

**2024/TDC (CBCS)/EVEN/SEM/
PHSDSE-601T (A/B)/097**

TDC (CBCS) Even Semester Exam., 2024

PHYSICS

(6th Semester)

Course No. : PHSDSE-601T

Full Marks : 70

Pass Marks : 28

Time : 3 hours

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

Candidates have to answer either from Option—A
or from Option—B

OPTION—A

Course No. : PHSDSE-601T (A)

(Astronomy and Astrophysics)

UNIT—I

1. Answer any four of the following questions :

$1 \times 4 = 4$

- (a) What aspect of a sphere's geometry is essential for understanding the celestial sphere?**

(2)

- (b) What is the duration of sidereal day in solar time?
 - (c) Define radiant flux in astronomy.
 - (d) Define one method used in the determination of temperature of a star.
 - (e) What is the significance of apparent magnitude scale in astronomy?
2. Answer any one of the following questions :

- (a) Explain how astronomers determine the radius of a star using observational data and theoretical models.
- (b) What is local sidereal time (LST)?

3. Answer any one of the following questions :

- (a) Define astronomical coordinate system and their significance. Explain the equatorial coordinate system (right ascension and declination) in connection with the position of a stellar object. Outline the methods for converting different coordinate systems.

1+5+2=8

- (b) Explain the concept of sidereal time and its relationship to the apparent motion of star. Define apparent solar time and describe its connection to the position of

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(3)

sun in the sky. Explain how apparent solar time differs from mean solar time and explain why this difference occurs. Describe the factors contributing to variations in the equation of time.

2+4+2=8

UNIT-II

4. Answer any four of the following questions :

1×4=4

- (a) What does resolving power refer to in context of telescope?
- (b) What are atmospheric windows in observational astronomy?
- (c) Name the types of detector commonly used in telescope.
- (d) What is the range of the magnitudes of stars which can be seen without the help of a telescope?
- (e) What is the type of telescope which has chromatic aberration?

5. Answer any one of the following questions :

2

- (a) Explain how the detectors in telescopes enhance the astronomical observation.

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(4)

- (b) Why are the atmospheric windows important for ground-based astronomical observation?
6. Answer any one of the following questions : 8
- (a) Explain the main two types of telescope mounting. Discuss with the help of a diagram the equatorial mounting. 4+4=8
- (b) Discuss in detail the basic component of an optical telescope and explain the function of each component.
- UNIT—III
7. Answer any four of the following questions : 1×4=4
- (a) What is solar corona?
- (b) What do stellar spectra reveal about stars?
- (c) Name the surface layer of the sun.
- (d) What is the approximate temperature of the sunspot?
- (e) What is tidal force?
8. Answer any one of the following questions : 2
- (a) Describe the composition, structure and possible origin of planetary rings.

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- (b) Explain how the tidal forces influence the celestial bodies within a system.
9. Answer any one of the following questions : 8
- (a) Define and explain the properties of solar corona. Explain in brief the nebular model and its implication for the formation of solar system. Describe the structure of the sun including interior and surface layer. 2+4+2=8
- (b) Define the blackbody approximation and its application to stellar radiation. Describe the construction of H-R diagram plotting stellar luminosity against surface temperature. 2+4+2=8
- UNIT—IV
10. Answer any four of the following questions : 1×4=4
- (a) What are the main types of galaxies in Hubble's classification?
- (b) What is galactic bulge and where is it located within the Milky way?
- (c) Which class of the star the halo of the Milky way mainly contain?

(6)

- (d) Name the type of galaxy that is not included in Hubble's classification system.
- (e) What is the approximate distance of our solar system from the centre of our galaxy?
11. Answer any one of the following questions : 2

- (a) Describe the properties of galactic nucleus.
- (b) Describe the basic structure and properties of Milky way.

12. Answer any one of the following questions : 8

- (a) Describe Hubble's morphological classification of galaxies. What feature forms the basis of this classification and distinguishes the subclasses? 3+5=8
- (b) Draw a neat sketch of the Milky way galaxy as seen from the sun showing its different parts and indicate on it the distribution of (i) gas and dust, (ii) population I star and (iii) population II star including globular clusters.

$$4+1+1+2=8$$

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(7)

UNIT—V

13. Answer any four of the following questions :

$$1 \times 4 = 4$$

- (a) What is the primary role of dark matter in cosmology?
- (b) How are the Cepheid variables utilized in measuring distances in space?
- (c) What evidence supports the Big Bang theory as the most widely accepted explanation for the origin of universe?
- (d) Name the method used in cosmic distance ladder aside from Cepheid variables.
- (e) State virial theorem.

14. Answer any one of the following questions : 2

- (a) What does Hubble's law suggest about the relationship between distance and velocity in universe?
- (b) What is cosmic distance ladder? Write the different steps involved in it.

15. Answer any one of the following questions : 8

- (a) Write short notes on the following : $4 \times 2 = 8$
- (i) Hubble's law
- (ii) Big Bang theory

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- (b) Explain the application of virial theorem in estimating the masses of astronomical systems. How this theorem (virial theorem) relates the potential and kinetic energies of particles within a gravitationally bound system? Explain how it can be used to galaxy dynamics and dark matter.

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OPTION—B

Course No. : PHSDSE-601T (B)

(Nanomaterials and Applications)

UNIT—I

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

$1 \times 4 = 4$

- (a) What do you mean by nanoscience?
(b) Name the scientist who first used the term 'nanotechnology'.
(c) Give an example of naturally occurring nanostructure.
(d) What is quantum dot?
(e) What do you mean by band gap of a particle?

2. Answer any *one* of the following questions : 2

- (a) Explain the term 'quantum confinement'.
(b) Write the difference between nanoscience and nanotechnology.

(10)

3. Answer any one of the following questions : 8

- (a) A particle of mass m is confined in an infinite 1D box. It is described by the function

$$V(x) = \begin{cases} 0 & \text{if } 0 < x < L \\ \infty & \text{otherwise} \end{cases}$$

Using Schrödinger equation, derive the normalized wave function. Also find the ground-state energy and the ratio of first excited energy and ground-state energy.

4+2+2=8

- (b) (i) Briefly explain different nanostructures based on their quantum confinement. 4

- (ii) Explain how the property of a nanoparticle changes with size in case of band gap. 4

UNIT-II

4. Answer any four of the following questions :

1×4=4

- (a) Give an example of top down method used in the synthesis of nanoparticles.
 (b) Write the full form of PVD, a synthesis technique of nanoparticle.

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(11)

(c) Write one advantage of sol-gel technique.

(d) "Ball milling is a Bottom-up approach." State true or false.

(e) What do you mean by photolithography?

5. Answer any one of the following questions : 2

(a) Differentiate between top down and bottom up approach used for the synthesis of nanostructure material.

(b) Mention two synthesis techniques of nanoparticle based on bottom-up approach.

6. Answer any one of the following questions : 8

(a) Describe in detail any one of the top-down approaches used for the synthesis of nanostructure material.

(b) Describe in detail any one of the bottom-up approaches used for the synthesis of nanomaterial.

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UNIT—III

7. Answer any four of the following questions : $1 \times 4 = 4$
- (a) What do you mean by characterization?
 - (b) What is thermionic emission?
 - (c) Write the full form of TEM.
 - (d) Write the name of any crystal defect.
 - (e) Write the Bragg's law in connection with X-ray diffraction.
8. Answer any one of the following questions : 2
- (a) Write the difference between optical microscopy and electron microscopy.
 - (b) What is Coulomb blockade effect?
9. Answer any one of the following questions : 8
- (a) (i) Explain in detail the different properties of nanoparticle. 4
(ii) Explain the working principle of Scanning Electron Microscope (SEM) with a suitable sketch. 4
 - (b) (i) Name any three material characterization techniques for nanoparticle. 3
(ii) Explain the working principle of TEM with a neat sketch. 5

UNIT—IV

10. Answer any four of the following questions : $1 \times 4 = 4$
- (a) What do you mean by dielectric constant?
 - (b) Mention one example of indirect band gap semiconductor.
 - (c) What is quasi-particle?
 - (d) Write the full form of CNT.
 - (e) What do you mean by exciton?
11. Answer any one of the following questions : 2
- (a) Distinguish between direct and indirect band gap semiconductor.
 - (b) Write the difference between photoluminescence and electroluminescence.
12. Answer any one of the following questions : 8
- (a) (i) What do you mean by diffusion? Explain different types of diffusion. $1 + 3 = 4$
(ii) Explain how different optical parameters of nanoparticle can be calculated by optical absorption spectroscopy. $1 + 3 = 4$

(14)

- (b) Explain in detail the different optical properties of heterostructures and nanostructures. $4+4=8$

UNIT—V

13. Answer any four of the following questions :

$$1 \times 4 = 4$$

- (a) Name one application of nanoscience in material science.
(b) Give an example of photonic device.
(c) What is electronic nose?
(d) Mention one application of carbon nanotube.
(e) What is the full form of MEMS?

14. Answer any one of the following questions : 2

- (a) What is molecular manufacturing?
(b) How is nanoparticle used for the treatment of cancer?

15. Answer any one of the following questions : 8

- (a) Write short notes on (i) LED and
(ii) solar cell. $4+4=8$

(15)

- (b) "There is plenty of room at the bottom." Explain the meaning of the statement with reference to the lecture given by Richard P. Feynman.

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