2023/TDC(CBCS)/EVEN/SEM/ PHSDSE–601T (A/B)/011

TDC (CBCS) Even Semester Exam., 2023

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 from _either_ Option—A _or_ Option—B

OPTION—A

Course No. : PHSDSE–601T (A)

(Astronomy and Astrophysics)

SECTION—A

Answer any _twenty_ questions from the following :

1×20=20

1. Which great circle passes through two poles?

2. What will be the zenith distance for the altitude _A_ ?

(2)

3. What is the range of magnitude of a star which can be seen without the help of a telescope?

4. Name the points of intersection of ecliptic and celestial equators.

5. What will be the hour-angle of a star when it is on the observer's meridian?

6. The light gathering power of a telescope depends on what?

7. What is the optical range for optical window?

8. What is f-ratio of a telescope?

9. Give one example of a space telescope.

10. On what factor resolving power of a telescope depends?

11. What is the approximate temperature of sunspot?

12. What is the source of energy in the core of the sun?

13. Which solar planet has largest mass?

14. What is the sequence of classification of star?

(Continued)

(3)

15. What is the name of the graph between luminosity and effective temperature of stars?

16. What is the possible size of central bulge of our galaxy?

17. Which class of stars, the central bulge of the Milky Way mainly contains?

18. What are the typical size of a globular cluster?

19. Which class of the stars does the disc of the Milky Way mainly contains?

20. Dark matter is experienced by gravitational attraction. Write True or False.

21. What is a cephoid variable?

22. Who is the father of Big Bang theory?

23. What is the distance of Venus from Earth?

24. What is the period of cephoid variable?

25. What is Hubble's constant?

(Turn Over)

(4)

SECTION—B

Answer any *five* questions from the following :
2×5=10

26. Write the values of declination of the celestial equator and pole.

27. Write two uses of detectors when they are used with telescope.

28. Draw and label the Newtonian telescope.

29. Write down two salient features of black-body spectrum.

30. Define sunspot.

31. Define galactic halo.

32. Define rotation curve of a spiral galaxy.

33. What is virial theorem?

34. Define dark matter.

35. What are sidereal time and mean solar time?

(Continued)

(5)

SECTION—C

Answer any *five* questions from the following :
8×5=40

36. *(a)* Draw the celestial sphere and label zenith, nadir, celestial pole, celestial meridian, celestial equator and ecliptic. 3

   (b) Explain briefly the equatorial coordinate system. 5

37. What are apparent and absolute magnitude of a star? Derive the relation between them. The apparent magnitude of sun is −26·74. Determine the absolute magnitude of sun. 3+3+2=8

38. Discuss in brief the different types of reflecting telescope.

39. Compare the advantage and disadvantage of reflecting telescope. 4+4=8

40. Sketch HR diagram and discuss briefly the various spectral classes of star.

41. Explain briefly the UVF photometric system.

42. Explain PP chain reaction and CNO-cycle. What are binary stars? Discuss briefly the classification scheme of binary stars. 2+2+1+3=8

(Turn Over)

(6)

43. Derive Jeans condition for star formation in molecular cloud. Explain the physical significance of Jeans limit. 6+2=8

44. Discuss briefly the Big Bang and steady-state model of the universe.

45. State and explain Hubble's law. Give a physical interpretation of the Hubble's constant. 6+2=8

(7)

OPTION—B

Course No. : PHSDSE–601T (B)

(Nanomaterials and Applications)

SECTION—A

Answer any *twenty* questions from the following : 1×20=20

1. How many nanometers are contained in one meter?

2. What do you mean by 1D nanostructure?

3. What is a nanodot?

4. What is a thin film?

5. What do you mean by density of states of a material?

6. Write the name of any one synthesis technique of nanostructured materials.

7. Write the full form of MBE in connection with synthesis of nanomaterial.

8. What is colloidal solution?

9. What is meant by sol gel?

(8)

10. What do you mean by annealing?

11. What is the full form of XRD in structural characteristic of materials?

12. Write the name of an instrument used for imaging nanoparticle.

13. What do you mean by point defects?

14. Mention any two types of carrier transport mechanism in nanostructures.

15. Write the empirical formula for obtaining crystallite size.

16. What do you mean by red shift?

17. Define dielectric constant.

18. What is quasi-particle?

19. Give an example of indirect band gap semiconductor.

20. What is exciton?

21. Mention one application of quantum dot.

22. Write the full form of MEMS.

(Continued)

(9)

23. Give an example of thin-film photonic device.

24. What is Carbon Nano Tube (CNT)?

25. Name one application of nanotechnology in medical science.

SECTION—B

Answer any *five* questions from the following :

2×5=10

26. Write two objectives of nanotechnology.

27. Explain quantum confinement of nanoparticles.

28. Explain the top-down approach of synthesis of nanoparticle with suitable diagram.

29. What is the difference between physical vapour deposition (PVD) and chemical vapour deposition (CVD)?

30. Distinguish between optical microscopy and electron microscopy.

31. Explain in brief the 'Coulomb blockade effect'.

32. Differentiate between direct and indirect band-gap semiconductors.

(Turn Over)

33. Mention two negative effects of nanoparticle.

34. Briefly explain photoluminescence phenomenon with a suitable example.

35. What do you mean by magnetic quantum well?

SECTION—C

Answer any *five* questions from the following :

8×5=40

36. *(a)* Explain the difference between 1D, 2D and 3D nanostructures based on quantum confinement of carriers. 4

    (b) Write a short note on band structure and density of states of materials at nanoscale. 4

37. *(a)* What is $\left(\dfrac{S}{V}\right)$ ratio? Explain how the property of a nanoparticle changes with size w.r.t. $\left(\dfrac{S}{V}\right)$ ratio. 1+3=4

    (b) What is Schrödinger wave equation? What are the two types of Schrödinger equation? Write one of the applications of Schrödinger wave equation. 1+2+1=4

38. Describe with a schematic diagram, the synthesis of nanostructure materials by any *one* of the following techniques :

    (a) Spray pyrolysis

    (b) Photolithography

    (c) Pulsed laser diposition

    (d) Thermal evaporation

Write one advantage and one disadvantage of that technique. 6+2=8

39. What do you mean by bottom-up approach for the synthesis of nanostructure materials? Describe any one of the bottom-up approach and hence discuss the advantages and disadvantages of bottom-up approach. 2+4+2=8

40. What do you mean by the characterization of nanoparticle? Mention any three techniques used for characterizing nanoparticles and explain any one of them. 1+3+4=8

41. Describe with schematic diagram the principle and working of transmission electron microscope (TEM).

42. Explain in detail the different optical properties of heterostructures and nanostructures. 4+4=8

43. *(a)* Explain the different properties of nanoparticle in detail. 4

   (b) Differentiate among metals, semiconductors and insulators in terms of energy band gap. 4

44. *(a)* Explain with a schematic diagram the principle and working of LED. 4

   (b) Explain the meaning of the statement given by Richard Feynman, "there is plenty of room at the bottom." 4

45. *(a)* Write a short note on the Nano Electromechanical System (NEMS). 4

   (b) Discuss the applications of Carbon Nano Tube (CNT) in electronics. 4

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