

**INTERNAL EXAMINATION'2021**  
**PAPER : CC11**  
**SEMESTER-5 (HONOURS)**  
**EACH QUESTION CARRIES 2 MARKS**

Answer any 10

1. Write down Maxwell's equations in free space.
2. Write down Poynting's theorem.
3. What is Displacement current?
4. How Maxwell's equation gets modified in a conducting medium?
5. Write down continuity equation. Whether Maxwell's equations include continuity equation?
6. What is wave impedance?
7. What is optic axis of a crystal ?
8. What are uniaxial and biaxial crystal?
9. What are ordinary and extraordinary rays?
10. What are retardation plates? Explain with example.
11. What is optical rotation?
12. How can circularly polarized light be produced ?
13. How can light be polarized by double refraction?
14. How can you generate an electric field that is non-conservative in nature?
15. What is Brewster's angle?
16. How can you produce elliptically polarized light?
17. Consider an interface of a dielectric and conducting medium along yz plane, write down boundary conditions for **E** and **H** when an electromagnetic wave propagating along +ve x direction, incident normally on the surface.
18. 5. What are O-ray and E-ray ?

**INTERNAL EXAMINATION'2021**  
**SEMESTER : 5 (Honours), PAPER : CC-12**  
**Statistical Mechanics**

(Each question carries two marks)

Answer any ten of the following

1. Define phase space .
2. Explain the outcome of Liouville's theorem.
3. Two Ergodic surfaces can't intersect each other-explain
4. Find out volume of a 4-dimensional sphere.
5. Suppose two systems characterized with  $(E, N, V)$  are brought in contact with each other. The systems come to thermal equilibrium with each other by exchanging energy between them. Draw the  $\Gamma(E)$  vs  $E$  ,  $E$  is the total energy of the two systems. Other symbols have their usual meanings.
6. Find out the pressure of radiation from quantum theory.
7. State the Wien's displacement law.
8. State the Wien's law of energy distribution.
9. A black body at temperature of 1646 K has the wavelength corresponding to the maximum emission ( $\lambda_m$ ) equal to 1.78 micron. Find the temperature of the moon (assumed to be a black body) if  $\lambda_m$  for the moon is 14 micron.
10. What are bosons? Give examples.
11. In case of a stochastic system, what are the aspects on which the quantum distribution Function should depend ?
12. Consider a stochastic system of volume  $V$ , total energy  $E$  and having a large number  $N$  of particles. Write down the conditions which the accessible microstates of the system satisfy.
13. The entropy of a stochastic system is given by  $S(N, V, E) = k \ln W\{n\}$  where  $\{n\}$  is the distribution of the system that maximizes  $W\{n\}$ . What are the conditions under which the maximization is performed ? What is the method of this maximization ?
14. The partition function of a classical canonical ensemble is given by

$$Q(V, T) = \frac{V^N \lambda^{3N}}{N!}$$

Where  $\lambda$  is the mean thermal wavelength of the particles. What is the physical interpretation of this mean thermal wavelength ?

15. How is it possible to identify a stochastic quantum system of a large number of particles as a Bose system or a Fermi system ?

**INTERNAL EXAMINATION'2021**  
**SEMESTER : 5 (Honours), PAPER : DSE-A(a)**  
**Advanced Mathematical Methods**

(Each question carries two marks)

Answer any ten of the following

1. Define normal subgroups of a group  $G$
2. Let  $\phi: G \rightarrow G'$  be a group homomorphism. Define kernel of this homomorphism. And show that  $\text{Ker } \phi$  is a normal subgroup of  $G$  ( $\text{Ker } \phi$  symbolises the kernel of homomorphism)
3. Let  $\phi: G \rightarrow G'$  be a group homomorphism. Show that  $\phi$  is 1-1 if and only if  $\text{Ker } \phi = e_G$  (Here  $e_G$  is the identity element of group  $G$ )
4. Show that for a group homomorphism the identity element of  $G$  maps to the identity element of  $G'$  (if Let  $\phi: G \rightarrow G'$  be a group homomorphism), what is automorphism ?
5. Define Cyclic group and the generator of the cyclic group.  
Consider the group  $(\mathbb{Z}, +)$ . Write down the generator of this group.
6. Write down the force-acceleration relation in an anisotropic medium and interpret the constant, if any.
7. What are the possible ways a vector can transform under a coordinate transformation ?
8. Verify whether the acceleration of a moving particle is a contravariant tensor or a covariant tensor.
9. Write down the components of the divergence of a covariant tensor  $A_i$  in cylindrical polar system.
10. Verify that the product of two tensors may not necessarily be a tensor.
11. A binary operation is defined as:  $a \circ b = a + b - ab$  ( $a, b \in \mathbb{Z}$ ). Is it a commutative operation?
12. Let  $A = \{4, 5, 6\}$  and  $B = \{7, 8, 9\}$  be two sets. Which one of the followings is a relation from  $A$  to  $B$ ? (i)  $R_1 = \{(4,7), (5,9), (6,5)\}$  and  $R_2 = \{(4,8), (6,8)\}$ .
13. Proof that the identity element of a group  $(G, \circ)$  is unique.
14. Suppose the mapping  $F: \mathbb{R}^2 \rightarrow \mathbb{R}^2$  is defined by  $F(x) = 15x$ . Is  $F$  a linear transformation (homomorphism)?
15. Let  $V = \mathbb{R}^n$ . Is  $W$  a subspace of  $V$  if  $W = \{\alpha: \alpha \in \mathbb{R}^n \text{ and } a_1 + 3a_2 = a_3\}$ ?

**DSE (Nuclear Physics) IA**  
**Answer any 10 questions**  
**PAPER : DSE-B**  
**NUCLEAR AND PARTICLE PHYSICS**  
**EACH QUESTION CARRIES 2 MARKS**

1. What is nucleus composed of?
2. What are values of spin and charge for proton and neutron?
3. What is Q value of a nuclear process?
4. What is the difference between elastic and inelastic scattering?
5. What do you mean by cross section of nuclear reaction?
6. What is the value of momentum in centre of mass frame?
7. Write down the Bethe Bloch formula explaining the different terms.
8. What is Cerenkov radiation ?
9. What is photoelectric effect?
10. Define Compton scattering .
11. What is the basic principle of scintillation detectors ?
12. What is a photomultiplier tube?
13. State the principle for ionization chamber.
14. A hadron has a quark content ddu. Find the charge and strangeness of this hadron.
15. What is meant by Eightfold way?
16. Define lepton number and baryon number.
17. Write two limitations of cyclotron.
18. What is quark model?