

**SECTION - C**

[ 3 X 10 = 30 ]

**Answer Any THREE Questions.**

16. State and prove Cauchy's integral theorem.

17. a) How will you find the residue when  $f(z)$  has a pole of order  $n$ .

b) Evaluate the definite integral by the use of residue theorem  $I = \int_0^{2\pi} \frac{d\theta}{5 + 4\cos\theta}$ .

theorem  $I = \int_0^{2\pi} \frac{d\theta}{5 + 4\cos\theta}$ .

18. Define a) equality of tensor, b) null tensor, c) addition and subtraction of tensors, d) inner and outer product of tensors.

19. What do you mean by a unitary group? Also arrive at the irreducible representation of character of SU(2).

20. Show that the normal distribution is a limiting case of binomial distribution.

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**END SEMESTER EXAMINATION - NOVEMBER 2019**

Programme : M. Sc., Physics

Date : 13.11.2019

Course Code: 18PPHC21

Time: 1.00p.m. to 5.00p.m.

Course Title : Mathematical Physics - II Max. Marks : 75

**SECTION - A**

[10 X 1 = 10]

**Answer ALL the Questions.**

**Choose the Correct Answer.**

1. The value of the integral  $I = \frac{1}{2\pi i} \int_C \frac{dz}{z-3}$  where 'c' is a circle, then  $|z|=1$  is \_\_\_\_\_.

[a] 1

[b] 0.5

[c] 2

[d] zero

2. Which of the following is true for the given function  $u = x^2 - y^2$  and

$v = \frac{y}{x^2 + y^2}$  ?

[a] both function u and v are harmonic

[b] function u is harmonic but v is not

[c] function v is harmonic but u is not

[d] both functions u and v are not harmonic

3. If a function  $f(z)$  has a simple pole of order  $n$  at  $z = z_0$ , then the function

$f'(z) | f(z)$  has \_\_\_\_\_.

[a] no pole

[b] a simple pole

[c] pole of order  $(n-1)$

[d] an essential singularity.

4. If  $C$  is a circle  $|z-1|=3$  in the complex plane, then  $\int \cos z|_{z \in C} = 3$  is equal to \_\_\_\_\_.

- [a]  $\pi i$   
[c]  $-2\pi i$

5. Moment of inertia is a \_\_\_\_\_.

- [a] scalar  
[b] vector

[c] a tensor of rank 2

[d] a tensor of high rank

6. The differentiation of a scalar with respect to variable  $x^{\mu}$  results in \_\_\_\_\_.

- [a] scalar  
[c] a covariant vector

7. Two groups  $G = (G_1, G_2, \dots, G_n)$  and  $H = (H_1, H_2, \dots, H_n)$  are isomorphic if \_\_\_\_\_.

- [a]  $G_1 G_2 = H_1 H_2$   
[b]  $G_1 H_1 = G_2 H_2$

- [c]  $\frac{G_1}{H_1} = \frac{G_2}{H_2}$   
[d]  $\frac{G_1}{G_2} = \left( \frac{H_1}{H_2} \right)^2$

8. In the group  $G = [E, A, A^2]$ , the element conjugate to  $A^2$  is \_\_\_\_\_.

- [a]  $E$   
[b]  $A^2$   
[c]  $A$   
[d]  $A^{-2}$

9. The probability that a leap year selected at random will contain 53 sundays is \_\_\_\_\_.

- [a]  $1/2$   
[b]  $3/10$   
[c]  $2/7$   
[d]  $53/366$

10. In a given race, the odds in favour of horses A, B, C are 1:3, 1:4, 1:5, 1:6 respectively. The probability that the horse C win the race is \_\_\_\_\_.

- [a]  $1/4$   
[b]  $1/5$   
[c]  $1/3$   
[d]  $1/6$

SECTION - B

[5 X 7 = 35]

Answer ALL the Questions.

11. a) State the theorem which indicate whether a complex function is analytic or not. [OR]

b) Find the real and imaginary part of  $u(x, y)$  and  $v(x, y)$  of

$$\sqrt{z} [z = x + iy].$$

Also comment on the sign of  $u$  and  $v$ .

12. a) How will you find the residue of a simple pole at  $Z = Z_0$ .

Find  $R(-1/2)$  and  $R(5)$  for  $f(z) = \frac{z}{(2z+1)(5-2)}$ .

[OR]

b) Find the Laurent series of the function  $\frac{1}{z(z+1)}$  about  $Z = 0$  and hence find the residue.

13. a) Briefly describe the concept of a group, also an abelian group with an example. [OR]

b) Prove that the group of order 3 is always cyclic and order 4 may or may not be cyclic.

14. a) What are covariant vectors?

[OR]

b) What are contravariant vectors?

15. a) i) What do you mean by a sample space ii) define probability, and iii) construct the sample space if the coin is tossed three times. [OR]

b) The radius of a wire is measured in cm as 0.17, 0.15, 0.18, 0.19, 0.16, 0.17. Find the mean radius and the standard deviation.

b) Explain the state of electromagnetic theory represents the divergence and curl of magnetic and electric fields before Maxwell.

14. a) Obtain the wave equation for propagating in one dimension.

[OR]

b) Derive the expressions for electric and magnetic fields in a monochromatic plane wave.

15. a) Determine the Coulomb gauge and Lorentz gauge by the distribution of charge.

[OR]

b) Obtain the expressions for scalar and vector potentials.

SECTION - C [3 X 10 = 30]

Answer Any THREE Questions.

16. Obtain the solutions to Laplace equation in spherical coordinates.
17. Describe the magnetic scalar potential and magnetic pole density.
18. Reformulate the Maxwell's equations for the materials subjected to electric and magnetic polarization.
19. Derive an expression for reflection coefficient and the transmission coefficient at normal incidence.
20. Solve the inhomogeneous wave equation for specified sources for using the retarded potentials.

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**END SEMESTER EXAMINATION - NOVEMBER 2019**

Programme : M. Sc., Physics

Course Code: 18PPHC22

Course Title : Electromagnetic Theory

Date : 15.11.2019

Time: 2.00p.m. to 5.00p.m.

Max. Marks : 75

SECTION - A [10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. The integral of the normal component of electric field over a closed surface is \_\_\_\_\_.  
[a] total charge enclosed by the closed surface  
[b] surface charge density  
[c] electric flux  
[d] electric potential
2. Poisson's equation gives \_\_\_\_\_.  
[a] gradient of the potential  
[b] Laplacian of the potential  
[c] gradient of the electric field  
[d] Laplacian of the electric field



3. One weber is \_\_\_\_\_

- [a] Newton-second per coulomb-meter
- [b] Newton-second-meter per coulomb
- [c] Tesla per meter
- [d] Tesla meter

4. Lorentz force refers to \_\_\_\_\_

- [a] electric force on a charge
- [b] magnetic force on a moving charge
- [c] electric force on a moving charge
- [d] electric and magnetic forces on a moving charge

5. The divergence of an induced electric field is equal to \_\_\_\_\_

- [a] the ratio of charge density
- [b] volume charge density
- [c] surface charge density
- [d] zero

6. Magnetization results in \_\_\_\_\_

- [a] bound charges
- [b] bound charge density
- [c] bound currents
- [d] polarization of charges

7. The velocity of electromagnetic waves in vacuum is given by \_\_\_\_\_

- [a]  $1/\epsilon_0$
- [b]  $1/\mu_0$
- [c]  $1/\epsilon_0\mu_0$
- [d]  $1/\sqrt{\epsilon_0\mu_0}$

8. Bound current is due to \_\_\_\_\_

- [a] linear motion of charge when electric polarization changes
- [b] magnetic polarization
- [c] free charges
- [d] magnetic potential

9. Gauge transformations refer to \_\_\_\_\_

- [a] changes in electric field vector
- [b] changes in magnet field vector
- [c] charges in potentials alone
- [d] changes in potential and area vector

10. The advantage of Coulomb gauge is \_\_\_\_\_

- [a] scalar potential is easily calculated
- [b] vector potential is easily calculated
- [c] area vector is easily calculated
- [d] the charge distribution can be measured

SECTION - B

[5 X 7 = 35]

Answer ALL the Questions.

11. a) Explain the multipole expansion of electric fields.

[OR]

b) Write a short note on polarization.

12. a) Give the applications of Ampere's law.

[OR]

b) Explain i) Magnetic flux ii) Magnetization?

13. a) State and explain the Faraday's law of electromagnetic induction.

Answer Any **THREE** Questions.

16. Brief about phase transitions.
17. Explain the thermodynamics of magnetism.
18. Write a note on ensembles.
19. Explain Bose-Einstein distribution function.
20. Describe Debye's theory of specific heat capacity of solids.

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**END SEMESTER EXAMINATION - NOVEMBER 2019**

Programme : M. Sc., Physics

Course Code: 18PPHC23

Course Title : Statistical Mechanics  
and Thermodynamics

Date : 18.11.2019

Time: 2.00p.m. to 5.00p.m.

Max. Marks : 75

SECTION - A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. Change of heat depends on \_\_\_\_\_
 

[a] transfer of heat	[b] change of temperature
[c] transfer of mass	[d] the thermodynamic state
2. Maxwell's equations consists of \_\_\_\_\_ equations.
 

[a] four	[b] three
[c] two	[d] one
3. The unit of surface tension in CGS System is \_\_\_\_\_.
 

[a] N/m	[b] Kg/cm
[c] Dynes/cm	[d] Dynes /m

4. Energy released by a radiating surface is not continuous but is in the form of successive and separate packets of energy is called \_\_\_\_\_.
- [a] photons  
[b] protons  
[c] electrons  
[d] neutrons
5. The condition in which the quantum statistics reduces to classical statistics is \_\_\_\_\_.
- [a]  $\rho\lambda^3 = 1$   
[b]  $\rho\lambda^3 \gg 1$   
[c]  $\rho\lambda^3 \ll 1$   
[d]  $\rho = 0$
6. Specific heat of metals can be expressed as \_\_\_\_\_.
- [a]  $T^3$   
[b]  $AT + BT^2$   
[c]  $AT^2 + BT^3$   
[d]  $AT + BT^3$
7. The statistics that have no restriction on the number of particles in a given quantum state is \_\_\_\_\_.
- [a] Maxwell - Boltzmann  
[b] Fermi - Dirac  
[c] Bose - Einstein  
[d] partition function
8. In Bose Einstein statistics, the absolute zero is taken to be \_\_\_\_\_.
- [a] 0  
[b] 1  
[c] 3  
[d] 2
9. In Debye's Theory of specific heat, at low temperature, specific heat is \_\_\_\_\_.
- [a] T  
[b]  $T^2$   
[c]  $T^3$   
[d] Independent of T

10. The value of probable distribution  $n_1, n_2, n_3$  denotes about \_\_\_\_\_.
- [a] isolated state  
[b] combined state  
[c] state of occupancy  
[d] degenerated state
- SECTION - B**  
**[5 X 7 = 35]**
- Answer ALL the Questions.**
11. a) Brief about Helmholtz and Giff's function.  
[OR]
- b) State and explain Nernst heat theorem.
12. a) Explain the phase equilibrium.  
[OR]
- b) How does vapour pressure depend on total pressure?
13. a) Give an account on macrostates and microstates.  
[OR]
- b) Describe density of states.
14. a) Brief about Fermi-Dirac statistics.  
[OR]
- b) Explain the partition function of a system.
15. a) Write a note on principle of equilibrium of energy.  
[OR]
- b) Explain Einstein's theory of specific heat capacity of a solid.

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**END SEMESTER EXAMINATION - NOVEMBER 2019**

Programme : M. Sc., Physics

Course Code: 18PPHE21

Course Title : Nano Physics

Date : 20.11.2019

Time: 2.00p.m. to 5.00p.m.

Max. Marks :75

**SECTION - A**

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. \_\_\_\_\_ are used to detect contrast between areas of different chemical composition.

[a] EBSD

[b] BSE

[c] CCD

[d] REM

2. Nanometer is in the order of \_\_\_\_\_.

[a]  $10^{-7}$  m

[b]  $10^{-8}$  m

[c]  $10^{-9}$  m

[d]  $10^{-10}$  m

3. X-ray lithography uses shorter wavelength about \_\_\_\_\_.

[a] 0.1nm

[b] 0.2nm

[c] 0.3nm

[d] 0.4nm

4. Nanolithography refers to fabrication of \_\_\_\_\_ scale structure.

[a] nano

[b] micro

[c] milli

[d] metre



5. Drop hammer machine is used to determine \_\_\_\_\_.

- [a] voltage
- [b] current
- [c] impact
- [d] temperature

6. Atomic force microscopy (AFM) is also known as \_\_\_\_\_.

- [a] SEM
- [b] TEM
- [c] SPM
- [d] FTIR

7. The hollow structure with the walls formed by one atom thickness of carbon is called \_\_\_\_\_.

- [a] carbon
- [b] graphene
- [c] diamond
- [d] lignite

8. CNT have \_\_\_\_\_.

- [a] high thermal expansion
- [b] low thermal expansion
- [c] low thermal conductivity
- [d] low viscosity

9. Atomic force microscopy is a type of \_\_\_\_\_ microscopy.

- [a] light
- [b] scanning probe
- [c] electron
- [d] travelling

10. The meaning of nano is \_\_\_\_\_.

- [a] very small
- [b] large
- [c] small
- [d] very large

SECTION - B [5 X 7 = 35]

Answer ALL the Questions.

11. a) Explain the preparation and visualization of samples in transmission Electron Microscope.

*Raathna*

[OR] Dr. D. Malitha

--2-- ASST. Prof. & Head

Pa. Dept of Physics

b) Explain the imaging structure of scanning probe microscopy.

12. a) Explain photolithography and its limitations. [OR]

b) Explain the working principle of electron beam lithography.

13. a) Explain the fabrication of nanostructure by milling process. [OR]

b) Explain nanofabrication by scanning probe techniques.

14. a) Explain the ability of the cluster to react with other species. [OR]

b) Explain the application of carbon nanotubes in Fuel cells.

15. a) Write a note of excitons. [OR]

b) Explain the behaviour of type - II superconductor in an applied magnetic field.

SECTION - C [3 X 10 = 30]

Answer Any THREE Questions.

16. Describe the working principle of Scanning Electron Microscope.

17. Brief about the direct growth of AFM tips by chemical vapour deposition.

18. Explain the growth of nanomaterial by molecular beam epitaxy method.

19. Describe the theoretical modelling of nanoparticles.

20. Explain the function of FET type nanostructure.

Verified by

*Dr. S. K. Selvaraj*

Dr. S. K. Selvaraj

8/8/19