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

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(Held in January/February, 2022)

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) The largest unit of distance among the following is

(i) light-year

(ii) parsec

(iii) astronomical unit

(iv) Mpc

- (b) The apparent brightness of a star is the
- (i) total amount of power it radiates into space
 - (ii) total amount of light it radiates into space per unit time
 - (iii) amount of light reaching as per unit area from the star
 - (iv) None of the above
- (c) The apparent magnitude of a faint star in comparison to a bright star is
- (i) positive and high
 - (ii) negative and high
 - (iii) negative and low
 - (iv) imaginary
- (d) On the celestial sphere, the north pole has a declination of
- (i) 0
 - (ii) $-\frac{\pi}{2}$
 - (iii) $+\frac{\pi}{2}$
 - (iv) π
- (e) The source of energy of a star is
- (i) chemical in nature
 - (ii) mechanical in nature
 - (iii) thermonuclear in nature
 - (iv) gravitational in nature

(f) The spiral arm where the sun is located in our Milky Way galaxy is

(i) Cygnus Arm

(ii) Norma Arm

(iii) Perseus Arm

(iv) Orion Arm

(g) The transition region in the solar atmosphere lies

(i) below photosphere

(ii) above corona

(iii) in between chromosphere and corona

(iv) in between photosphere and chromosphere

(h) The mass-luminosity relation is

(i) $L \propto M$

(ii) $L \propto M^{2.5}$

(iii) $L \propto M^{0.5}$

(iv) $L \propto M^{3.5}$

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

(a) What is parsec? Convert 1 parsec into kilometer.

(b) Explain the direct method of determining the radii of stars.

(c) Write the difference between sidereal time and solar time.

- (d) State the virial theorem.
- (e) Name two telescope mounting systems which are widely used. Mention the different axes used in these systems.
- (f) Explain the terms 'angular magnification' and 'light gathering power' associated with an optical telescope.
- (g) Two stars of spectral class O and A have temperatures 40000 K and 10000 K, respectively. Draw their black-body radiation curves.
- (h) A star is found to radiate like a black-body with peak wavelength at 1.45 nm. Calculate its temperature. Assume that the constant for Wien's displacement law is equal to 2.9×10^{-3} mK.
- (i) What is lenticular galaxy? How is it different from spiral galaxy?
- (j) What is sunspot? Why does it appear dark?
- (k) What is exoplanet? Name one of the techniques of detecting it.
- (l) What are the characteristics of spiral galaxies?

3. (a) Draw the celestial sphere showing the celestial poles, celestial equator, ecliptic, vernal equinox and autumnal equinox. 3
- (b) Compare the brightness of the sun and Sirius B, given that the apparent magnitude of the sun ($m_{\text{sun}} = -26.81$) and the apparent magnitude of Sirius B ($m_{\text{Sirius B}} = +8.68$). 3
- (c) Show how the parallax method is used for determination of stellar distance. Why is it not possible to measure very distant object by this method? 3

Or

Obtain the relation connecting the absolute magnitude with apparent magnitude and the distance of the star in parsec.

- (d) With proper sketches, explain the horizon coordinate system to locate the position of a star. What are the shortcomings of this system? 4+1=5

Or

What is a visual binary? Show how the masses of stars are determined by analyzing binary stars. 1+4=5

4. (a) Describe the different layers of solar atmosphere with a diagram on variation of temperature with distance. 3
- (b) Write a short note on any *one* of the following : 3
- (i) Nebular theory
- (ii) Solar activity
- (c) Explain briefly the spectral classification of stars. Also explain its dependence on stellar temperatures. 5
- (d) Draw an H-R diagram and explain its significant features. 3
5. (a) Discuss how spiral galaxies differ from elliptical galaxies. Give one example of each. 2+1=3
- (b) Differentiate between population-I stars and population-II stars. 3
- (c) Draw the rotation curve of the Milky Way galaxy. 3
- (d) Discuss the basic structure and properties of Milky Way with a sketch labeling different components. 5

6. (a) What is the interstellar medium of a galaxy? 2
- (b) Explain Hubble's scheme of galaxy classification with an appropriate diagram. 4
- (c) Explain how the Cepheid variables are used to estimate astronomical distances. 4
- (d) State Hubble's law. On the basis of this law, explain the phenomenon of expanding universe. 4

Or

What are the dimensions of the Hubble constant? If the age of the universe is estimated to be 14 billion years, calculate the value of Hubble's constant in the units of $\text{kms}^{-1} \text{Mpc}^{-1}$.

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) A JFET has three terminals, namely

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

(b) In an L - C 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) An N -channel MOSFET 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

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

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

(e) 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. (a) Discuss the emitter characteristics of a unijunction transistor (UJT). 2

(b) Describe the working principle of a MOSFET. Give a comparison between E-MOSFET and D-MOSFET. 2+2=4

3. Write short notes on any *two* from the following : 3×2=6

(a) CMOS

(b) Tunnel diode

(c) Charge coupled device

4. (a) Discuss a power supply with block diagram. 3

(b) Define low pass, high pass, band pass and band reject filters. 2

Or

Show how the input voltage wave is modified in presence of the C filter.

5. With a neat sketch, explain the working of a monostable multivibrator. 3

6. (a) What is phase locked loop (PLL)? Discuss its necessity. 2

(b) Show how an XOR gate can be used as phase detector and discuss its phase detector response curve. 3

Or

Discuss varactor as a voltage-controlled oscillator.

7. Describe the basic steps involved in integrated circuit fabrication process. 3

Or

Discuss electronic grade silicon mentioning its properties.

8. What do you mean by positive and negative masking effects in the fabrication process? 1+1=2

9. Write a short note on any *one* from the following : 2

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

10. How many communication wires are available in an RS232 serial bus? Write down the full form of UART. 1+1=2

11. Discuss the three handshaking lines of GPIB. 3

Or

Discuss the characteristics of GPIB.

12. (a) Draw the block diagram of electronic communication system. 2

Or

Why is modulation important in communication system?

- (b) Explain any *one* of the following types of digital modulations : 3
- (i) FSK types
 - (ii) ASK types
 - (iii) PSK types

- (c) Give the mathematical analysis of AM wave. 3

13. 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.

Paper : DSE-2 (C)

(**Physics of Earth**)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

1. Choose the correct answer/Fill in the blanks
(any eight) :

1×8=8

(a) Milky Way galaxy 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 earth

(ii) under the earth

(iii) above the surface of a planet

(iv) All of the above

- (c) Freshwater accounts for _____ of the water on the earth.
- (i) 2.5%
 - (ii) 5%
 - (iii) 7.5%
 - (iv) 10%
- (d) What is the point on the earth's surface directly above an earthquake form?
- (i) Earthquake centre
 - (ii) Epicentre
 - (iii) Fault
 - (iv) Focus
- (e) Volcanoes are associated with all of the following areas, *except*
- (i) rift zone
 - (ii) epicentre
 - (iii) subduction zone
 - (iv) hot spots
- (f) The combined portion of the earth in which all living things exist is called
- (i) biome
 - (ii) ecosystem
 - (iii) community
 - (iv) biosphere

- (g) Eons and eras are units of ____.
- (h) What is the atmospheric layer closest to the ground?
- (i) Mesosphere
 - (ii) Troposphere
 - (iii) Thermosphere
 - (iv) Stratosphere
- (i) Gravitational force is ____ (strongest/weakest) at the centre of the earth.
- (j) Photosynthesis, decomposition, respiration and combustion are the four steps of
- (i) water cycle
 - (ii) nitrogen cycle
 - (iii) carbon cycle
 - (iv) phosphorous 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. 5

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

Or

Define meteorology. Describe 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 do 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 crusts? Mention three most common elements of the earth's crust. $1+2+2=5$

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

Or

Discuss in detail about the 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 about the principle of uniformitarianism. 3

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

(c) Define geological time scale. 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? How does the evolution of the solar system may lead to the death of the earth? 2+3=5

6. Answer any two from 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? How can they lead to environmental pollution?
