

U.G. 5th Semester Examination - 2023

PHYSICS

[PROGRAMME]

Skill Enhancement Course (SEC)

Course Code : PHYS(G)SEC-T-03(A), (B), (C), (D), (E) & (F)

Full Marks : 40

Time : 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-SEC-T-03

(Radiation Safety)

GROUP-A

1. Answer any **five** of the following questions:

2×5=10

- a) Do isotopes of an element have the same physical properties?
- b) Determine the mass of a single Aluminium ($^{27}_{13}\text{Al}$) atom.
- c) Give two examples of man-made sources of radiations.
- d) What are Auger electrons?
- e) What happens to the atomic nucleus $^{14}_6\text{C}$ when it undergoes successively β and γ decay?
- f) What is nuclear fission?
- g) What is KERMA?
- h) What is Cherenkov radiation?

[Turn over]

GROUP-B

2. Answer any **two** of the following questions:

5×2=10

a) i) Consider that both ${}^8_{14}\text{O}$ and ${}^8_{19}\text{O}$ undergo β -decay. Which would you expect to emit a positron and which an electron? Give an explanation.

ii) The atomic masses of ${}^1_3\text{H}$, ${}^2_3\text{He}$ and ${}^4_2\text{He}$ are respectively 3.016050, 3.016029 and 4.002603 amu. How much energy is needed to remove one neutron from the nucleus of ${}^4_2\text{He}$? What will be the corresponding energy to remove one proton? Are the energies same? Give a reason to support your answer. 2+3=5

b) i) State the factors on which maximum energy of a photoelectron depends.

ii) The maximum wavelength for photoelectric emission in tungsten is 230 nm. What wavelength of light must be used in order for electrons of maximum energy of 1.5 eV to be ejected? 2+3=5

c) i) What is bremsstrahlung?

ii) Explain the incidents fluorescence and thermoluminescence. 2+3=5

d) i) Describe the mechanism through which nuclear radiation affects the living cells.

ii) What do you mean by absorbed dose, equivalent dose and effective dose?

3+2=5

GROUP-C

3. Answer any two of the following questions: $10 \times 2 = 20$

- a) i) What is Compton Effect?
ii) Define activity, decay constant, half life and mean life of a radionuclide. Find the relation between decay constant and half life.

iii) The activity of a radionuclide decreases to 20% of its original value in 15 days. Find its half life. How long will it take for 80% of the original sample to decay? $2 + (2+3) + 3 = 10$

- b) i) What is meant by the stopping power of a medium? Write down the Bethe-Bloch formula for stopping power explaining each term.

ii) What do you mean by the range of a charged particle?

iii) Describe two major applications of nuclear techniques in each of the following purposes:

A) medical sciences,

B) industry. $(2+2) + 2 + (2+2) = 10$

- c) i) What do you mean by the radiation hazard?

What is meant by the internal and external radiation hazard? Describe three methods by which external radiation hazard is controlled.

ii) What is meant by Annual Limit of Intake (ALI) and Derived Air Concentration (DAC)? $(2+2+3) + 3 = 10$

- d) i) Which class of solid state radiation detector is suitable for measuring a person's accumulated radiation dose? How does the detector function?

ii) Describe the operation of a Geiger-Muller counter. $(1+4) + 5 = 10$

OPTION-B
PHY-G-SEC-T-03
(Workshop Skills)

GROUP-A

1. Answer any **five** questions: $2 \times 5 = 10$
- a) Write the requirements of good pattern materials.
 - b) What are the functions of coating on electrode?
 - c) What are the differences between alloy and composites?
 - d) Define Least Count of a Screw Guage. What do you mean by Screw Pitch?
 - e) Find the mechanical advantage of a Class 3 lever.
 - f) Define joule. How it is related to erg?
 - g) What is the mechanical advantage of a pulley to lift a mass of 15 kg using pulley?
 - h) Write down the advantages of wood as pattern material.

GROUP-B

2. Answer any **two** questions: $5 \times 2 = 10$
- a) Write short notes on Continuous Casting and Resistance welding. What do you understand by metal forming? $2 + 2 + 1$
 - b) What do you mean by breakdown in a diode? Distinguish between Avalanche and Zener Breakdown. Write down one application of Zener diode. $1 + 3 + 1 = 5$
 - c) Explain the process of making a funnel using a metal sheet, including the layout, cutting, and bending procedures. 5
 - d) What is Sextant? The angle of elevation of a building from two successive points A and B are 60 degree 30 degree respectively. If $AB = 15$ m; determine the height of the building. $1 + 4 = 5$

GROUP-C

3. Answer any two questions: $10 \times 2 = 20$
- a) i) Define lissajous figures. What is CRO? With the help of suitable diagram explain CRT and the deflection mechanism of CRO. $(1+1+2+2)+4=10$
- ii) Find out an expression of electrostatic deflection sensitivity of cathode ray tube.
- b) i) A see-saw is, 10 m long with a fulcrum in the middle of the board. If a 30 kg child sits, 3m from the fulcrum, what is the lowest weight that will lift the child?
- ii) Explain the construction of a Screw Guage with proper diagram. Explain briefly how the volume of a cylinder can be determined using vernier calipers.
- iii) Write down some applications of laser beam welding. $3+3+2+2=10$
- c) i) What are the hazards involved in soldering of electrical circuit?
- ii) Using suitable circuit diagram explain the switching operation of a transistor.
- iii) Name the different types of breaking systems. $2+4+4=10$
- d) i) Explain briely the working principle of hydel power station.
- ii) Write down the common properties and application of Cutting Fluid.
- iii) Write down two advantages of pulley. $4+(2+2)+2=10$

OPTION-C

PHY-G-SEC-T-03

(Electrical Circuits and Network Skills)

GROUP-A

1. Answer any **five** questions: $2 \times 5 = 10$
- a) Calculate the *r.m.s.* value of the current given by $i = I_0 + I_1 \cos(\omega t + \theta)$.
 - b) What is average current and *r.m.s.* current in an ac circuit?
 - c) What are short and open circuits?
 - d) Write the expression of efficiency of a transformer.
 - e) If a shunt of 1Ω is connected to a galvanometer of resistance 99Ω , what fraction of the main current will flow through the galvanometer?
 - f) Show that in case of AC, the potential drop across an inductor leads the current by 90° .
 - g) What are the losses in D.C. generator?
 - h) Explain the effect of temperature on resistance.

GROUP-B

2. Answer any **two** questions: $5 \times 2 = 10$
- a)
 - i) What are two phase and three phase ac generators?
 - ii) Show that the quantity 'CR' (product of capacitor and resistor) has the dimension of time. $3+2$
 - b) A 100 volt 60 watt lamp is to be operated on 220 volt 50 Hz main A.C supply. What is (i) pure resistance, (ii) pure inductance placed in series

with the lamp will enable it to be correctly used?

$$2\frac{1}{2} + 2\frac{1}{2}$$

c) What will happen when DC voltage applied to a series LR circuit? Explain the general principle of a dc generator. 3+2

d) An alternating voltage of 250 V, 50 Hz is applied to a coil which takes 5 A of current. The power absorbed by the circuit is 1 kW. Calculate the resistance and inductance of the coil. 5

GROUP-C

3. Answer any **two** questions: $10 \times 2 = 20$

- a) i) The total current drawn by a circuit consisting of three resistors connected in parallel is 12 A. The voltage drop across the first resistor is 12 V, the value of second resistor is 3Ω and the power dissipation of the third resistor is 24 W. What are the resistances of the first and third resistor? What are the characteristics of a circuit containing resistances connected in series and in parallel? 4+2
- ii) Find the values of different voltages that can be obtained from a 12 V battery with the help of voltage divider circuit having three resistances 4Ω , 3Ω and 1Ω . 4

b) i) ρ_1 and ρ_2 are the resistivities of the materials of two wires of the same dimensions. What will be the equivalent resistivity of the series combination of the two wires?

ii) A metallic wire is stretched to increase its length by 20%. What will be the percentage change of its resistance?

iii) If a shunt of 1Ω is connected to a galvanometer of resistance 99Ω , what fraction of the main current will flow through the galvanometer? 4+4+2

c) i) Draw a full wave rectifier circuit.

ii) Explain the operation of the circuit and Plot output waveforms.

iii) Find the efficiency of this circuit.

1+2+2+5

d) What is the basic multimeter used to measure?

What are the two types of multimeters? What

are the parts of a multimeter? How can one

measure an unknown resistance, voltage and test

a continuity by a multimeter? 1+2+2+5

OPTION-D
PHY-G-SEC-T-03
(Basic Instrumentation Skills)
GROUP-A

1. Answer any five from the following questions: 2×5=10

- a) Write down the S.I unit of capacitance and magnetic field.
- b) Mention the different types of digital multimeter.
- c) Define loading effect.
- d) Write down the full forms of DAC and ADC.
- e) What is the significance of signal generator?
- f) Write down the advantages of digital instruments over analog instruments.
- g) Mention the basic differences of a pulse generator and a function generator.
- h) How do you confirm the continuity of a circuit by using conventional multimeter?

GROUP-B

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

- a) With suitable diagram describe the working principle of a frequency counter. 5
- b) How is the electron beam deflected horizontally and vertically in a CRT? Why fluorescent screen is used in a CRO? 3+2
- c) Discuss on instrumental accuracy and sensitivity of a measuring instrument. 5

- d) Write down the steps for measuring AC voltage and AC current by using digital multimeter. 5

GROUP-C

3. Answer any two from the following questions:

10×2=20

- a) Write down the working principle of a DVM with a suitable block diagram. Write down the advantages of using EVM over conventional multimeter for measuring voltage. Write down the significance of Max hold button in a digital multimeter. 5+3+2

- b) Write short notes on:

i) CRO and

ii) AC millivoltmeter 5+5

- c) What do you mean by deflection sensitivity and derive an expression for electrostatic deflection sensitivity of CRT? Mention the comparisons between magnetic and electrostatic deflection of a CRT. 2+5+3

- d) Discuss how the capacitance of a large capacitor is measured by Q-meter? Draw circuit diagram of a basic Q-meter and write down the basic principle of its operation. A sine wave is displayed on a CRO screen with the calibrated time base set at 0.5 ms/div. One cycle of displayed waveform spreads over 8 divisions along the horizontal axis. Find the frequency of the waveform. 5+(2+1)+2

OPTION-E
PHY-G-SEC-T-03
(Renewable Energy and Energy Harvesting)

GROUP-A

1. Answer any five questions: 2×5=10
- a) What are the limitations of using Fossil Fuel?
 - b) How can renewable energy benefit the environment?
 - c) What is ocean biomass?
 - d) What is the working principle of sun tracking systems?
 - e) What is the source of thermal energy in Ocean?
 - f) What is piezoelectric effect?
 - g) Which type of turbine is commonly used in tidal energy?
 - h) What are the basic characteristics of an ideal photovoltaic cell?

GROUP-B

2. Answer any two questions: 5×2=10
- a) What is Offshore Wind Energy? What are the basic components of Wind Energy Conversion System? What are the limitations of Wind Energy? 2+2+1
 - b) How does Biomass conversion take place? How thermo-chemical conversion helps to convert the biomass energy? 2+3
 - c) How does greenhouse gas helps to flourish lives on earth? State basic working principle of solar green house. 2+3

- d) What is non-convective solar pond? How a solar pond is used to store solar energy? 2+3

GROUP-C

3. Answer any two questions: 10×2=20

- a) What is solar cell? What are the components of a photo-voltaic cell? Draw the schematic diagram of a PV-cell. Write the basic principle of a photovoltaic cell. Draw equivalent circuit of photovoltaic circuit. 2+2+2+2+2
- b) What is small Hydel Development? Draw a schematic diagram of hydroelectric power station. What are the common components of hydroelectric scheme? What is the impact of hydroelectric power station on the environment? 2+2+3+3
- c) What is the source of Ocean Energy? How does the tidal energy used as alternative energy source? Draw a schematic diagram of Ocean Thermal Electric Conversion System. If A is the Basin surface area, σ is the water density of the sea and R is the tidal range, calculate the average tidal power. 2+3+3+2
- d) What are the basic advantages of Carbon capture technologies? Briefly discuss the principle of carbon capture methods. Write a short note on Environment and sustainability. 3+3+4

OPTION-F

PHY-G-SEC-T-03

(Applied Optics)

GROUP-A

1. Answer any **five** questions: $2 \times 5 = 10$
- a) What do you mean by graded and step index optical fibre?
 - b) Differentiate between transmission and reflection type holograms.
 - c) Explain briefly how haplography can be used in microscopy.
 - d) What is splice loss in optical fibre?
 - e) Explain the terms Spontaneous and Stimulated emissions.
 - f) What do you mean by optical pumping and population inversion?
 - g) What do you mean by spatial frequency filtering?
 - h) Give one example for each of the following:
solid-state laser and Gas laser.

GROUP-B

2. Answer any **two** questions: $5 \times 2 = 10$
- a) "FTS is a powerful method for measuring emission and absorption spectra"– explain. 5

- b) Write down the full form of LDR. Draw the I-V characteristics of a LED. What are common uses of LED? $1+2+2=5$
- c) What are the major advantages and disadvantages of optical fibre? 5
- d) With the help of a suitable diagram explain briefly the action of a Gas laser. 5

GROUP-C

3. Answer any two questions: $10 \times 2 = 20$
- a) Explain briefly the basic principle of holography. Write down the names of different types of holograms. With the help of suitable circuit diagram explain briefly how V-I characteristics curves of a LDR can be obtained using a laser. $3+2+5=10$
- b) Discuss the concept of spatial frequency filtering. Show that a thin lens can be used as a Fourier Transformer. Write a short note on Fibre Bragg Grating. $2+3+5=10$
- c) What are Einstein's A and B coefficients? With the help of a suitable diagram explain how population inversion is achieved in a two level laser system. Establish the relations between A and B coefficients. $2+3+5=10$

- d) With the help of suitable diagrams derive the expressions for acceptance angle and numerical aperture of an optical fibre. Find the numerical aperture of a step index fibre when the refractive index of the core is 1.52 and that of the material used for cladding is 1.48. 6+4=10