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

2022

(Nov/Dec)

PHYSICS

(Discipline Specific Elective)

(For Honours)

Paper : DSE–2

The figures in the margin indicate full marks for the questions

Paper : DSE–2 (A)

(Astronomy and Astrophysics)

Full Marks : 80
Pass Marks : 32

Time : 3 hours

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

(a) One parsec is equal to

(i) $1 \cdot 496 \times 10^{11}$ m

(ii) $3 \cdot 085 \times 10^{16}$ m

(iii) $2 \cdot 062 \times 10^{8}$ AU

(iv) None of the above

(b) Which of the following statements about the celestial sphere is incorrect?

(i) The earth is placed at the centre of the celestial sphere.

(ii) The celestial sphere is just another name for our universe.

(iii) The celestial sphere does not exist physically.

(iv) When we look at the sky, the stars all appear to be located on the celestial sphere.

(c) The dimension of Hubble's constant is

(i) $[L]$

(ii) $[T^{-1}]$

(iii) $[MLT^{-2}]$

(iv) $[LT^{-1}]$

(d) The evolution of planets involves three stages in which of the following orders?

(i) Protoplanets, planetesimals, stabilization

(ii) Planetesimals, protoplanets, stabilization

(iii) Planetesimals, stabilization protoplanets

(iv) Stabilization, protoplanets, planetesimals

(Continued)

(e) The expansion of the universe is explained by

(i) virial theorem

(ii) Hubble's law

(iii) nebular theory

(iv) helioseismology

(f) The hottest layer of the solar atmosphere is

(i) photosphere

(ii) corona

(iii) chromosphere

(iv) transition region

(g) In lenticular galaxies, which of the following is not correct?

(i) They have a bulge and a disk

(ii) Disk does not contain spiral arms

(iii) Disk contains spiral arms

(iv) None of the above

(h) The sun is located in the Milky Way galaxy about _____ from the galactic centre of the galaxy.

(i) 1000 pc

(ii) 8000 pc

(iii) 28000 pc

(iv) 10 kpc

(Turn Over)

2. Answer any *eight* of the following : 2×8=16

(a) What are circumpolar stars?

(b) Differentiate between the terms 'absolute magnitude' and 'apparent magnitude' of a star.

(c) The apparent magnitudes of two stars are 0·06 and 1·06 respectively. Calculate the ratio of their brightness.

(d) What are atmospheric windows?

(e) The surface temperature of two stars *A* and *B* is the same and the luminosity of *A* is higher than *B*. Which of the two stars is bigger in size? Why?

(f) Define luminosity.

(g) Define elliptical galaxy.

(h) What is galactic halo?

(i) What is dark matter?

3. Answer any *three* of the following : 5×3=15

(a) Describe how the masses are determined in a binary star system.

(b) Discuss any one coordinate system used in astronomy.

(Continued)

(c) Define sidereal time. Explain why a sidereal day is shorter than the solar day. What do you mean by solar time? 1½+2+1½=5

(d) Write about the equation of time (ET) and draw the variation of ET during the year.

4. Answer any *two* of the following : 4×2=8

(a) Discuss, with neat diagram, the equatorial mounting system of telescope.

(b) Estimate the radius of a star in thermal equilibrium of mass 10^{30} kg and average internal temperature 10^{7} K. It is given that

$$k_B = 1{\cdot}38 \times 10^{-23}\ \text{J K}^{-1}$$

$$m_H \sim 1{\cdot}67 \times 10^{-27}\ \text{kg}$$

$$G = 6{\cdot}7 \times 10^{-11}\ \text{m kg}^{-1}\text{s}^{-2}$$

(c) Write a short note on virial theorem.

5. *(a)* Describe the Hertzsprung-Russell diagram. 4

(b) Discuss about spectral classification of stars. Also, explain its dependence on stellar temperature. 4

(Turn Over)

6. *(a)* What are the different layers of the solar atmosphere? What is coronal heating problem? 3+2=5

Or

Discuss briefly the theory of the solar system formation based on nebular hypothesis. 5

(b) What is exoplanet? Explain how extra-solar planets can be detected. 1+2=3

7. *(a)* Explain Hubble's tuning fork diagram with a neat sketch. 3+2=5

Or

Describe the Milky Way morphology. 5

(b) Describe the rotation curve for a galaxy. 3

Or

State and explain de Vancouver's law.

8. *(a)* Explain Hubble's law along with the velocity-distance plot. 2+1=3

(b) What is cosmic distance ladder technique? Give an example of a cosmic distance ladder technique and explain its working. 3+3=6

Paper : DSE–2 (B)

(Physics of Devices and Instruments)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

1. Choose the correct answer from the following : 1×5=5

(a) The terminals of a unijunction transistor are

(i) collector, base and emitter

(ii) emitter, base 1 and base 2

(iii) gate, drain and source

(iv) gate, drain, body and source

(b) The voltage regulator IC7905 provides regulated output voltage equal to

(i) 78 volt

(ii) +5 volt

(iii) 12 volt

(iv) –5 volt

(c) Which semiconductor is most widely used for fabrication of integrated circuit?

(i) Germanium

(ii) Gallium arsenide

(iii) Silicon

(iv) None of the above

(d) GPIB stands for

(i) General Purpose Interface Bus

(ii) General Purpose Institute Bus

(iii) General Parallel Institute Bus

(iv) General Parallel Interface Bus

(e) Which of the following parameters is varied in amplitude-modulated wave?

(i) Frequency

(ii) Phase

(iii) Amplitude

(iv) None of the above

2. Answer the following questions : 2×5=10

(a) Differentiate between depletion and enhancement mode MOSFET.

(b) What are positive and negative masks?

(c) Explain the basic idea of UART.

(d) Write the basic idea of sending data through a COM port.

(e) Why is modulation required in communication system?

(Continued)

3. (a) Explain the characteristics and small signal equivalence of JFET. What is metal semiconductor junction? 4+2=6

Or

Discuss the construction and working of D-MOSFET with diagram. What is charge-coupled device? 4+2=6

(b) Draw the *I-V* characteristic curve of a tunnel diode and explain. 3

4. Draw the block diagram of a power supply and explain its operation. Explain the action of shunt capacitor in a rectifier circuit as filter. What are load and line regulations? 4+2+2=8

Or

What are active and passive filters? Explain constant-*k* low-pass filter with circuit diagram. Write the limitation of constant-*k* filter. 4+2+2=8

5. Explain the basic principle of phase-locked loop (PLL) with circuit diagram. Draw and label the PLL IC 565. 4+1=5

Or

Explain the working of a voltage-controlled oscillator (VCO). What is loop filter? 4+1=5

(Turn Over)

6. *(a)* Discuss the basic steps involved in integrated circuit fabrication process. 4

Or

Discuss briefly about defects in the lattice.

(b) Write a short note on optical lithography or metallization techniques. 3

7. *(a)* Derive the equation and power relation for an AM wave. Compare AM and FM. 4+2=6

Or

Explain the demodulation of AM wave using diode detector with circuit diagram. Define modulation index of AM wave. 4+2=6

(b) Compare ASK and PSK. 3

Paper : DSE–2 (C)

(Physics of Earth)

Full Marks : 80
Pass Marks : 32

Time : 3 hours

1. Choose the correct answer/Fill in the blank from the following (any *eight*) : 1×8=8

(a) Milky Way is a/an

(i) peculiar galaxy

(ii) irregular galaxy

(iii) elliptical galaxy

(iv) spiral galaxy

(b) The hydrosphere is the mass of water found

(i) on the surface of the earth

(ii) below the surface of the earth

(iii) both on and below the surface of the earth

(iv) None of the above

(c) Freshwater accounts for _____ of the water on the earth.

(i) 2·5%

(ii) 5%

(iii) 7·5%

(iv) 10%

(d) Discuss about energy and particle fluxes incident on the earth. 5

Or

Describe the different stages of formation of a planet.

3. Answer the following questions :

(a) Define geothermal energy and mention three main uses of it. 1½+1½=3

(b) What do you mean by cryosphere? How are glacier ice sheets and polar ice caps formed? 1+3=4

(c) What are the main three layers of the earth? What do you mean by continental and oceanic crust? Mention three most common elements of the earth's crust. 1+2+2=5

(d) Discuss the variation of temperature, density and composition of the atmosphere with altitude. 5

Or

Discuss, in detail, three basic components of the biosphere.

(Continued)

4. Answer the following questions :

(a) What do you mean by seafloor spreading? Explain how convection currents may be related to plate tectonics. 1+2=3

(b) What are tides and how are they useful? What happens, when a tsunami enters shallow water? 2+2=4

(c) What causes earthquakes? Compare and contrast primary, secondary and surface waves. Define Richter scale. 1+3+1=5

(d) How do volcanoes form? Discuss about different types of volcanoes and their products and distribution. 1+4=5

Or

Write a short note on water cycle. 5

5. Answer the following questions :

(a) Discuss the principle of uniformitarianism. 3

(b) Give a brief discussion on nebular and catastrophic hypotheses on the origin of the earth. 2+2=4

(c) Define geological timescale. Discuss about some major geological events. 1+4=5

(Turn Over)

(d) Discuss the origin of life on the earth. 5

Or

How does biosphere help the environment? Describe how the evolution of the solar system may lead to the death of the earth. 2+3=5

6. Answer any *two* of the following questions : 2×2=4

(a) What is the difference between global warming and climate change?

(b) How does the growth of population and deforestation affect the environment?

(c) What are nuclear hazards and how can they lead to environmental pollution?

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