BRAINWARE UNIVERSITY

Course – BTECH (CS)

Engineering Physics II (PH201)

(Semester – 2)

Time allotted: 3 Hours   **Full Marks: 70**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group –A

(Multiple Choice Type Question)   10 x 1 = 10

1. *Choose the correct alternative from the following*
(i)   The number of pins of the IC741 OP-AMP is

    a. 10   b. 12

    c. 8   d. 16

(ii) The emissive power of a black body is proportional to (T is the temperature in K)

    a. T^4 b. T^3

    c. T^{-1} d. T^5

(iii) An ideal OP AMP has
    a. infinite input impedance   b. zero output impedance
    c. infinite voltage gain   d. all of the above

(iv) Photons obey
    a. MB Statistics   b. BE Statistics
    c. FD Statistics   d. None of these

(v)   Two wave functions $\psi_m(x)$ and $\psi_n(x)$ are orthogonal to each other. Which of the following relation must hold for them?
    a. $\psi_m^*(x)\psi_n(x) = 0$ b. $\psi_m^*(x)\psi_n(x) = 1$

    c. $\int_{-\infty}^{+\infty} \psi_m^*(x)\psi_n(x)dx = 1$ d. $\int_{-\infty}^{+\infty} \psi_m^*(x)\psi_n(x)dx = 0$

(vi)   If the refractive indices of core and cladding of an optical fiber are n_1 and n_2 respectively. Then

      a. $n_1 \rangle n_2$ b. $n_1 \langle n_2$

      c. $n_1 = n_2$ d.   None of these

(vii) FET is advantageous over BJT since it is

      a.   thermally more stable   b.   it use one p-n junction

      c.   it is a voltage controlled device   d.   none of these

(viii) Which of the following devices is expected to have the highest input impedance

      a.   MOSFET   b.   FET

      c.   BJT   d.   OPAMP

(ix)   In He-Ne laser, neon atoms get energy

      e.   on collision with He atoms   f.   from chemical reactions

      g.   from optical pumping   h.   from electrical pumping

(x)   The common mode rejection ratio of an OP AMP is

      a.   much smaller than unity   b.   much larger than unity

      c.   unity   d.   none of these

Group – B

(Short Answer Type Questions)   3 x 5 = 15

Answer any *three* from the following

2.   What do you mean by Lissajous figure? Calculate the displacement to amplitude ratio for SHM when the kinetic energy is 90% of total energy.

                         [2+3]

3.   Why is the field-effect transistor called unipolar device? What is the significance of the term field-effect? Define the pinch-off voltage   [1+2+2]

4.   Write down i) MB distribution ii) BE distribution iii) FD distribution formula. State also the assumptions involved in each case. State also the meaning of each notation used.   [5]

5.   Define slew rate. The output voltage of operational amplifier changes by 10V within 5 μs. Calculate the slew rate.   [2+3]

6.   Write short note on Ruby Laser.   [5]

Group – C

(Long Answer Type Questions)   3 x 15 = 45

Answer any *three* from the following

7. (a) Define CMRR. Derive an expression of CMRR.   [1+2]
    (b) Describe the use of an operation amplifier as an adder. What type of feedback is used in an OPAMP adder?   [4+1]
    (c) Develop the theory of the action of OPAMP as an integrator.
                                                                    [5]
    (d) In an Integrator circuit, the value of RC is 1 Sec, find out the output voltage at t=3Sec when input voltage in 2 V. Notations carry the usual meanings.   [2]

8. (a) Describe briefly the inadequacy of classical mechanics.   [3]
    (b) Prove that $\left[\hat{x}, \hat{p}_x \right] = i\hbar$
                                                                    [5]
    (c) A system has two energy states ε_0 and $3\varepsilon_0$. ψ_1 and ψ_2 are the corresponding normalized wave functions. At an instant, the system is in a superposed state $\psi = C_1 \psi_1 + C_2 \psi_2$ and $C_1 = \dfrac{1}{\sqrt{2}}$

        i)   Find the value of C_2 if ψ is normalized.
        ii) Find out the expectation value of energy.   [3+4]

9. (a) Compare the performance of n-channel and p-channel MOSFETs   [5]
    (b) An amplifier has a voltage gain of -100. The feedback ratio of -0.04. Find (i) the voltage gain with feedback (ii) the output voltage of the feedback amplifier for an input voltage of 40 mV (iii) the feedback factor (iv) the feedback voltage.   [5]
    (c) Mention the advantage and disadvantage of negative feedback amplifier.   [5]

10. (a) Derive the relation between Einstein's A and B coefficients associated with LASER.   [7]
    (b) Write down the fundamental postulates of quantum mechanics.   [5]
    (c) Obtain Wien's law of radiation from Planck's law of radiation.   [3]

11. (a) Explain the behaviour of Fermi distribution formula at T = 0 K and T > 0 K. Present the behaviour graphically. Hence define Fermi energy level.   [3+3+2+2]
    (b) Calculate the Fermi temperature and Fermi velocity for Sodium whose Fermi level is 1.6 eV.
        (Given Boltzmann constant =1.38 X 10^{-23} JK^{-1} ; mass of electron = 9.1 X 10^{-31} Kg)   [5]