U.G. 5th Semester Examination - 2022

PHYSICS

[PROGRAMME]

Skill Enhancement Course (SEC)

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

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

(Applied Optics)

GROUP–A

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

a) What do you mean by spontaneous and stimulated emission of radiation?

b) If one dimensional field distribution of an object is represented by the function given :

$$f(x)=\sin(\pi x)+\sin(2\pi x)+\sin(3\pi x)$$

Then determine different spatial frequencies contained by the object.

c) What do you mean by Fourier transforming property of a thin lens?

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

e) What do you mean by transmission and reflection type holograms?

f) Write down two applications of FTS.

g) Write down the full forms of the following terms: LASER, FTS.

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

GROUP-B

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

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

b) Explain briefly different types of losses faced in optical fiber communication. 5

c) What are the main advantages and disadvantages of communication using optical fibre compared to other modes of communication? 5

d) Write down the full form of LED. With the help of suitable circuit diagrams draw the characteristics of an LED. Write down one use of an LDR. 1+3+1=5

GROUP-C

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

a) With the help of appropriate diagram how the rays pass in a graded and step index fibre. What do you mean by acceptance angle and numerical aperture of an optical fibre? Derive the expression for the numerical aperture of an optical fibre. Find the numerical aperture of a step index fibre when the refractive index of the core is 1.65 and that of the material used for cladding is 1.50. 2+2+3+3=10

b) Explain briefly recording and reconstruction process of holograms. Write down the application of holography in interferometry. 5+5=10

c) Discuss the concept of spatial frequency filtering. What is fibre optic sensor? Write down the full form of NMR. Explain briefly how the grating radial spacing of the Compact Disc (CD) can be determined by reflection using a laser. 2+2+1+5=10

d) Explain the terms 'optical pumping' and population inversion in a laser system. 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

OPTION-B

PHY-G-SEC-T-03

(Computational Physics Skills)

GROUP–A

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

a) What is the Importance of computers in Physics?

b) Define: Sequence, Branching (Selection) and Loop (Repetition).

c) What are the advantages of algorithm?

d) Write down the algorithm to convert temperature from Celsius to Fahrenheit.

e) Express the Flowchart to swap two numbers using Temporary Variable.

f) In a FORTRAN program, I have set $x = 2.0$, $a = 2.0$ and $b = 4.0$. What is the value of y if $y = a * x+b**2/x$?

g) What is the minimum number of disk partitions required to install Linux? How to copy file in Linux?

h) What is the purpose of a header file? Is the use of header file absolutely necessary?

GROUP-B

2. Answer any **two** questions: $5\times2=10$

a) Write the algorithm for trajectory of a projectile thrown at an angle with the horizontal.

b) Write a program that calculates the real roots of any quadratic equation $ax^2+bx+c=0$ for given values of a, b and c. The program should print a message on sereen if the roots are imaginary and should also be able to solve the equation if a = 0.

c) Write a program that reads a number and writes on the screen if it is a prime number or not.

d) Write a program to solve and plot the output for visualization of the following differential equation:

$$6x^2-17x+12=0.$$

GROUP-C

3. Answer any **two** questions: $10\times2=20$

a) What is difference between algorithm and pseudo code? Write down the algorithm for trajectory of a projectile thrown at an angle with the horizontal. Also draw the flowchart for it. 2+4+4

b) Write a program to evaluate the integral: $\int f(x)dx = \int [tan^{-1}x - e^{-2cosx}]dx$ between x=0 and x=1 using the (i) Trapezoidal rule and (ii) Simpson's Rule. 5+5

c) Write a program to find a transpose of a matrix.

Write short notes on : (i) Call statement (ii) Save statement. 4+3+3

d) Type the following question paper in your answer script using LaTeX command: 10

OPTION-C

PHY-G-SEC-T-03

(Radiation Safety)

GROUP–A

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

   a) If the work function of a metal is w_0 eV, then find the value of threshold frequency for the metal?

   b) What is 'mirror nuclei'?—explain with example.

   c) Give examples of man-made sources of radiations.

   d) What are Auger electrons?

   e) What is pair production?

   f) Define the decay constant of a radionuclide.

   g) What is KERMA?

   h) What is meant by the term 'mass defect'?

GROUP-B

2. Answer any **two** of the following questions: $5\times2=10$

a) i) What is binding energy? How much energy is required to remove one neutron from ${}^{14}_{6}C$ nuclei?

ii) What is bremsstrahlung process? $(1+2)+2=5$

b) What do you mean by the stopping power of a medium? Define energy straggling and range straggling. $2+3=5$

c) What happens to the atomic nuclei ${}^{238}_{92}U$ when it

i) emits an alpha particle

ii) emits an electron

iii) captures an electron

iv) emits γ radiation? 5

d) Discuss the role of neutron-to-proton ratio in the stability of a nuclide. 5

GROUP-C

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

a) i) Explain the phenomenon 'photoelectric effect'. Calculate the maximum energy of the photoelectron when the surface of barium is illuminated with a light of wavelength 300 nm. Work function of barium is 2.5 eV.

ii) What is Compton Effect? Find the expression of change in wavelength of a photon in Compton scattering. (3+2)+(2+3)=10

b) i) Explain the phenomenon nuclear fission.

ii) What is the basic principle behind the generation of energy in nuclear power plant?

iii) What do you mean by half life of a radionuclide? If the half life of radon (^{222}Rn) for alpha decay is 3.82 days then what fraction of sample of radon will remain undecayed after 10 days? 3+2+(1+4)=10

c) i) What do you mean by radioactive wastes and why the radioactive waste management is so important?

ii) What is meant by Annual Limit of Intake (ALI)? (3+4)+3=10

d) i) State some general principles on the basis of which the radiation detectors are constructed. Describe the operation of a radiation detector which is constructed on the basis of the principle of ionizing effect of radiation in gases.

ii) Describe some applications of nuclear techniques in the industry. 2+4+4=10

OPTION-D

PHY-G-SEC-T-03

(Technical Drawing)

GROUP–A

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

   a) Name ten drawing instrument used in Technical drawings.

   b) Name four curves obtain form conic section.

   c) Draw a line used to indicate Long-break line, central line, hidden line, Locus line.

   d) What is pitch of a helix and helix angle?

   e) What is principle of Projection?

   f) What is Plan and what is Elevation?

   g) How is cutting plane drawn?

GROUP-B

2. Answer any **two** of the following: $5\times2=10$

   a) Explain the principle of vernier scale with a neat sketch.

   b) Draw the locus of a point equidistant from a fixed circle and a fixed point.

c) Explain the Orthographic projection. Write 3 differences between 1st angle and 3rd angle projection.

d) Difference between CAD and Autocad. How will you find moment of inertia in AutoCAD? What is the full form of UCS? And what is the full form of WCS?

GROUP-C

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

a) A line AB, 75 mm long is inclined at 45° to the Horizontal Plane(H.P,) and 30° to the Vertical Plane (V.P.). Its end B is in the H.P. and 40 mm in front of the V.P. Draw its projections and determine its traces.

b) Draw the projection of a hexagonal pyramid, 40 mm side, 50 mm long, based on H.P. and a side of the base is parallel to and 25 mm in front of the V.P.

c) How you can create a user interface in Autocad and what is the use of LAYMRG command in AutoCAD? How will you use that?

d) What is the process of copying the dimension styles from one drawing to another in Autocad and how can you remove the empty layers from drawing? What is the use of ISOLATE command in AutoCAD?

OPTION-E

PHY-G-SEC-T-03

(Renewable Energy and Energy Harvesting)

1. Answer any **five** of the following questions: $2 \times 5 = 10$

a) What is Fossil fuel? What are its limitations?

b) What is biomass? Name two types of biomass.

c) What is Solar pond? Write two applications of Solar pond.

d) What is piezoelectric effect?

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

f) Define Geothermal energy. What are geothermal resources?

g) What are the conventional and Non-conventional energy sources?

h) Define Ocean thermal energy conversion (OTEC).

2. Answer any **two** questions. $5\times2=10$

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

b) Explain the action of Solar cooker and Flat plate collector. $2\frac{1}{2}+2\frac{1}{2}$

c) What are the difficulties in tidal power developments? 5

d) What are the advantages and limitations of renewable energy? 5

3. Answer any **two** questions: $10\times2=20$

a) Write short notes on (any **two**): $5\times2=10$

i) Biochemical conversion

ii) Solar energy and its storage

iii) Electromagnetic energy storage

b) What is piezoelectric energy harvesting? Write the applications of piezoelectric energy harvesting. Write down the working principle of linear generator. 2+5+3

c) i) Write down the basic principles of wind energy conversion. Write down the advantages and disadvantages of wind power energy.

ii) Discuss the environmental impact of hydropower sources.

d) Write short notes on (any **two**) $5 \times 2 = 10$

i) Solar green house

ii) Hydroelectricity

iii) Ocean thermal energy

OPTION-F

PHY-G-SEC-T-03

(Physics Workshop Skills)

1. Answer any **five** of the following questions: $2 \times 5 = 10$

   a) Give the cgs unit of force. How can it be converted to SI unit?

   b) How is a diode soldered on a PCB?

   c) State and explain the various classes of lever.

   d) State three types of flame setting used in gas welding. Which is most commonly used and why?

   e) What is a sextant used for and how?

   f) Mention the advantages of integrated circuits over discrete circuits.

   g) Draw the circuit diagram of an electronic switch with a transistor and relay.

   h) How is the least count of a screw gauge determined?

2. Answer any **two** questions: $5\times2=10$

a) Draw the circuit diagram of a timer and explain the working principle. $2\frac{1}{2}+2\frac{1}{2}$

b) What is meant by sand casting? Which material is used to make patterns for sand casting and what is the main consideration when making patterns? 2+2+1

c) What is meant by sheet metal? How is a sheet distinguished from a plate? Explain the process of making a funnel from sheet metal. 1+1+3

d) Describe the basic principle of the Vernier scale. What are the main advantages and disadvantages of a vernier caliper? 2+3

3. Answer any **two** questions: $10\times2=20$

a) What is a multimeter used for? How can an electrical fuse be tested with a multimeter? How is frequency of a waveform measured with an oscilloscope? 2+4+4

b) How is a regulated power supply different from an unregulated power supply? Give the circuit diagram of a regulated power supply and explain the working principle. 2+4+4

c) What is a gear? Describe the parts of a gear with a suitable diagram. Explain the operation of a simple gear mechanism consisting of two gears. What is gear ratio? What are the main methods of attaching gears to shafts? 1+3+3+2+1

d) What is meant by metal filing? What are the various kinds of files? How can the edge of a sheet be smoothened with a file? Why is it necessary to clamp work during a drilling operation? 2+2+4+2

OPTION-G

PHY-G-SEC-T-03

(Electrical Circuits and Network Skills)

GROUP–A

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

a) What is a step-up and step-down transformer?

b) What are the three types of wiring connections.

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

d) Calculate the *r.m.s* value of the current given by $i = i_0 + i_1 \cos(\omega t + \theta)$.

e) What are shot and open circuits?

f) Write the expression of efficiency of a transformer.

g) State Kirchhoff's voltage law and explain.

h) 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?

GROUP–B

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

a) i) Calculate the equivalent resistance when the capacitance are connected in parallel and in series.

ii) What is the time constant of a growth CR (charging) circuit? 3+2

b) i) What are the advantages and disadvantages of induction motor?

ii) Calculate the condition for maximum power developed by a DC motor. 3+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) Calculate the rms value, average value and form factor of a full-wave rectified alternating current. 2+2+1

GROUP–C

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

a) i) The total current drawn by a circuit consisting of three resistors connected in parallel is 12A. The voltage drop across

the first resistor is 12V, the value of second resistor is 3 Ω and the power dissipation of the third resistor is 24W. 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 4 Ω, 3 Ω and 1 Ω. 4

b) Three sinusoidal alternating currents of rms values 5, 7, and 10 A are having same frequency of 50Hz, with phase angles of 30°, –60° and 45°.

i) Find their average values.

ii) Write equations for their instantaneous values.

iii) Draw waveforms and phasor diagrams taking first current as reference.

iv) Find their instantaneous values at 100 msec from the original reference.

2+2+3+3

c) i) Show that the power of an AC circuit is $i_{rms} \times v_{rms} \cos\theta$. Where $\cos\theta$ is power factor.

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

d) 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) In an ac circuit the complex impedance is Z= 1+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
