NAME (IN BLOCK LETTERS):

ROLL NUMBER:



UNIVERSITY OF PUNE

DEPARTMENT OF ATMOSPHERIC AND SPACE SCIENCES ENTRANCE TEST FOR M.Tech. (Atmospheric Science)

DATE : 2nd **JULY 2014 TIME: 2 p.m. to 4 p. m.**

INSTRUCTIONS

1. Enter your Name and Roll number at the Space specified above.

2. All 50 questions to be answered. Each Question carries 3 marks, Maximum marks = 150.

3. For each Question four answers have been given. Tick the correct answer on the question paper.

4. Use of calculator and Logarithm Tables is allowed.

5. Return the Question paper duly filled in to the Invigilators.

6. There is no negative marking for wrong answer.

MARKS OBTAINED:

1. Two harmonic transverse waves of the same frequency with displacements at right angles to each other can be represented by the equations

 $y = y_o \sin (\omega t - kx)$ $z = z_o \sin (\omega t - kx + \phi)$

where y_o and z_o are nonzero constants.

The equations represent a plane-polarized wave if ϕ equals

a) 2 b) 3p/2 c) p/4 d) 0

- 2. If ψ is a normalized solution of *Schrödinger Equation* and *Q* is the operator corresponding to a physical observable *x*, the Quantity $\int \psi' Q \psi dx$ represents
 - a) Normalization constant for ψ

b) Spatial overlap of Q with ψ

c) Mean value of x

d) Uncertainty in x

3. The capacitors in the circuit below are all identical. The *EMF* of the battery is 2V. Calculate the effective capacitance.



4. The Potential Energy of a body constrained to move on a straight line is $k x^4$, where k is a constant. The position of the body is x, its speed v, its linear momentum p and its mass m. The Hamiltonian function for this system is

a)
$$\frac{p^2}{2m^2} + k x^4$$

b) $\frac{p^2}{2m^2} - k x^4$
c) $k x^4$
d) $\frac{1}{2}mv^2$

5. The components of orbital Angular momentum operator $L = (L_x, L_y, L_z)$ satisfy the following commutation relations

$$[L_x, L_y] = i \hbar L_Z; [L_y, L_z] = i \hbar L_x; [L_z, L_x] = i \hbar L_y$$

What is value of the commutator $[L_x L_y, L_Z]$?

a) $i \hbar (L_x^2 + L_y^2)$ b) $- i \hbar (L_x^2 + L_y^2)$ c) $i \hbar (L_x^2 - L_y^2)$ d) $- i \hbar (L_x^2 - L_y^2)$

6.

7.

20.

21. $\phi = r^m$ Where $\overline{r} = x\overline{i} + y\overline{j} + z\overline{k}$, $\nabla \phi$ is

a) mr^{m-1}

b) $mr^{m-1}r$

- c) $mr^{m-2}r$ d) mr^{m-2}
- 22. The solution of the differential equation

The general solution of $\frac{d^2 y}{dx^2} + 9y = \sec 3x$ is

a) $y = c_1 \cos 3x + c_2 \sin 3x + x/3 \sin 3x + 1/9 \cos 3x \log(\cos 3x)$

b)
$$y = c_1 e^{3x} + c_2 e^{-3x} + x/3(\sin 3x + \cos 3x)$$

c) $y = c_1 \cos 3x + c_2 \sin 3x + x/3 \sin 3x$

d)
$$y = c_1 \cos 3x + c_2 \sin 3x + \log \cos 3x$$

23. A and B are $n \times n$ invertible matrices, where n > 1, and I is the $n \times n$ identity matrix. If A and B are similar matrices, which of the following statements must be true?

I. A -2I and B- 2I are similar matrices.

II. *A* and *B* have the same trace.

III. A^{-1} B^{-1} are similar matrices.

a) I only b) II only

c) III only d) I,II and III

24. Equation of normal portability density function is given by

a) $f(x) = \frac{1}{\sqrt{2\Pi\sigma}} e^{-(x-\mu)^2/2\sigma^2} - \infty < x < \infty$, where μ and σ are mean and standard deviation

deviation.

b)
$$f(x) = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{\infty} e^{-x^2/2} dx$$

c)
$$f(x) = \int_{-\infty}^{\infty} \frac{(x-\mu)\sqrt{n-1}}{\sigma} dx$$

d)
$$\frac{1}{\sqrt{2\Pi}} e^{-(x-x)^2/2} \qquad -\infty < x < \infty$$

25. In a harmonic Analysis, if number of observations is N. The maximum number of harmonics can be equal to

a) N-2 b)
$$\frac{N}{4}$$

c) $\frac{(N-1)}{2}$ d) $\frac{N}{2}$

26.

27.

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35.

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a) tropopause	b) stratopause	
c) mesopause		d) ionosphere

37. El Nino is associated with a temporary change in the sea surface temperature around the coast of

a) Sri Lanka	b) Indonesia
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c) Peru

d) Madagascar

38. Global warming is related to:

a) trapping of solar radiation by greenhouse gases

b) trapping of terrestrial radiation by greenhouse gases

c) heat generated due to industrial activities

d) increased amount of solar radiation reaching earth's surface.

39. Antarctic ozone hole refers to the depletion of ------ over south pole.

- a) Surface ozone b) Stratospheric ozone
 - c) Ionospheric ozone d) Tropospheric ozone

40. Among the following states, largest number of cyclonic storm in a year strikes the Indian coasts at:

- a. Gujrat
- b. Andhrapradesh
- c. Kerala
- d. West Bengal

41. 42. 43.