(zz^*)^{1/2}=|z|$.
4   Define analytic function. Write Cauchy-Riemann conditions.
5   Define Laplace transform.
6   Explain Parseval's relation.
7   Write the Fortran 90 statement for   (i) $\log x + \sin(10^0)$ (ii) $e^{-kt} + \sqrt{x^2 y}$
8   Write full form of FORTRAN. How is a FORTRAN program compiled?
9   Write the general structure of a Fortran 90 program.

Q:3 (a) Define Hermitian operator and prove that its Eigen values are real   [6]
          quantities. Also explain projection operators.

     (b) Define covariant and contravariant tensors. State and prove Quotient rule.   [6]

                                    OR

     (b) Write a note on dual tensors and irreducible tensors.   [6]

Q:4 (a) Show that $\cdot \int_{0}^{2\pi} \dfrac{d\theta}{(a+b\cdot\cos\theta)} = \dfrac{2\pi}{(a^2-b^2)^{1/2}}$; a>b.   [6]

     (b) Define Green's function. Obtain Green's function for $\dfrac{d^2 y}{dx^2} - k^2 y = f(x)$ [6]
          where $y(\pm\infty) = 0$.

                                    OR

     (b) Find the residue of $f(z) = \dfrac{z^4}{(z-1)^3(z-2)(z-3)}$ at z = 1.   [6]

Q:5 (a) Define the Fourier cosine transform. Discuss convolution theorem.   [6]

     (b) Using proper integral transform, explain how a finite pulse could be   [6]
          resolved into sinusoidal waves.

                                    OR

     (b) Write a note on Group, its representation and character. Using a suitable   [6]
          example explain group multiplication table.

Q:6 (a) Explain the IF-ELSEIF construct using suitable example.   [6]

     (b) Write short notes on (i) arithmetic expressions (ii) input-output statements.   [6]

                                    OR

     (b) Explain arrays. Write a fortran program to read a matrix row wise and write   [6]
          it column wise.

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