2023

PHYSICS

Paper : PHYSE4022/PHYSE4032/PHYSE4042

Full Marks : 50

Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

Option—A

Paper : PHYSE4022

(Computational Physics Skill)

1. Choose the correct answer from the following (any *five*) : 1×5=5

   (a) Decision is denoted in flowchart with

   (i) a rectangle

   (ii) an ellipse

   (iii) a diamond

   (iv) an arrow

(b) An algorithm represented in the form of programming language is

(i) flow chart

(ii) visualization

(iii) program

(iv) pseudo code

(c) In flow chart calculation is represented by

(i) rectangle

(ii) circle

(iii) rhombus

(iv) arrow

(d) A valid variable declaration in FORTRAN is

(i) Real :: Celsius

(ii) Real : Celsius

(iii) Real Celsius

(iv) Celsius real

(e) The 'cd' command in Linux expands to

(i) common directory

(ii) change directory

(iii) class division

(iv) Corel Draw

(f) 'If A is true B is true then C is true' is

(i) a logical operator

(ii) not a logical operator

(iii) not related to programming language

(iv) None of the above

(g) .bib (<dot>bib) is

(i) related to Bible

(ii) a LaTeX file format

(iii) a FORTRAN file format

(iv) Gnuplot file format

(h) The delimeter in FORTRAN is

(i) blank space

(ii) semicolon

(iii) colon

(iv) comma

(i) The basic datatypes in FORTRAN are

(i) Integer, Real, Complex, Character

(ii) Real, Complex, Character, Logical

(iii) Integer, Real, Complex, Character, Logical

(iv) Integer, Real, Complex, Logical

(j) The correct way to import a package in LaTeX is

(i) \use {package_name}

(ii) \package{package_name}

(iii) \use package{package_name}

(iv) \{package_name}

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

(a) What is a variable? How does a variable differ from a constant?

(b) Is FORTRAN a high level language? Give reason.

(c) Write about Linux commands.

(d) Write down the gnuplot script to display dotted and dashed line in a graph.

(e) What do you understand by visualization? Mention a tool used for visualization.

(f) Write down the following equations in FORTRAN :

(i) $e^{-\frac{x^2}{2}} = 1$

(ii) $\sqrt{\frac{1}{\sqrt{x}}} + y = 0$

(g) Write down the LaTeX script to generate the following :

(i) Content table

(ii) List of images

(iii) List of figures in LaTeX

3. Answer any *five* of the following : 5×5=25

(a) Draw a flow chart to generate Fibonacci series.

(b) Write LaTeX script to generate

$$f(x) = \int_a^b \frac{1}{3} e^x dx$$

(c) Write LaTeX script to generate

$$\sum_1^\infty 2^n = 1$$

(d) Write an algorithm to find the roots of the quadratic equation $ax^2 + bx + c = 0$.

(e) What is an array? How is array useful in computer programming?

(f) Mention all relational operators and explain their uses.

(g) What are unconditional GOTO and computed GOTO statement? What is the general form of unconditional GOTO form? Explain the statement

GOTO (300, 400, 500), L

(h) Write the gnuplot scripts to plot the following functions with axes name and label :

$$f(x) = 0 \cdot 9 \sin(2x)$$
$$g(x) = 0 \cdot 9 \cos x$$

(i) Write an algorithm to find the sum of two matrices.

4. Answer any *one* of the following : 10

(a) Write LaTeX script to prepare a report which must include title, author, table of content, introduction, sections, chapter and appendix.

(b) What are operators? Explain the different types of operators used in FORTRAN.

(c) Write LaTeX script to generate the following table :

Country list		
Country name	ISO code 2	ISO code 3
Afghanistan	AF	AFG
Algeria	DZ	DZA
Angola	AO	AGO
Albania	AL	ALB

Option—B

Paper : PHYSE4032

(Renewable Energy and Energy Harvesting Skill)

1. Choose the correct answer (any *five*) : 1×5=5

(a) Which of the following is bio-fuel?

(i) Gasoline

(ii) Ethanol

(iii) Methane

(iv) Coal

(b) Which of the following is renewable natural resource?

(i) Biological resources

(ii) Tin

(iii) Salt

(iv) Natural gas

(c) Geothermal energy is

(i) energy derived from underground water

(ii) energy from surface ocean currents

(iii) energy from coal

(iv) energy derived from the heat of the earth's crust

(d) Solar energy is _____ source of energy.

(i) non-renewable

(ii) exhaustible

(iii) non-conventional

(iv) conventional

(e) Out of the following, select the correct combination which represents non-renewable natural resources?

(i) Natural gas, fossil fuels, coal and oil

(ii) Clean air, phosphates, nuclear energy

(iii) Fertile soil, fossil fuels and fresh water

(iv) Oil, forests, fertile soil, fresh water and natural gas

(f) Which one of the following is a fossil fuel?

(i) Natural uranium

(ii) Wood

(iii) Coal

(iv) Hydrogen

(g) Which of the following factors is the most important in the site selection of a nuclear power plant?

(i) Abundant availability of water

(ii) Remotely located from residential area

(iii) Absence of earthquake-prone zone in nearby areas

(iv) Proximity to fuel source

(h) Which one of the following is not a radioactive material?

(i) Uranium

(ii) Radium

(iii) Sodium

(iv) Plutonium

(i) Least polluting energy generating technique among the following is

(i) magneto-hydrodynamics

(ii) thermal power

(iii) fission based thermal energy

(iv) photovoltaic cell

(j) Which medicinal plant is known as winter-cherry?

(i) Rose

(ii) Lily

(iii) Chandani

(iv) Ashwagandha

2. Answer the following questions in brief (any *five*) : 2×5=10

(a) What is hydel energy and how is it produced?

(b) What are the advantages of wind energy conversion system?

(c) List the different ways to conserve energy at home.

(d) Give two examples of alternative energy sources.

(e) Write down the factors that determine the output power from wind energy.

(f) How is piezoelectricity related to human power?

(g) Define solar constant and declination angle.

3. Answer the following questions (any *five*) : 5×5=25

(a) State the necessity of microhydro power plant, also explain the components of microhydro power plant. 2+3=5

(b) State and explain application of bio-fuels. 2+3=5

(c) State installation procedure for wind solar PV hybrid system.

(d) What is geothermal energy? Explain the working principle of a geothermal power plant with the help of a neat diagram.

(e) Discuss the theory and working principle of ocean thermal energy conversion system.

(f) Describe the various renewable energy resources available in India and its potential to supplement the conventional energy resources.

(g) Explain the working of tidal power plant with neat layout and specify the site requirement.

(h) With a schematic diagram, explain the structure of medium temperature solar power plant.

(i) Mention various types of fuel cells with their electrochemical reactions.

4. Answer the following questions (any *one*) : 10

(a) Explain the working of a solar water pumping system.

(b) Write short notes on any *four* of the following : 2½×4=10

(i) Wind turbine

(ii) Wave energy devices

(iii) Ocean biomass

(iv) Environmental impact on big hydel project

(v) Piezoelectric energy harvesting system

(vi) Fossil fuel

(vii) Nuclear fusion

(c) What is the principle behind nuclear energy harvesting? Give the associated nuclear reactions. What are the pros and cons of nuclear energy? 2+3+5=10

Option—C

Paper : PHYSE4042

(Applied Optics Skill)

1. Choose the correct answer (any *five*) : 1×5=5

(a) The semiconductor material not used in LED is

(i) silicon carbide

(ii) GaAsP

(iii) GaAs

(iv) Si

(b) The ratio of Einstein's coefficients A_{21} and B_{12} is

(i) $8\pi h\nu^3 / c^3$

(ii) $8\pi h\nu^2 / c^3$

(iii) $8\pi\nu^3 / c^3$

(iv) $8\pi h\nu^2 / c^2$

(c) Which of the following is not a candidate material for laser source in fibre-optics?

(i) N_d–YAG

(ii) He–Ne

(iii) Argon

(iv) Phosphorus

(d) The population inversion in semi-conductor laser diode is achieved by

(i) lightly doping *p* and *n* sides

(ii) introducing trap centres on *p* and *n* sides

(iii) heavily doping *p* and *n* sides

(iv) reverse biasing the junction

(e) Which fibre is preferred for long distance communication?

(i) Step index single-mode fibre

(ii) Graded index multimode fibre

(iii) Step index multimode fibre

(iv) Graded index fibre

(f) In case of optical fibre transmission link, LED's and Laser's are used as

(i) detectors

(ii) sources

(iii) repeaters

(iv) amplifiers

(g) The technique by which image is obtained from a hologram is called

(i) formation

(ii) construction

(iii) reconstruction

(iv) projection

(h) Which of the following is used for formation of hologram?

(i) X-ray

(ii) Visible light

(iii) Infrared

(iv) Laser

(i) Holography is based on the principle of

(i) interference

(ii) diffraction

(iii) interferometer

(iv) polarization

(j) The hologram found on credit cards are an example of

(i) volume hologram

(ii) rainbow hologram

(iii) reflection hologram

(iv) hybrid hologram

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

(a) Mention two applications of photodiode.

(b) Write two differences between spontaneous and stimulated emission process.

(c) Mention different types of optical fibres.

(d) Define core and cladding of an optical fibre.

(e) Draw the diagram of light propagation through a step index multimode optical fibre.

(f) Mention two properties of Laser beam.

(g) What is holography?

3. Answer any *five* of the following questions : 5×5=25

(a) Derive the mathematical treatment of holography.

(b) Deduce the relation between Einstein's coefficients A and B.

(c) What is population inversion? Explain the process of population inversion.

(d) Explain the construction of Ruby laser.

(e) Describe the recording process of a holography.

(f) Explain the light propagation process through an optical fibre.

(g) Explain the Fourier Transform Spectroscopy (FTS) for application in atmospheric remote sensing.

(h) Write a short note on NMR spectrometry.

(i) With the help of energy level diagram, explain how He–Ne laser is produced.

4. Answer any *one* of the following questions : 10

(a) Describe the construction and working principle of He–Ne Laser. 5+5=10

(b) Write short notes on LED and semi-conductor laser. 5+5=10

(c) Derive an expression for numerical aperture and hence the acceptance angle of an optical fibre. Calculate the numerical aperture and acceptance angle for an optical fibre. Given that the refractive indices of core and cladding are 1·45 and 1·40 respectively. 8+2=10

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