## U.G. 6th Semester Examination - 2022

# PHYSICS

**[PROGRAMME]**

**Skill Enhancement Course (SEC)**

**Course Code : PHY-G-SEC-T-04(A-I)**

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-04**

**(Physics Workshop Skill)**

**GROUP–A**

1. Answer any **five** questions: 2×5=10

   a) Find out the Vernier constant of a slide caliper having 100 Vernier divisions in Vernier scale. One main scale division is 0.05 cm.

   b) Define Force? Convert SI unit of force to CGS unit.

   c) What is metal casting?



   d) What are the uses of a Digital Multimeter?

   e) Find the mechanical advantage of a Class 2 lever.

   f) Define Horsepower? How it is related to watt?

   g) What is the mechanical advantage of a pulley to lift a mass of 15kg using pulley?

**GROUP-B**

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

   a) Distinguish between Avalanche and Zener Breakdown. Explain the I-V characteristics of a Zener diode. $1\frac{1}{2}+1\frac{1}{2}+2$

   b) What do you understand by metal forming? Briefly discuss different types of metal forming. 1+4

   c) Explain the construction and working of a regulated power supply. 5

   d) What is Sextant? What is its principle? Explain the theory to measure the height of a building using sextant. 1+1+3

## GROUP-C

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

a) i) What is CRO? Draw the block diagram of a CRO with its different components.

ii) Explain the function of sweep generator.

iii) Find out an expression of electrostatic deflection sensitivity of cathode ray tube. 1+2+2+5

b) i) A see saw is 30 ft long with a fulcrum in the middle of the board. If a 60 pound child sits 5 ft. from the fulcrum, what is the lowest weight that will lift the child?

ii) Explain the construction of a Slide Calliper with proper diagram. How will you measure the volume of a cylindrical beaker using slide calliper?

iii) Write down some application of laser beam welding. 3+3+2+2

c) i) Explain the operation of a transistor as a switch with proper circuit diagram.

ii) Write short notes on continuous casting.

iii) Name the different types of breaking systems. 4+4+2

d) i) What are Cutting Fluids?



ii) What are the Common Properties of Cutting Fluid.

iii) Briefly describe different types of cutting fluid'

iv) Write some applications of Cutting Fluid. 2+3+3+2

## OPTION-B

## PHY-G-SEC-T-04

## (Electrical Circuits and Network Skills)

## GROUP–A

1. Answer any **five** questions: 2×5=10

a) What is unit of potential difference in S.I unit? Establish a relation of potential difference between S.I and C.G.S unit.

b) Equal number of identical cells are joined in series and then in parallel in a circuit with resistance R to send a current through it. Under what condition, the current in both the cases will the same?

c) Show that in case of AC, the potential drop across a capacitor lags the current by $90^{o}$.

d) What is average or mean value of alternating current? Show that the mean value of alternating current is $\frac{2I_0}{\pi}$. Where symbols are their usual meaning.

e) What do you mean by the term ' Impedance', 'Reactance' and 'Power factor' of an AC circuit?



f) Calculate the *r.m.s* value of,the current given by $i = I_0 + I_1 \cos(\omega t + \theta)$.

g) What is electric circuit and electric network?

h) Write Kirchhoff's current and voltage law.

## GROUP-B

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

a) i) A dc emf 'E' is suddenly applied to a circuit consisting of a resistor R an inductor L in series. Write the emf equation for the circuit and hence find the current at any instant.

ii) Calculate the time constant of the circuit. 3+2

b) i) What is 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

c) Show that the power of an AC circuit is $I_{rms} \times V_{rms} \times \text{Cos}\theta$. Where $\text{Cos}\theta$ is power factor. 5

d) i) Name a substance whose resistance decreases with the increase in temperature.

ii) Two conduction wires of lengths $l$ and $2l$ have the same cross sectional area. Compare their resistances.

iii) When a shunt of $1\Omega$ is connected in parallel with a galvanometer, l% of the main current flows through the galvanometer. Determine the resistance of the galvanometer. l+2+2

## GROUP-C

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

a) i) What is a transformer?

ii) In an ideal transformer, show that the ratio of output voltage to the input voltage is equal to the ratio of the number of secondary turns to the primary turns.

iii) Write the expression of efficiency of a transformer. 2+6+2

b) i) $\rho_1$ and $\rho_2$ 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 $1\Omega$ is connected to a galvanometer of resistance $99\Omega$, what fraction of the main current will flow through the galvanometer? 4+4+2

c) i) An ac source of frequency 50Hz is applied to series LR circuit with L=10mH and $R = 2\Omega$. Calculate the power factor. What capacitance placed in the circuit will make the power factor unity?

ii) ln an ac circuit the complex impedance is Z=l+2j and complex voltage is –4+7j V. Find the complex current in the circuit.

iii) A step-up ideal transformer has primary to secondary turns ratio as 2:25. If the primary voltage is 220V and the transformers supplies 1A current to an external load, find the output power. 4+2+4

d) 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. l+2+2+5

## OPTION-C

### PHY-G-SEC-T-04

### (Computational Physics Skills)

1. Answer any **five** questions: 2×5=10

   a) What do you mean by "algorithm" related to computer programming?

   b) Write down some uses of Linux editors? Give two examples of Linux editors.

   c) What are the three types of variables used in a FORTRAN program?

   d) What is the difference between the executable and the nonexecutable statements?

   e) How does a two dimensional array is declared in FORTRAN?

   f) Write down the latex script to write the equation:

$$\frac{d^2y}{dt^2}+\omega^2 y=0$$

   g) What is the use of "CALL" statement in a FORTRAN program?

   h) Give two examples of logical operators used in FORTRAN.



2. Answer any **two** questions (symbols have their usual meanings): 5×2=10

   a) Write down the flowchart to find the roots of any given quadratic equation. 5

   b) Write down the algorithm to find out the factorial of any given number. 5

   c) Write down a FORTRAN programme to find out the maximum height reached by a projectile when it is thrown vertically. Initial velocity will be given as an input. 5

   d) Write down the latex script to print the following table: 5

**Table 1 : X versus Y**

| Sl No. | X | Y |
|---|---|---|
| 1 | 2.5 | 15.2 |
| 2 | 3.9 | 19.5 |
| 3 | 5.6 | 27.5 |

3. Answer any **two** questions (symbols have their usual meanings): 10×2=20

   a) Write down a FORTRAN program to multiply two arbitrary matrices.

      i) The order of the two matrices will be given as inputs.

ii) It will check whether those matrices are multipliable or not.

iii) The elements of the two matrices will be given as inputs. 10

b) Write a FORTRAN program to find the trajectory of a projectile.

i) Initial velocity and the angle of projection will be supplied as inputs.

ii) It will print the x and y coordinates as a function of time in a file.

iii) Write a GNUPLOT script to plot the *x* versus *y* data from the file. 10

c) Write a FORTRAN program to calculate sin(x) as a series; use a subroutine to evaluate the factorial. 10

d) Write down the latex script to print the following text:

i) Introduction to electrodynamics:

ii) The well-known Maxwell's equations[1] are:

$$\vec{\nabla}.\vec{E}=\frac{\rho}{\epsilon_0}$$

$$\vec{\nabla}.\vec{B}=0$$

$$\vec{\nabla}\times\vec{E}=\frac{\partial\vec{B}}{\partial t}$$

$$\vec{\nabla}\times\vec{B}=\mu_0\vec{J}+\mu_0\epsilon_0\frac{\partial\vec{E}}{\partial t}$$

10



## OPTION-D

## PHY-G-SEC-T-04

## (Radiation Safety)

## GROUP–A

1. Answer any **five** questions: 2×5=10

a) If the nuclear radius of $^{12}_{6}C$ nucleus is $2.7\times10^{-15}$m then find the density of the nucleus.

b) What are Auger electrons?

c) Why the minimum wavelength $(\lambda_{min})$ of the X-rays produced at a particular accelerating potential, is the same for two targets of different material?

d) What is pair production?

e) What is KERMA?

f) Define Annual Limit of Intake (ALI)?

g) What is meant by Derived Air Concentration (DAC)?

h) What is Cherenkov radiation?

## GROUP-B

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

a) i) Ordinary chlorine is a mixture of $^{35}_{17}Cl$ and $^{37}_{17}Cl$ isotopes and has atomic

mass of 35.46 amu. What percentage of each isotope is present in ordinary chlorine?

ii) What is bremsstrahlung? 3+2

b) What happens to the atomic number and mass number of a nucleus when it

i) emits an alpha particle

ii) emits an electron

iii) emits a positron

iv) captures an electron

v) emits $\gamma$ radiation 5

c) i) What are the chief sources of radiation?

ii) What is meant by exposure, absorbed dose and equivalent dose? 2+3

d) i) The binding energies of ($^{56}_{26}$Fe and $^{64}_{30}$Zn nuclei are 493 and 559 MeV respectively. Explain which one is more stable nuclide.

ii) The masses of hydrogen atom $\left(^{1}_{1}\text{H}\right)$ and neutron are 1.007825 and 1.008665 amu respectively. If the atomic mass of the neon isotope $\left(^{20}_{10}\text{Ne}\right)$ is 19.992 amu then



find binding energy per nucleon of the neon isotope 2+3

## GROUP-C

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

a) i) What is Compton effect? Find the expression of change in wavelength of a photon in Compton scattering.

ii) Define energy straggling and range straggling.

iii) The maximum wavelength for photoelectric emission in copper is 278 nm. Find the maximum energy of the photoelectrons when the surface of copper is illuminated with light of frequency $1.5\times10^{15}$ Hz. (1+4)+2+3

b) i) Define decay constant and half life of a radionuclide. Find the relation between them

ii) If the half life of radon for alpha decay is 3.82 days then how long does it take for 60 percent of a sample of radon to decay?

iii) In nuclear fission or fusion large amount of energy is released – what is the source of this energy? (1+3)+3+3

c) i) Why is the radiation safety important? How can we protect ourselves from the radiation hazards?

ii) What is Accelerator driven Sub-critical system (ADS)? How is it used for waste management? (3+3)+(2+2)

d) i) What is the basic working principle of radiation detectors? Describe the operation of a Geiger-Muller Counter.

ii) Describe some major applications of nuclear techniques in medical sciences. (2+4)+4



**OPTION-E**

**PHY-G-SEC-T-04**

**(Technical Drawing)**

1. Answer any **five** questions: 2×5=10

a) What is a plain scale?

b) What is a least count?

c) Draw a diagonal scale of 1 cm :2.5km and mark on the scale a length of 26.7km.

d) The major and minor axes of an ellipse are 80 mm and 50mm respectively. Construct the curve.

e) Draw a parabola whose focus is at a distance of 50 mm from the directrix. Draw a tangent and normal at any point on it.

f) A vertex of a hyperbola is 50mm from its focus. Draw two parts of the hyperbola; if the eccentricity is 3/2.

g) Draw the projections of a point A Which is at 40mm above HP and 25 mm in front of,V.P.

h) What is a conic section?

2. Answer any **five** questions 3×5=15

a) A fixed point is 75 mm from a fixed straight line. Draw the locus of a point p moving such

a way that its distance from the fixed straight line is (i) twice its distance from the fixed point; (ii) equal to its distance from the fixed point. Name the curves?

b) The major axis of an ellipse is 100 mm long and the foci are at a distance of 15 mm from its ends. Find the minor axis. Prepare a trammel and draw the ellipse using the same.

c) Draw a triangle having sides 8 cm, 9 cm and 10 cm long respectively and measure its angles with the aid of a scale of chords.

d) Define orthographic projection. Describe briefly the method of obtaining an orthographic projection of an object.

e) Explain clearly the difference between the first-angle projection method and the third-angle projection method.

f) Draw the isometric view of a cone 40mm diameter and axis 55mm long when its axis is horizontal. Draw to isometric scale.

g) The foci of an ellipse are 90 mm apart and the major axis is 120 mm long. Draw ellipse by using four centre methods.



3. Answer any **three** questions: 5×3=15

a) The foci of an ellipse are 100 mm apart and the minor axis is 70 mm long. Determine the length of the minor axis and half the ellipse by concentric circles methods and the other half by oblong method. Draw a curve parallel to the ellipse and 25 mm away from it.2+2+1

b) Construct a conic when the distance between its focus and its directrix is equal to 60 mm and its eccentricity is one. Name the curve. Draw a tangent at any point on the curve. What is generating circle? 1+2+2

c) Write down the advantages of CAD. Name two systems of projection. 3+2

d) Draw a venier scale of meters when 1mm represents 25cm and mark on it a length of 24.4cm and 23.1mm. What is the RF? Define vertical trace of a line. 3+2

e) A line of length 70 mm is parallel and 20 mm in front of VP. it is also inclined at $45^{o}$ to HP and one end is on it. Draw its projections. Sketch the symbols of Projection. 3+2

## OPTION-F

### PHY-G-SEC-T-04

### (Weather Forecasting)

1. Answer any **five** questions: 2×5=10

   a) What is Acid rain?

   b) Define Aura.

   c) What do you mean by weather map?

   d) What is Global warming potential?

   e) Explain Mie Scattering?

   f) What is Easterly Jet Stream?

   g) What is the theoretical value of Adiabatic Lapse Rate?

   h) Explain Aerosols.

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

   a) Describe the historical background of weather forecasting.

   b) Briefly discuss about Hadley and Ferrel cells, Highlight their importance in the global wind circulation pattern.



   c) Give a tabular description of surface weather parameters with their corresponding measuring instruments.

   d) Describe the structure of the atmosphere based on temperature and composition profiles through a comprehensive schematic diagram.

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

   a) Describe different types of weather forecasting methods with example.

   b) Discuss the set criteria for cyclogenesis in northern hemisphere.

   c) What are the different types of climate? Explain the causes of climate change.

   d) Give a schematic diagram of the cloud structure of a typical thunderstorm. Highlight the charge separation zone.

## OPTION-G

### PHY-G-SEC-T-04

### (Renewable Energy & Energy Harvesting)

1. Answer any **five** questions: 2×5=10

   a) What are the Conventional and Non-conventional energy sources?

   b) What is solar pond? Where first solar pond was established in India?

   c) Differentiate between primary and secondary energy sources.

   d) What are the main components of tidal power plant?

   e) What is meant by photovoltaic effect? Where photovoltaic energy is used?

   f) Define Geothermal energy. What are geothermal resources?

   g) Define Ocean Thermal energy conversion (OTEC).

   h) What is biochemical conversion? Name two types of biomass.

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

   a) Write need for use of renewable energy resources. 5



   b) What do you mean by fossil fuels? Write the environmental impacts of burning them. 1+4

   c) What is a Solar cell? Briefly explain how it works. Draw I-V characteristic less of a Solar cell. 1+3+1

   d) Briefly explain (qualitatively) piezoelectric effect by simple molecular model. How piezoelectric energy harvested from human motion? 3+2

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

   a) i) Explain action of Solar Cooker, Flat plate collector, Solar Green House.

      ii) Write down advantage and disadvantage of solar energy. (2+2+2)+4

   b) i) Write down basic principle of wind energy conversion.

      ii) Write down advantage and disadvantages of wind power energy.

      iii) Derive the expression for wind power. 3+4+3

   c) What is hydro energy? Discuss the impact of hydro power sources on the environment in detail. 2+8

d) i) Write application of piezoelectric energy harvesting.

ii) Write working principle of linear generator. 5+5



**OPTION-H**

**PHY-G-SEC-T-04**

**(Basic Instrumentation Skills)**

**GROUP–A**

1. Answer any **five** questions: 2×5=10

a) Write down the unit of electric field and magnetic field in SI units.

b) What is a CRO used for.

c) What is continuity on a multimeter?

d) Distinguish between digital and analog instruments.

e) What is signal generator?

f) What do you mean by Impedance Bridge?

g) What is distortion factor meter?

h) Write down the advantages of electronic voltmeters.

**GROUP-B**

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

a) Why do we use AC millivoltmeter? Draw the block diagram of an AC millivoltmeter.

b) Explain the following terms applied to digital display: i) Resolution, ii) Sensitivity.

c) Write down the working principle of RLC bridge.

d) Write down the steps for measuring ac voltage and resistance of a wire by a conventional multimeter.

## GROUP-C

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

a) With a block diagram, explain the working principle of Q-meter. Write down the applications of Q-meter. 5+5

b) With a block diagram, explain the working of a CRO. Determine how many cycles of a 2-kHz sinusoidal signal are viewed if the sweep frequency is: i) 2 kHz, ii) 4kHz iii) 1 kHz. 6+4

c) Write short note on: i) Digital multimeter, ii) Function generator. 5+5

d) Draw a block diagram of digital frequency counter and write down its working principle. The expected value of the voltage across a resistor is 50 V. However, the measurement gives a value of 49 V. Calculate absolute error, percentage error, and relative accuracy. (3+3)+4



## OPTION-I

## PHY-G-SEC-T-04

## (Applied Optics)

## GROUP–A

1. Answer any **five** questions: 2×5=10

a) What is splice loss in optical fibre?

b) Explain the terms coherence time and coherence length.

c) Write down two applications of NMR spectroscopy in forensic science.

d) Explain briefly how haplography can be used in interferometry.

e) Write down the full form of the following terms - FTS. MFD.

f) What do you mean by graded index and step index optical fibre?

g) Write down the difference between reflection and transmission type holograms.

h) Giye one example for each of the following: Gas laser and solid-state laser.

## GROUP-B

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

a) With the help of suitable diagram explain the working principle of a white light reflection hologram. Write down the application of holography in microscopy. 3+2=5

b) With the help of a suitable diagram explain briefly the action of a semiconductor laser. 5

c) "FTS is a powerful method for measuring emission and absorption spectra"- Explain. 5

d) Write down the full form of LED" Draw the I-V characteristics of a LED. What are common uses of LED? 1+2+2=5

## GROUP-C

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

a) What do you mean by optical pumping and population inversion? With the help of a suitable diagram explain how population inversion is achieved in a two level laser system. What are Einstein's A and B coefficients? Establish the relations between A and B coefficients. 2+3+2+3=10



b) What do you mean by acceptance angle and numerical aperture in an optical fibre? 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 1.50 and that of the material used for cladding is 1.48. 2+2+4+2=10

c) Write a short note on recording and reconstruction 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. 5+5=10

d) What is fibre optic sensor? Discuss the concept of spatial frequency filtering. Show that a thin lens can be used as a Fourier Transformer. Describe how a transmission hologram is made. 2+2+3+3=10

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