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

2024

(November)

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. Choose the correct option of the following : $1 \times 4 = 4$

(a) The apparent magnitude of the sun is

(i) -26.8

(ii) $+28.6$

(iii) -28.6

(iv) $+26.8$

(2)

(b) The correct order of units of measuring astronomical distance is

(i) 1 Parsec < 1 Astronomical unit < 1 Light year

(ii) 1 Light year < 1 Parsec < 1 Astronomical unit

(iii) 1 Astronomical unit < 1 Light year < 1 Parsec

(iv) None of the above

(c) Milky way is a/an _____ galaxy.

(i) elliptical

(ii) irregular

(iii) lenticular

(iv) None of the above

(d) Cepheid variable is

(i) a type of variable

(ii) a type of satellite

(iii) a type of star

(iv) None of the above

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(Continued)

(3)

2. Answer the following questions : $2 \times 4 = 8$

(a) What are proper motion and radial motion of a star?

(b) Describe the term 'atmospheric windows'.

(c) What are circumpolar stars?

(d) Describe briefly the term 'sidereal time'.

3. Answer any *four* of the following questions :

$5 \times 4 = 20$

(a) Describe the parallax method for determination of stellar radius. The parallax angle measured for a star is 0.375 arc second. What is the distance of the star from us? $3 + 2 = 5$

(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? $3 + 2 = 5$

(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? $4 + 1 = 5$

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(Turn Over)

- (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-Russell diagrams? $3+2=5$

4. Answer any *five* of the following questions : $8 \times 5 = 40$

- (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 apparent and absolute magnitude of a star? The apparent magnitude of star 1 is -26.81 and that of the star 2 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 system 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 constants? $4+3+1=8$
- (d) Describe the rotation curve of Milky Way. What is dark matter? Describe how the rotation curve of the galaxy points indicates the existences of dark matter. $3+2+3=8$
- (e) What are the three basic types into which galaxies are classified? Describe Hubble's tuning fork diagram for classification of galaxies. What are "active galaxies"? $3+4+1=8$
- (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 :

- (a) Solar activity $4 \times 2 = 8$
- (b) Spiral galaxy
- (c) Binary stars

Paper : DSE-2 (B)

(Physics of Devices and Instruments)

Full Marks : 53

Pass Marks : 21

1. Choose the correct answer from the following (any five) : $1 \times 5 = 5$

(a) The three terminals of a JFET are

- (i) cathode, anode and grid
- (ii) ammeter, base and collector
- (iii) source, gate and drain
- (iv) None of the above

(b) An N-channel MOSFET is preferred over a P-channel MOSFET because

- (i) it allows fast switching
- (ii) it is TTL compatible
- (iii) of its low input impedance
- (iv) of low noise

(c) The unit of voltage-controlled oscillator gain is

- (i) hertz per volt
- (ii) volt per second
- (iii) volt per hertz
- (iv) unitless

(d) For modern lithographic processes

- (i) a class 100 clean room is required
- (ii) a class 1000 clean room is required
- (iii) a class 10 or better clean room is required
- (iv) None of the above

(e) Data transmission rate of serial communication is

- (i) slower than parallel communication
- (ii) faster than parallel communication
- (iii) equal to parallel communication
- (iv) None of the above

(f) In frequency modulation

(i) frequency of the carrier remains constant

(ii) carrier frequency varies in accordance with the modulating signal frequency

(iii) carrier frequency varies in accordance with the modulating signal amplitude

(iv) Both (i) and (ii) are true

2. Explain the characteristics and small signal equivalent circuits of a unijunction transistor (UJT). Discuss metal semiconductor junction. $4+2=6$

Or

Write short notes on : $2 \times 3 = 6$

- (a) Metal oxide semiconductor (MOS) device
- (b) Charge couple devices
- (c) Tunnel diode

3. (a) Describe the construction and working principle of D-MOSFET with diagram. Give a comparison between E-MOSFET and D-MOSFET. $2+2=4$

(b) Draw the I-V characteristic curve of a tunnel diode. 2

4. What is the need of filter circuit? Describe qualitatively the action of C filter. $1+3=4$

Or

Give a comparison between active and passive filters with examples of each type. $3+1=4$

5. What is Phase-Locked Loop (PLL)? Discuss the basic elements of PLL. $1+3=4$

Or

Show how an XOR gate can be used as phase detector and discuss its phase detector response curve. 4

6. (a) Describe the fabrication of a p-n junction diode showing all the steps involved. 3

(b) Discuss briefly about defects in the lattice. 3

7. What is the difference between positive and negative masking in the fabrication process? 1

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

- (a) Optical lithography
- (b) Metallization technique
- (c) Photoresists
- (d) Chemical vapour deposition

(10)

9. Draw the structure of the GPIB interface mentioning all of its components. 3

Or

Mention the characteristics and advantages of GPIB. 2+1=3

10. (a) Give a comparison between the three types of modulation process. 3

(b) Give the mathematical analysis of amplitude modulated wave. Define sidebands. 4+1=5

11. Discuss the operation of diode detector as demodulator for AM wave. 3

Or

In a broadcasting studio, a 100 MHz carrier having an amplitude of 50 V is amplitude modulated by a 5 kHz audio signal having an amplitude of 20 V. Find the modulation index and sideband frequencies.

12. Define different shift keying methods used in digital modulation technique. 3

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(Continued)

(11)

Paper : DSE-2 (C)

(Physics of Earth)

Full Marks : 80

Pass Marks : 32

1. Choose the correct answer from the following : 1×8=8

(a) The most successful theory of 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

- (i) 29.1 km/s
- (ii) 29.3 km/s
- (iii) 29.5 km/s
- (iv) 29.8 km/s

(c) The average depth of Atlantic Ocean is

- (i) 3,338 metres
- (ii) 3,138 metres
- (iii) 2,338 metres
- (iv) 2,138 metres

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(Turn Over)

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

- (h) The Solar System is estimated to come to an end in
- (i) 100 billion years
 - (ii) 150 billion years
 - (iii) 200 billion years
 - (iv) 250 billion years

2. Answer the following in short : 2×8=16

- (a) What is the difference between Climate and Weather?
- (b) What is the dimension of Milky Way galaxy? How many stars are there in Milky Way?
- (c) What are the Jovian planets in our solar system?
- (d) What is the order of magnitude of Earth's magnetic field in Tesla? How does the magnetic field protect us from high energy particles from the Sun?
- (e) Write the chemical composition of ocean water.
- (f) What are the four major categories of clouds that appear in the atmosphere of Earth?
- (g) What is the Gulf Stream and why is it so important?

- (h) Where is Mariana Trench located?
What is the depth of deepest spot in it?

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

- (a) What is the shape of Moon's orbit around Earth? Why do we always see the same face of the Moon from Earth? $1+2=3$
- (b) What are meteorites and asteroids? Where is the main asteroid belt located in our solar system? $2+1=3$
- (c) Explain the internal structure of Earth with a diagram.
- (d) Explain how chemical composition changes from Troposphere to Thermosphere.
- (e) What are ice caps and ice sheets? What is the dimension of Antarctic Ice sheet? $1+1+1=3$
- (f) Describe briefly about the origin of Earth's magnetic field.
- (g) Give an outline of world's major volcanic eruption patterns.
- (h) What are the differences between a Tidal wave and a Tsunami? Give the timeline of recent occurrence of a major Tsunami in the world. $2+1=3$

- (i) What is the principle of faunal succession? Explain. $1+2=3$

- (j) Describe how the terrestrial biosphere plays an important role in shaping Earth's environment.

4. Explain how the different structures of the universe started to appear after the Big Bang 13.7 billion years ago. 7

5. Explain the change of density and temperature with altitude in different layers of the atmosphere. $3+4=7$

Or

What is the mid-oceanic ridge system? Where do they occur? Write briefly about two well-known mid-oceanic ridge systems in the world. $2+1+4=7$

6. What are cyclones? Describe two major categories of cyclone. $2+4=6$

7. Write a short note on Indian Monsoon System. 6

Or

What is greenhouse effect? Explain how greenhouse effect is causing global climate change. $2+4=6$
