U.G. 3rd Semester Examination - 2022

PHYSICS

[PROGRAMME]

Course Code : PHY-G-CC-T-03

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer all the questions from Selected Option.

OPTION–A

PHY-G-CC-T-03

(Elements of Modern Physics)

GROUP–A

1. Answer any **five** questions: $2\times5=10$

   a) Write the full form of LASER.

   b) Write the position momentum uncertainty principle.

   c) Define half life of a radioactive nucleotide.

   d) Can pair production take place in vacuum ? Explain your answer.

   e) What are the differences between nuclear fission and fusion?

f) What is the relation between phase velocity and group velocity?

g) What is the frequency of a photon having energy 200 eV ?

h) What is the physical significance of wave function?

GROUP-B

2. Answer any **two** questions from the following: 5×2=10

a) Define the binding energy of a nucleus. How does the binding energy per nucleon vary with the mass number? Give examples of isotope and isotone. 2+2+1

b) What is the stopping potential in photoelectric effect? Is stopping potential dependent on frequency of incident electrons? The maximum kinetic energy of photoelectron is 1.3eV when ultraviolet light of wavelength 350 nm is directed at a potassium surface. Find the work function of potassium. 2+1+2

c) What is the Compton effect? Show that energy of the recoil electron in compton effect is always less than the energy of the incident X-ray photon. What will be the value of Compton shift if visible light is used ? 1+2+2

d) What is the de Broglie hypothesis ? Calculate the de Broglie wavelength of an electron moving with a speed of 105 m/s and also that of an electron moving with a speed of 0.99×10^8 m/s. Be careful in your choice of formulae in the second case as it is relativistic.

2+3

GROUP-C

3. Answer any **two** questions from the following: 10×2=20

a) What is population inversion ? What is optical pumping? Explain optical pumping with a suitable example. What do you mean by Einstein's A and B coefficients? Establish relation between the coefficients.

2+2+2+2+2

b) Write Weizsacker's mass formula and explain each term involved. Show from the semi empirical mass formula that $A \simeq 2Z$ for light nuclei. Define packing fraction and explain the utility of packing fraction curve. A nucleus with A = 235 splits into two nuclei whose mass no.s are in the ratio 2:1 . Find the radii of the new nuclei. (R_0 = 1.4 *fm*). 2+2+2+2+2

c) i) A particle is confined to move in one dimensional box with perfectly rigid walls at x = 0 and at x = a. Find the normalized wave functions and energy eigenvalues.

ii) An electron is trapped in a one dimensional region of length 1.0×10^{-10}m. How much energy must be supplied to excite the electron from ground state to first excited state.

iii) Show that eigenvalues of a Hermitian operator are real. 5+3+2

d) i) Find the eigenfunctions and eigenvalues for the operator $x+\frac{d}{dx}$.

ii) Normalize $\Psi_1(x)=A_1e^{-\alpha x^2}$ and $\Psi_1(x)=A_2xe^{-\alpha x^2}$ over the interval $-\infty\le x\le\infty$. 5+(2+3)

OPTION–B

PHY-G-CC-T-03

(Analog Systems & Applications)

GROUP–A

1. Answer any **five** questions: $2\times5=10$

a) What do you mean by mobility of charge carriers? Write down its unit.

b) Draw the energy band diagrams of a metal, conductor and semiconductor.

c) Define r_{ac} and r_{dc} of a diode.

d) With the help of a schematic diagram, show the active region, cut off region and saturation region of a transistor.

e) Derive relation between α and β of a transistor.

f) With the help of a neat diagram show the frequency response of an R–C coupled amplifier. What do you mean by bandwidth?

g) State and explain Barkhausen criterion of oscillation.

h) Explain the term virtual ground of an OP–AMP.

GROUP-B

2. Answer any **two** questions: 5×2=10

a) With the help of a neat diagram explain the working principle of a centre-tapped full wave rectifier. Write down its two disadvantages. 3+2=5

b) What do you mean by the hybrid parameters of a transistor? Why are they called so? Write down the units of the hybrid parameters of a transistor. Draw the simplified hybrid model of a CE amplifier. 1+1+1+2=5

c) Explain the terms load line and Q point of a transistor? Define class A and Class B amplifiers. $1\frac{1}{2}+1\frac{1}{2}+2=5$

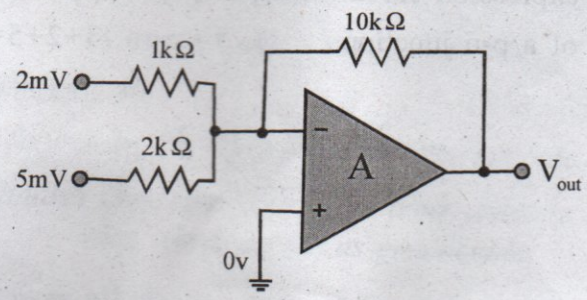
d) Write down the full form of LED. Draw the V-I curve of a forward biased LED. Write down two advantages of LED. What is a solar cell? 1+1+2+1=5

GROUP-C

3. Answer any **two** questions: 10×2=20

a) What do you mean by inverting and non inverting OP-AMP? Derive the expression for current gain in an inverting OP-AMP. Explain

briefly the working principle of an OP-AMP as adder. For the circuit given below determine the value of V_{out} 2+3+3+2=10



b) What do you mean by feedback, positive feedback and negative feedback in the case of an amplifier? Explain briefly how noise affects the feedback process of an amplifier. Write a short note on the A/D converter. 3+2+5=10

c) Draw energy band diagrams of a p-type and n-type semiconductor. Using the circuit diagram of a forward and reverse biased p-n junction diode, explain its I-V characteristics. What do you mean by the terms zener breakdown and avalanche breakdown? Explain the working principle of a zener diode as voltage regulator. 2+3+2+3=10

d) Establish the relation j=neV; where the symbols have their usual meaning. Draw the schematic diagram of an unbiased, forward biased and a reverse biased p-n junction. Derive the expression for the height of potential barrier of a p-n junction. 3+2+5=10
