PHY15

SUBJECT : **PHYSICS**

Candidate's Roll No.

6596

Time Allowed : 3 Hours

Maximum Marks : 150

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

1 There are eighteen (18) questions in all.

2 Candidate has to attempt any fifteen (15) questions in all.

3 Marks assigned to each question/part are given against it.

4 Word limit in questions, wherever specified should be adhered to.

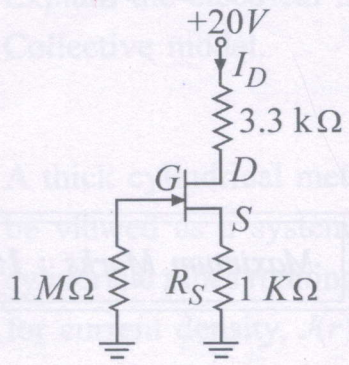
5 Attempts of questions shall be counted sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the answer booklet must be clearly struck off.

6 No extra/additional sheet will be provided.

7 Answer must be written in the authorized medium. No marks will be given for answers written in a medium other than the authorized one.

1 Derive an expression for the period of a compound pendulum. Hence deduce the period of a simple pendulum from it. **7+3=10**

2 Determine the operating point (V_{GSQ}, I_{DQ}), V_{DS}, V_s, V_G and V_D for the following FET circuit. **10**



3 Prove that fall in temperature of the gas during the adiabatic expansion from P_1 to P_2 at temperature T is given as $dT = \frac{T}{c_p}\left(\frac{\partial V}{\partial T}\right)_P dP = \frac{TV^{\alpha}}{c_p} dP$. **10**

4 Explain Legendre's transformations. Applying Legendre's transformations, obtain Hamilton's Canonical equations of motion. **4+6=10**

5 Establish Einstein's mass-energy relation and discuss some of its consequences. **4+6=10**

6 What is meant by mean free path ? Show that if molecular diameter is 'σ' and the molecular density is 'e' the mean free path of the molecules is given by $= \frac{1}{\pi p \sigma^2}$. **3+7=10**

7 Obtain Maxwell's electromagnetic equations in the integral form. **10**

8 Mention any 5 properties of stationary waves. Write the equation of the stationary wave formed after being superimposed with the wave $y = 15\sin\pi(0.20x - 0.8t)$. The constituent waves of a stationary wave have amplitude, frequency and velocity as 8 cm, 30 Hz and 180 cm/s respectively. Find out the equation of stationary wave. **5+2+3=10**

9 A Zener diode with V_Z = 5.0 V has R_Z = 20 Ohms and I_Z =10 mA. Calculate the upper and lower limits of V_Z, when I_Z changes from –2 mA to + 2 mA. **10**

10 Find the characteristic equation of the matrix $A = \begin{vmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{vmatrix}$ and verify that it is satisfied by A and hence obtain A^{-1}. **5+5=10**

11 Describe the behaviour of particle in a one dimensional infinite potential well in terms of Eigen values and function. For an electron confined to a one dimensional potential box of length $2A^{\circ}$, calculate the energies in 2^{nd} and 4^{th} quantum states (in eV). **5+5=10**

12 NaCl crystal has F.C.C. structure. The density of NaCl is 2.18 gm/cm^3. Calculate the distance between two adjacent atoms. **10**

13 There are 3×10^{27} free electrons per cubic meter of Sodium. Calculate the Fermi energy. **10**

14 Two masses m are connected by springs having equal spring constant, c so that the masses are free to slide on a frictionless table. The ends of the springs are attached with the fixed walls. Using Lagrangian equation, set up the differential equation of vibrating masses. **10**

15 Explain the working of a Bridge rectifier using p-n junction diodes and obtain the expression for ripple factor and efficiency. **5+5=10**

16 What is Paschen-Back effect ? Explain with energy level diagram **4+6=10**

17 Explain the electrical and magnetic properties of nucleus using Collective model. **5+5=10**

18 A thick cylindrical metal wire of radius, R carries a current, I which may be viewed as a system of large number of thin current carrying coaxial cylindrical pipes running parallel to the axis of cylinder. Obtain an expression for current density, $J(r)$ for $0 \le r \le R$, which produces a magnetic field of constant magnitude throughout the interior of the wire. Estimate the magnetic energy stored per unit length of this thick wire. **7+3=10**

SEAL