

U.G. 4th Semester Examination - 2020

PHYSICS

[HONOURS]

Skill Enhancement Course (SEC)

Course Code : PHYH-SEC-T-2(A-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

PHYH-SEC-T-2A

(A) (Renewable Energy and Energy Harvesting)

1. Answer any **five** questions: 2×5=10
 - a) What are the conventional and non-conventional energy sources?
 - b) Differentiate between primary and secondary energy sources.
 - c) Define altitude angle.
 - d) What are the main applications of a solar pond?
 - e) What are the factors which determine the output of a wind energy converter?

- f) Name the various models of biogas plants.
 - g) Define Geothermal source.
 - h) What are the main components of a tidal power plant?
2. Answer any **two** questions (symbols have their usual meanings): 5×2=10
 - a)
 - i) What are the methods of direct energy conversion? Describe in brief.
 - ii) What are the advantages and limitations of renewable energy sources? 3+2
 - b) With the help of a neat sketch, describe a solar heating system using water heating solar collectors. 2+3
 - c)
 - i) Differentiate between nuclear fusion and fission.
 - ii) What is the main advantage of D-D reaction?
 - iii) What do you mean by isotopes? Give examples. 2+1+2
 - d)
 - i) What are the main types of OTEC power plants?
 - ii) Describe their working in brief. 2+3
3. Answer any **two** questions (symbols have their usual meanings): 10×2=20
 - a)
 - i) Obtain the expression for power development due to wind.

- ii) Show graphically the dependence of wind-rotor power on wind speed and rotor diameter.
 - iii) Wind at 1 standard atmospheric pressure at 15°C has a velocity of 10m/s. The turbine has diameter 120 m and its operating speed is 40 r.p.m. at maximum efficiency. Calculate the total power produced. 4+3+3
- b)
- i) How biomass conversion takes place?
 - ii) Explain the process of “Photosynthesis”. What are the conditions, which are necessary for it?
 - iii) What is wet and dry fermentation?
 - iv) What materials can be used for biogas generation? 2+4+2+2
- c)
- i) Estimate the energy and power in the double basin tidal system.
 - ii) The basin area of a tidal power plant is $20 \times 10^6 \text{ m}^2$. The tidal range is 8 m, calculate the energy generation in kWh. 6+4
- d)
- i) Obtain the equations for the voltages and power output of an MHD generator.
 - ii) An MHD generator has the following parameters:

Plate area = 0.20 m²,
 Distance between plates = 0.4 m,
 Flux density = 2 Wb/m²,
 Average gas velocity = 1000 m/s,
 Conductivity of the gas = 10 mho/m.
 Calculate the open circuit voltage and maximum power output. 6+4

OPTION-B

PHYH-SEC-T-2B

(B) (Renewable Energy and Energy Harvesting)

GROUP-A

1. Answer any **five** questions: $2 \times 5 = 10$
- a) Define fossil fuel with example. Write down two limitations of fossil fuel.
 - b) What is solar pond? Where first solar pond was established in India?
 - c) Write down working principle of a wind turbine.
 - d) Define Osmotic Pressure and Ocean Biomass.
 - e) Define Geothermal energy. What are geothermal resources?
 - f) What is carbon capture technology? Write down two advantages of carbon capture technology.
 - g) What is meant by photovoltaic effect? Where photovoltaic energy is used?
 - h) What is biochemical conversion? Name two types of biomass.

GROUP-B

2. Answer any **two** questions: $5 \times 2 = 10$
- a) What is a solar cell? Briefly explain how it works. Draw I-V characteristics of a solar cell. $1+3+1$
 - b) Briefly explain (qualitatively) piezoelectric effect by simple molecular model. How piezoelectric energy harvested from human motion? $3+2$
 - c) Define Conventional and Non-conventional form of energy. Write down all major differences between them. $2+3$
 - d) Define Ocean Thermal energy conversion (OTEC). Explain by one method how does ocean thermal energy generate electricity? $2+3$

GROUP-C

3. Answer any **two** questions: $10 \times 2 = 20$
- a) i) Describe briefly how hydroelectricity is generated.
 - ii) Write down Environmental impact of hydropower.

- iii) Calculate how much power can be generated by power plant. The dam itself is 120 m high, the Head (distance water falls) is 72m. The typical Flow rate is 60 m³/s. The turbine generator is 80% efficient. 4+3+3
- b) i) Write down basic principle of wind energy conversion.
- ii) Write down advantages and disadvantages of Wind power energy.
- iii) Derive the expression for wind power. 3+4+3
- c) 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
- d) Write short notes on (any **two**): 5+5
- i) Environmental issue and Renewable sources.
- ii) Basic Principle of Linear Generator
- iii) Ocean energy potential against wind and solar
- iv) Tidal Energy

OPTION-C
PHYH-SEC-T-2C
(Radiation Safety)
GROUP-A

1. Answer any **five** questions: 2×5=10
- a) Write down main characteristics of x ray.
- b) What are Auger Electron?
- c) What is Bremsstrahlung Process?
- d) Explain with example, the terms 'Isotope', 'Isobar', 'Isotone' and 'Mirror Nuclei'.
- e) Define range of α particle. On what factor does range depend?
- f) What is nuclear fission? Give one example.
- g) The work function of zinc is 3.6 eV. The Threshold frequency for the metal is 9×10^{14} Hz. Find the value of Planck's Constant.
- h) Write two biological effects of ionizing radiation.

GROUP-B

2. Answer any **two** questions: 5×2=10
- a) i) Define decay constant λ of radioactive material. Hence obtain an expression for the number of radioactive atoms at time t, given that their initial number is N_0 .

- ii) Define Mean life and Half life . (1+2)+2
- b) i) Explain the term ‘mass defect’ and ‘binding energy’ of a nucleus.
- ii) The mass of hydrogen atom and neutron are 1.008142 and 1.008982 amu respectively. Calculate binding energy per nucleon of Boron -10 (mass=10.01612 amu) 2+3
- c) Briefly explain operation of Geiger-Muller Counter (GM). What is meant by ‘dead time’ of a GM counter. 4+1
- d) Define
 - i) KERMA
 - ii) Derived Air Concentration (DAC) related to Radiation. $2\frac{1}{2}+2\frac{1}{2}$

GROUP-C

3. Answer any **two** questions: 10×2=20
- a) i) Write down Principle, justification and limitation of International Commission on Radiological Protection (ICRP).
 - ii) How Accelerator driven Sub-critical system (ADS) used for waste management. 6+4

- b) Explain briefly (with one example) for application nuclear techniques in
 - i) Medical science
 - ii) Archaeology
 - iii) Crime detection
 - iv) Mining
 - v) Art 2+2+2+2+2
- c) i) Write down Einstein’s photoelectric equation and explain photoelectric effect.
- ii) What is Compton effect? Deduce the relation between the increase in wavelength and the angle scattering. (1+4)+(1+4)
- d) i) Distinguish between nuclear fission and Fusion with example.
- ii) How can the energy release in these processes be explained qualitatively with the help of packing fraction curve?
- iii) Name different type of nuclear reactions.
- iv) Explain what is meant by Q -value of a nuclear reaction.
- v) Give one example each for proton and α particle induced reaction. 2+2+2+2+2

OPTION-D
PHYH-SEC-T-2D
(Applied Optics)

GROUP-A

1. Answer any **five** questions: 2×5=10
- a) Mention any two important characteristics of a laser.
 - b) Give one example of a gas laser and one example of solid-state laser.
 - c) Show that a two-level system cannot act like a laser.
 - d) Describe with energy level diagrams the phenomena of stimulated emission, and stimulated absorption in a two-level system.
 - e) Draw a schematic for ray propagation in
 - i) Step index fiber
 - ii) graded-index fiber.
 - f) What is meant by splice loss in an optical fiber?
 - g) Name two laser pumping technique.
 - h) Describe how a transmission hologram was made.

GROUP-B

2. Answer any **two** questions: 5×2=10
- a) Describe the construction of a He-Ne laser. With the help of a simple energy level diagram show how population inversion achieved here. 2+3
 - b) What is meant by the numerical aperture of an optical fiber? What factors does it depend on? Name the two semiconductors which are extensively used in semiconductor lasers. 2+1+2
 - c) Show at thermal equilibrium, the ratio (R) of the number of spontaneous and stimulated emission is given by $R = (\exp(h\nu/k_B T) - 1)$. Mention some important applications of lasers. 3+2
 - d) Explain the principle of Holography. Mention the name of the different types of holograms. What is a white light reflection hologram? 2+2+1

GROUP- C

3. Answer any **two** questions: 10×2=20
- a) Briefly describe the application of Holography in microscopy, interferometry, and character recognition. Draw the I vs V characteristic of

Light Emitting Diode (LED). Fourier Transform Spectroscopy(FTS) is a powerful technique to measure the emission and absorption spectra, justify. 6+1+3

- b) What is a heterostructure semiconductor laser? Draw the energy band diagram corresponding to the three regions of double-heterostructure laser i) when they are in contact with no bias, and ii) under forward bias.

Derive relations between Einstein's A and B coefficients. 1+2+2+5

- c) Show that the time taken by a pulse to traverse a length L of the fiber is given by $\tau = L/v_g = L/c [n(\lambda_0) \lambda_0 dn/d\lambda_0]$. What is fibre optic sensors? How does Bragg fiber grating work? 5+3+2

- d) Discuss the concept of spatial frequency filtering. Show that a lens can be used as a Fourier Transformer. A Gaussian function is $f(x) = C \exp(-ax^2)$, where C and a is a constant, calculate its Fourier transform (F(k)). Plot F(x) and F(k) and explain the differences. 3+3+2+2

OPTION-E

PHYH-SEC-T-2E

(A) (Weather Forecasting)

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

- Define the term humidity.
- What is acid rain?
- What is Solar Constant?
- What are 'Aerosols'?
- Define thermal equator?
- What is Hadley Cell?
- What is atmospheric window?
- What do you mean by saturated vapour pressure?

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

5×2=10

- Discuss the nature and Composition of Atmosphere.
- Discuss the Different weather forecasting Method.
- Describe the origin and characteristics of tropical cyclones.

- d) Explain the relationship between pressure belts and planetary winds.

3. Answer any **two** from the following questions:

10×2=20

- a) Identify the green house gases. Account for the increase of these gases and explain the impact of such increase.
- b) Describe and account for the general wind circulation. Identify major jet streams and mention in brief their impact on surface weather condition.
- c) What is Weather forecasting? Describe the historical background of development of forecasting.
- d) Write a short note – Weather map, Radiation law, Geotropic wind, Global warming.

OPTION-F

PHYH-SEC-T-2F

(B) (Weather Forecasting)

GROUP-A

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

- a) Write down percentage composition of gas in atmosphere.
- b) Write down name of all the layers by which our atmosphere is composed of.
- c) Atmospheric temperature is governed by which factors?
- d) How does temperature vary in Troposphere?
- e) Define emissive power and Absorptive power in radiation.
- f) Define aerosol. How are they formed?
- g) Name the instrument by which speed of wind is measured. What is the normal unit of wind speed?
- h) State Kirchhoff's law of radiation.

GROUP-B

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

- a) Define adiabatic lapse rate.
Derive expression for adiabatic lapse rate

$$\frac{dT}{dh} = \frac{\gamma - 1}{\gamma} \frac{gM}{R} \quad 1+4$$

- b) Name different type of Temperature Sensor.
Briefly discuss how they work. 2+3
- c) State and Prove Stefan Boltzmann law of radiation. 1+4
- d) Define Coriolis Force. Explain how it influence wind. 2+3

GROUP-C

- 3. Answer any **two** questions: 10×2=20
 - a) i) What do you mean by tropical cyclone?
ii) Explain Tornadoes and Hurricanes.
iii) Define air masses and fronts and explain how they affect weather? 2+4+4
 - b) i) Explain cause and effect of global warming.
ii) How we can control global warming?
iii) Define aerosol. Explain how it formed. 4+2+(2+2)
 - c) i) What are the different methods of weather forecasting?
ii) What are the factors should be considered during selection of meteorological station?
iii) Define Geostationary and Polar Orbiting Weather satellite. 2+4+4
 - d) Write short notes on: 5+5
 - i) Ozone Depletion
 - ii) Acid Rain

OPTION-G

PHYH-SEC-T-2G

(Technical Drawing)

GROUP-A

- 1. Answer any **five** questions: 2×5=10
 - a) Name drawing instrument and accessories required for technical drawing.
 - b) Write name of two terms each, used in projection of line and planes.
 - c) Define eccentricity of a conic. What is the locus traced by a point moving along a pendulum, from one end to another, when the pendulum oscillates about an end .
 - d) Draw the locus of a point P equidistant from a fixed straight line AB and a fixed point F.
 - e) What are application of following lines
 - i) Projection line
 - ii) Construction line
 - iii) Centre lines
 - iv) Short Break Line?
 - f) What is full form of CAD? Define AutoCAD.
 - g) Write two command for internet collaboration

with AutoCad. What is the most effective command used to draw symmetrical object using AutoCAD?

- h) What are the function of GRID and SNAP command used in AutoCAD?

GROUP-B

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

- a) Write down Lettering Rules used in technical drawing. 5
- b) i) Name different methods used to construct ellipse.
ii) Draw an ellipse using Eccentricity Method if distance of focus from the directrix is 70mm and eccentricity is $\frac{3}{4}$. 2+3
- c) i) Define Plane of Projection (POP)
ii) Explain Isometric and oblique parallel projection of solid. 1+4
- d) What are the advantages of CAD? 5

GROUP-C

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

- a) Mention uses of all function keys from f 1 to f 10 in AutoCAD. 10

- b) i) Mention the function of following eight AutoCAD command
L ; C ; PL ; REC ; POL ; CO ; REG ; SC
ii) How do you make a 3d drawing in 2d in AutoCAD?
iii) What are dimensioning tools in AutoCAD?
iv) Draw following circle using AutoCAD command. Centre (95,52) and radius =16 units. 4+2+2+2
- c) Write down uses of following Drafting instrument
i) T-square
ii) Set-square
iii) Roller Scale
iv) Circle Template
v) Lettering Template. 2+2+2+2+2
- d) i) Write down principle of projection in technical drawing.
ii) Explain Orthographic projection of solids.
iii) Name different method used in technical drawing for construction of Parabola and Hyperbola.
iv) Define Cycloidal curves 2+2+4+2