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5 SEM TDC DSE PHY (CBCS) 2 (H) A/B/C

2025

(Nov/Dec)

PHYSICS

(Discipline Specific Elective)

(For Honours)

Paper : DSE-2

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Paper : DSE-2 (A)

(**Astronomy and Astrophysics**)

Full Marks : 80

Pass Marks : 32

1. Answer the following questions : 1×4=4

(a) State the virial theorem for a planet moving round the sun.

(b) What are atmospheric windows?

(2)

- (c) Name the two major forces that determine the stability of a star.
- (d) What are Cepheid variables?

2. Answer the following questions :

2×4=8

- (a) Can parallax method be used for measuring stars at any distance? Explain your answer with proper reason.
- (b) What are proper motion and radial motion of a star?
- (c) What are circumpolar stars?
- (d) Explain the term 'sidereal time'.

3. Answer any four of the following questions :

5×4=20

- (a) Describe the parallax method for determination of stellar radius. The parallax angle measured for star is 0.375 arc second. What is its distance from us?
- (b) Describe briefly the working of a reflecting telescope used for astronomical observations. What is light gathering power and how is it related to the telescope objective?

3+2=5

3+2=5

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(3)

- (c) Describe Nebular theory of origin of the solar system. What are tidal forces and planetary rings?

3+2=5

- (d) Describe the layers of the sun with a neat diagram. What is the approximate temperature of the photosphere?

4+1=5

- (e) What is absolute bolometric magnitude of a star? The absolute visual magnitude of a star is 8.7 and for its temperature, the bolometric correction is -0.5. Calculate the absolute bolometric magnitude and the luminosity of the star.

3+2=5

- (f) Describe the spectral luminosity classification of stars. What are Hertzsprung-Russel diagrams?

3+2=5

4. Answer any five of the following questions :

8×5=40

- (a) What are apparent and absolute magnitudes of a star? Describe the mathematical basis used for classification of stars on the basis of their apparent magnitude and derive the relation between brightness and apparent magnitude of a star. What is the mathematical relation between

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(Turn Over)

(4)

apparent and absolute magnitude of a star? The apparent magnitude of the sun is -26.81 and that of the star Sirius is -1.47 . Which one of them is brighter and by how much? $2+3+1+2=8$

(b) What is celestial sphere? Describe the horizon coordinate system and the equatorial coordinate systems with neat diagrams. Which is a better system for determining the position of a star in a celestial sphere and why? $2+4+2=8$

(c) Describe briefly the structure of the Milky Way. Explain the term 'differential rotation of the galaxy'. What are Oort's constant? $4+3+1=8$

(d) Describe the rotation curve of Milky Way. What is dark matter? Describe how the rotation curve of the galaxy point towards the existence of dark matter? $3+2+3=8$

(e) What are the three basic types into which galaxies are classified? Describe Hubbles tuning fork diagram for classification of galaxies. What are 'active galaxies'? $3+4+1=8$

(5)

(f) Explain the term 'cosmic distance ladder'. Describe how the idea of cosmic distance ladder can be used for measurement of distance by Cepheid variable stars. What is Hubble's law and what is its connection with the expansion of the universe? $2+3+3=8$

5. Write short notes on any two of the following : $4 \times 2 = 8$

(a) H-R diagram

(b) Spiral galaxy

(c) Binary stars

(6)

Paper : DSE-2 (B)

(Physics of Devices and Instruments)

Full Marks : 53

Pass Marks : 21

1. Choose the correct answer : $1 \times 5 = 5$

(a) The unique characteristic of tunnel diode that exhibits between its peak voltage and valley voltage is

- (i) Ohmic resistance
- (ii) negative resistance
- (iii) positive resistance
- (iv) constant resistance

(b) In a LC filter, the ripple factor

- (i) increases with load current
- (ii) increases with load resistance
- (iii) remains constant with load current
- (iv) has the lowest value

(c) What type of a device is MOSFET?

- (i) Current-controlled
- (ii) Voltage-controlled
- (iii) Voltage-controlled current source
- (iv) Voltage-controlled voltage source

(7)

(d) In an amplitude modulated wave useful power is carried by

- (i) carrier
- (ii) sidebands
- (iii) both sidebands and carrier
- (iv) None of the above

(e) UART communication is typically

- (i) synchronous
- (ii) parallel
- (iii) asynchronous
- (iv) None of the above

2. (a) Give three basic differences between MOSFET and JFET. 3

Or

Explain equivalent circuit of a unijunction transistor (UJT).

(b) Sketch the cross-section of an N-channel MOSFET and explain its working. 2+3=5

3. Write a short note on either (a) CMOS or (b) charge coupled devices. 3

4. Explain the frequency response of any one of the following :

- (a) Low-pass filter
- (b) Band reject filter

5. Explain the working of a monostable multivibrator using transistors with the necessary circuit diagram.

6. (a) Sketch a phase-locked loop and
(i) identify its major functional blocks and (ii) label the signals that appear at the output of each functional block.

Or

Sketch and label the transfer function of an XOR-based phase detector.

- (b) Discuss the purpose of the voltage-controlled oscillator (VCO).

7. Explain the process of epitaxial growth in IC fabrication process with neat diagrams.

Or

Describe in detail about the diffusion process of IC fabrication.

8. What is a clean room in IC fabrication and what is the maximum permissible dust particle count within it?

9. Explain the process of masking and photoetching in IC fabrication.

10. Write a short note on any one of the following :

- (a) Defects in lattice
- (b) Optical lithography

11. Discuss the three handshaking lines of GPIB.

Or

Discuss the characteristics of GPIB.

12. Discuss the significance of modulation in communication systems and mention the various modulation techniques commonly used.

13. (a) What is the basic difference between the analog and digital modulations? Define FSK, ASK and PSK types of digital modulations.

(10)

Or

What are the possible distortions encountered during diode demodulation, and how can they be effectively minimized?

- (b) Define modulation index for an amplitude modulated wave. What happens when the modulation index is more than 100%?

1+2=3

14. Draw the circuit of a common emitter amplitude modulator and derive the expression for its output.

3

Or

Peak to peak value of an amplitude modulated wave has maximum value of 8 V ($E_{\max}$) and minimum value of 2 V ($E_{\min}$). Find the percentage of modulation and the amplitude of the unmodulated carrier wave.

(11)

Paper : DSE-2 (C)

(Physics of Earth)

Full Marks : 80

Pass Marks : 32

1. Choose the correct answer : 1×8=8

- (a) The most successful theory of the origin of the universe till date is
- (i) the flat earth theory
 - (ii) the big bang theory
 - (iii) the geocentric model
 - (iv) the galacticocentricity model
- (b) The earth's orbital speed is approximately
- (i) 29.1 km/s
 - (ii) 30.1 km/s
 - (iii) 30.5 km/s
 - (iv) 29.8 km/s
- (c) The average depth of the Atlantic Ocean is
- (i) 3138 metres
 - (ii) 3646 metres
 - (iii) 2338 metres
 - (iv) 2138 metres

(12)

- (d) The ozone layer is found in the
- (i) troposphere
 - (ii) mesosphere
 - (iii) stratosphere
 - (iv) thermosphere
- (e) The largest tectonic plate of earth is the
- (i) Eurasian Plate
 - (ii) Antarctic Plate
 - (iii) Pacific Plate
 - (iv) Arabian Plate
- (f) Which of the following is not a primary greenhouse gas?
- (i) Carbon dioxide
 - (ii) Ammonia
 - (iii) Methane
 - (iv) Nitrous oxide
- (g) Which of the following is not a unit of the geological time scale?
- (i) Eons
 - (ii) Eras
 - (iii) Ages
 - (iv) Weeks

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(13)

- (h) The solar system is estimated to dismantle or end in approximately
- (i) 5 billion years
 - (ii) 100 billion years
 - (iii) 200 billion years
 - (iv) 250 billion years

2. Answer the following questions in short :

2×8=16

- (a) What is the difference between weather and climate?
- (b) What are the approximate dimensions of the Milky Way galaxy? How many stars does it contain?
- (c) Name the terrestrial planets in our solar system.
- (d) What is the approximate strength of earth's magnetic field in Tesla? How does it protect life on earth from solar radiation?
- (e) List the main chemical components of ocean water.
- (f) Name the four major types of clouds in earth's atmosphere.
- (g) What is the Coriolis force, and how does it influence ocean currents?

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(Turn Over)

- (h) Where is the Puerto Rico Trench located? What is its approximate maximum depth?

3. Answer the following questions : $3 \times 10 = 30$

- (a) What is the shape of earth's orbit around the sun? Why does the moon always show the same face to earth? $1+2=3$
- (b) What are asteroids and meteorites? Where is the asteroid belt located in the solar system? $2+1=3$
- (c) Briefly explain the internal structure of earth with a simple diagram.
- (d) Describe how the temperature varies with altitude in earth's atmosphere.
- (e) What are polar ice caps and glaciers? What is the approximate area of the Antarctic Ice Sheet? $1+1+1=3$
- (f) Explain the basic concept of plate tectonics.
- (g) Outline the major earthquake belts around the world.
- (h) What is the difference between a tide and a tsunami? Mention one recent major tsunami event. $2+1=3$

- (i) What is the law of superposition in geology? Explain briefly. $1+2=3$
- (j) How does the carbon cycle help maintain earth's steady state?

4. Describe the origin of the universe according to the Big Bang theory, including how structures like galaxies formed over time. 7
5. Explain the variation of density and composition with altitude in the different layers of earth's atmosphere. $3+4=7$

Or

What is sea-floor spreading? Where does it occur? Describe one major mid-oceanic ridge system. $2+1+4=7$

6. What are volcanoes? Describe the main types of volcanoes and their distribution on earth. $2+4=6$
7. Write a short note on the water cycle and its role in earth's dynamical processes. 6

Or

What is the greenhouse effect? Explain its impact on earth's temperature and recent climate changes. $2+4=6$

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