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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) 1.496×10^{11} m

(ii) 3.085×10^{16} m

(iii) 2.062×10^8 AU

(iv) None of the above

(2)

- (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

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(3)

- (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

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(4)

2. Answer any *eight* of the following : $2 \times 8 = 16$

- (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 : $5 \times 3 = 15$

- (a) Describe how the masses are determined in a binary star system.
- (b) Discuss any one coordinate system used in astronomy.

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(5)

(c) Define sidereal time. Explain why a sidereal day is shorter than the solar day. What do you mean by solar time? $1\frac{1}{2} + 2 + 1\frac{1}{2} = 5$

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

4. Answer any *two* of the following : $4 \times 2 = 8$

(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

$$k_B = 1.38 \times 10^{-23} \text{ J K}^{-1}$$

$$m_H \sim 1.67 \times 10^{-27} \text{ kg}$$

$$G = 6.7 \times 10^{-11} \text{ m kg}^{-1} \text{ s}^{-2}$$

(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

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(6)

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

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(7)

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

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(8)

- (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 : $2 \times 5 = 10$

- (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?

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(9)

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? $4+1=5$

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(10)

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

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(11)

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%

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(12)

- (d) What is the point on the earth's surface directly above an earthquake form?
- Earthquake centre
 - Epicentre
 - Fault
 - Focus
- (e) Volcanoes are associated with all of the following areas, except
- rift zone
 - epicentre
 - subduction zone
 - hot spots
- (f) The combined portion of the earth in which all living things exist is called
- biome
 - ecosystem
 - community
 - biosphere
- (g) Eons and eras are units of _____.

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(13)

- (h) What is the atmospheric layer closest to the ground?
- Mesosphere
 - Troposphere
 - Thermosphere
 - Stratosphere
- (i) Gravitational force is _____ (strongest/weakest) at the centre of the earth.
- (j) Photosynthesis, decomposition, respiration and combustion are the four steps of
- water cycle
 - nitrogen cycle
 - carbon cycle
 - phosphorus cycle

2. Answer the following questions :

- (a) What are meteorites and asteroids?
What are terrestrial and Jovian planets? $1\frac{1}{2}+1\frac{1}{2}=3$
- (b) Discuss the rotational and revolution parameters of the earth. $2+2=4$
- (c) Explain the origin of cosmic microwave background and its relationship to the Big Bang.

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- (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. $1\frac{1}{2}+1\frac{1}{2}=3$
- (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.

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. $1+4=5$

- (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 :

$2 \times 2 = 4$

- (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?
