2021/TDC(CBCS)/EVEN/SEM/
PHSDSE-601T/098

TDC (CBCS) Even Semester Exam.,
September—2021

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* Option—B

OPTION—A

Course No. : PHSDSE-601T (A)

(Astronomy and Astrophysics)

SECTION—A

Answer any *twenty* questions : 1×20=20

1. What is the name of the great circle passing through the poles of Earth?

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

3. At which points spin-axis of Earth intersects the celestial sphere?

4. What is the duration of mean solar day?

5. What is the angle between the orbit of the fictitious Sun and the celestial equator?

6. What is one light-year?

7. What is the range of the magnitudes of stars which can be seen without the help of a telescope?

8. What is the distance of objects from the observer for the absolute magnitude?

9. What is *f*-ratio of a telescope?

10. What is the type of telescope which has chromatic aberration?

11. On which factors resolving power of a telescope depends?

12. What is the light sensitive element used in a CCD?

13. Write one main advantage of an infrared telescope.

14. Write one main advantage of a radio telescope.

15. Write the name of one famous space telescope.

16. What will be the type of telescope which has 2 m diameter?

17. What is the source of energy in the core of the Sun?

18. What is the time period of solar magnetic activity for getting the same polarity?

19. What is the time interval for having consecutive maximum number of sunspots?

20. Up to what latitude (approx.) the sunspots lie?

21. Which solar planet has the largest mass?

22. Which solar planet has the smallest period of revolution?

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

24. What is the sequence of classification of stars?

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

26. In which season, a person in the north hemisphere on the Earth sees towards the centre of the Milky Way in the night?

27. What is the typical size of a globular cluster?

28. Which class of the stars, does the disc of the Milky Way mainly contain?

29. In the halo of Milky Way, the rotational speed and random speed, respectively, are small and large. State true or false.

30. Which class of the stars, the halo of the Milky Way mainly contains?

31. In which season, a person in the south hemisphere on the Earth sees towards the centre of the Milky Way in the night?

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

33. Dark matter is experienced by the gravitational attraction. State true or false.

34. What is the latest measured value of Hubble's constant?

35. What is a Cepheid variable?

36. What is the average temperature of Cepheid variables?

37. What is the period of Cepheid variable?

38. What are Cepheid variables used for?

39. Who is the father of Big-bang theory?

40. What is the distance of Venus from the Earth?

SECTION—B

Answer any *five* questions : 2×5=10

41. What is local sidereal time (LST)?

42. What are the declinations of the celestial equator and the celestial pole?

43. Define light gathering power of a telescope.

44. What is Coudé focus?

45. What is solar corona?

46. Write two salient features of black-body spectrum.

47. Define galactic halo.

48. Define rotation curve of a spiral galaxy.

49. What is virial theorem?

50. Define dark matter.

SECTION—C

Answer any *five* questions : 8×5=40

51. Discuss the horizontal coordinate system to locate the position of a stellar object. What are meant by right ascension and declination? 5+3=8

52. What are apparent and absolute magnitudes of a star? Derive the relation between them. The apparent magnitude of the Sun is –26·74. Determine the absolute magnitude. 3+3+2=8

53. Discuss in brief about the different types of reflecting telescopes with the help of diagrams. 8

54. Compare the advantages and disadvantages of reflecting and refracting telescopes. 8

55. Draw a schematic diagram showing the variations of density and temperature in layers of the Sun's atmosphere starting from the photosphere. 8

56. Sketch the Hertzsprung-Russell diagram and explain briefly all the components. 8

57. Describe Hubble's morphological classification of galaxies. What are the principal observable features that form the basis for this classification? What features distinguish the subclasses? 5+2+1=8

58. 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 *(a)* gas and dust, *(b)* population I stars and *(c)* population II stars including the globular clusters. 4+1+1+2=8

59. State Hubble's law. Using this law, derive the conclusion that the expanding universe has no central point. Give a physical interpretation of the Hubble's constant. 2+4+2=8

60. Write a short note on Big-bang theory with observational evidence. 8

OPTION—B

Course No. : PHSDSE-601T (B)

(Nanomaterials and Applications)

SECTION—A

Answer any *twenty* questions : 1×20=20

1. One nanometre is equal to how much metre?

2. Which scientist used the term 'nano-technology' first and when?

3. What is the size of a virus and width of a DNA molecule?

4. Define nanoscience.

5. What is the origin of the prefix 'nano'?

6. What is quantum confinement of carriers in nanodot?

7. What is a unit cell and a primitive cell?

8. What is the nature of valence band and conduction band?

9. Write the full forms of PVD and CVD.

10. What do you understand by synthesis of nanomaterials?

11. What is lithography?

12. What is a sol?

13. What is bottom-up approach in case of synthesis of nanoparticles?

14. Give two synthesis methods that follow top-down approach.

15. What is the basic approach of chemical method?

16. What type of beam is used to anneal quantum well?

17. Explain thermionic emission.

18. Write the empirical formula for obtaining crystallite size.

19. What is the significance of Bragg's law?

20. Write the full forms of STM and AFM.

21. What do you understand by the characterization of nanoparticles?

22. In which instrument contact and non-contact modes are used for the purpose of surface imaging?

23. What is determined by X-ray diffraction study?

24. What is the main difference between STM and AFM?

25. Name the scientist who proposed the dual nature of matter.

26. What is PVA matrix?

27. Name different growth modes observed during thin film growth.

28. How does the melting point of materials change when particle size is reduced?

29. What is blue shift effect?

30. What is photoluminescence?

31. How is a dielectric material polarized?

32. Give two examples where the bulk properties get modified upon size reduction.

33. Give two properties of carbon nanotube.

34. List any four commercial applications of nanotechnology.

35. Give two applications of quantum dots.

36. What is graphene?

37. What is magnetic nanoparticle?

38. Name two applications of nanoscience in material science.

39. Name two nanomaterial devices.

40. What are the applications of nanocrystalline diamond (NCD) films?

SECTION—B

Answer any *five* questions : 2×5=10

41. Write the characteristics of three types of nanoparticles.

42. What is the difference between nanoscience and nanotechnology?

43. Differentiate between top-down and bottom-up approaches.

44. Write the differences between solid-state reaction route and sol-gel route.

45. Deduce Bragg's law in case of X-ray diffraction.

46. What do you understand by elastic scattering and inelastic scattering of electrons?

47. Explain the different growth modes observed during thin film growth.

48. What are nanocomposites? Mention one method of synthesis.

49. Explain how the band gap of a material changes when taken from bulk to nano-structure.

50. How is nanotechnology useful in destroying tumours of cancer?

SECTION—C

Answer any *five* questions : 8×5=40

51. "Nanoscience is not a new science." Comment with reference to—

(a) addressed by Richard P. Feynman;

(b) presence of nanoscience in nature. 4+4=8

52. *(a)* How does the property change with size—

(i) in case of band gap;

(ii) with respect to surface to volume ratio? 2+2=4

(b) Differentiate between metal, semi-conductor and insulator in terms of energy band gap. 4

53. Describe with schematic diagram the principle and working of transmission electron microscope. 8

54. *(a)* List any four material characterization techniques for nanoparticles. 2

(b) Explain the working principle of AFM with a neat sketch. 6

55. *(a)* Give a schematic of electron-beam lithography and UV lithography processes to create well-defined nano-structures. 3+3=6

(b) Give two main points of difference between PVD and CVD. 2

56. *(a)* Write a short note on nanofabrication. 4

(b) What do you understand by the term 'microfabrication'? 4

57. *(a)* What are different types of diffusion? 2

(b) What are the mechanisms governing material diffusion? 2

(c) State and explain first and second law of diffusion. 2

(d) What is cohesive energy? How does it change with particle size? 2

58. *(a)* What are the properties of nano-particles? Explain in detail. 4

(b) Give short account of nanotubes and nanowires. 2

(c) Explain quantum confinement. 2

59. *(a)* Discuss the applications of nano-technology in the fields of electronics and medicine. 4

(b) Explain the good and bad effects of nanotechnology for the environment. 4

60. Write short notes on the following : 4×2=8

(a) LED

(b) Solar cell

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