Bachelor of Civil Engineering 1st Year 1st Semester Supplementary Examination – 2017

Physics – IC   Time: Three hours   Full Marks: 100

Answer any *five* questions
All questions carry equal marks

1. (a) State and explain the 1st law of thermodynamics. Which thermodynamic function would you get from this law? [6]

(b) Distinguish between isothermal and adiabatic process. For an ideal gas show that PV^γ is constant for adiabatic process, where P and V are pressure and volume of the gas and $\gamma=C_p/C_v$ [8]

(c) One mole of an ideal gas changes its temperature from T_i to T_f adiabatically and quasistatically. Show that the work done by the gas is $\frac{R}{\gamma-1}[T_i - T_f]$. [6]

2. (a) Describe Carnot's reversible cycle. Show that the efficiency of the Carnot's engine working between a source and a sink at absolute temperature T_1 and T_2 respectively is $(1-T_2/T_1)$. [14]

(b) The temperature of the source of a heat engine is 300K and its efficiency is 40%. To increase 50% efficiency what will be the increase of the temperature of the source? [6]

3. (a) What is vector field? [2]

(b) Find $\nabla\varphi$ if (a) $\varphi = \ln \left|\vec{r}\right|$ [4]

(c) Show that the Coulomb field is conservative. [4]

(d) State Gauss's theorem in electrostatics. [2]

(e) Four point charges of +120, +60, +60 and +120 e.s.u., respectively are placed at the corners of a square of side 12 cm. If the surrounding medium is air, find the direction and magnitude of the field strength at the point of intersection of the diagonals. [4]

(f) Using Gauss's law in electrostatics, determine the electric field at a distance r from a straight infinitely long wire having a charge λ per unit length. [4]

4. (a) What is Ampere's circuital law. [2]

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(b) Calculate the magnetic field at a point on the axis of a circular current carrying conductor using Biot-Savart law. [7]

(c) State Faraday's law of induction and express it in differential form. [4]

(d) What do you understand by 'self' and 'mutual' inductances? [2]

(e) Calculate the inductance per unit length of a long solenoid. [5]

5. (a) What are the conditions for interference of light? [4]

(b) Describe interference of light using Young's double slit experiment and calculate the fringe width. [10]

(c) In a Newton's ring experiment, the diameter of 15th and 5th ring were found to be 0.590 cm and 0.336 cm respectively. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light? [6]

6. (a) What is Fraunhoffer diffraction due to single slit. Find the condition of diffraction minima. How the positions of diffraction maxima can be obtained? [10]

(b) State Brewster's law of polarization of light. [2]

(c) Explain the phenomenon of polarization of light. What do you understand by double refraction? [5]

(d) The critical angle of light in certain substance is 45^0. What is the polarizing angle? [3]

7. (a) Starting from the Bohr atomic model, obtain an expression for the electron energy levels in a hydrogen atom. [7]

(b) What are X-rays? Describe the origin of continuous and characteristic lines in X-ray spectrum. [7]

(c) Deduce the Bragg's Law. What are its applications? [6]

8. (a) What is Compton effect? Derive the expression of the change in the wavelength for X-rays during Compton scattering. [10]

(b) State Heisenberg uncertainty principle and discuss its significance. [4]

(c) Give an elementary deduction of uncertainty relation. [6]