PG Even Semester (CBCS) Exam., May—2018

PHYSICS

(2nd Semester)

Course No. : PHYOC–203

<u>Full Marks : 70</u>
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 : PHYOC–203 (A) *or* Option—B : PHYOC–203 (B) *or* Option—C : PHYOC–203 (C)

OPTION—A

Course No. : PHYOC–203 (A)

(BASIC ASTRONOMY)

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* Discuss different spherical coordinate systems used in astronomical observation. 10

   (b) Describe the diurnal circles of stars seen from the equator. What are circumpolar stars? 2+2=4

2. *(a)* Define sideral, apparent and mean solar time. Write their relation. 6

   (b) What is Julian date? What is the importance of heliocentric correction? 2+2=4

   (c) Write a brief note on Zodiac belt. 4

UNIT—II

3. *(a)* What is distance modulus? Obtain its relation. 2+3=5

   (b) What is colour index? Discuss how colour index gives an estimate of the spectral type of the star. 2+3=5

   (c) Discuss how variable stars are used as distance indicators. 4

4. Write short notes on the following : 7+7=14

   (a) Reflecting telescope and the basic optics involved

   (b) CCD and its uses in astronomical telescope

(3)

UNIT—III

5. *(a)* Write a brief note on the origin and evolution of the solar system.   9

(b) What are meteorites? How are they formed?   2+3=5

6. *(a)* What are sunspots? Explain how sunspots prove the existence of magnetic field of the sun. By studying the sunspot, how can one infer that the sun is rotating?   2+3+4=9

(b) Discuss the origin of comets.   5

UNIT—IV

7. *(a)* What is a brown dwarf?   2

(b) What do you understand by the Chandrasekhar's limit?   2

(c) Briefly explain various stages of evolution of a 15 $M_\odot$ star.   10

8. Write brief notes on the following :   7+7=14

(a) Galactic rotation

(b) Star formation in molecular cloud

(4)

UNIT—V

9. *(a)* What could be the possible explanation for the existence of very massive objects/stars of the centre of our galaxy? Discuss briefly.   6

(b) Write a detailed note on the classification scheme for external galaxies.   8

10. *(a)* What do you understand by dark matter and dark energy?   3+3=6

(b) What is C-field? Describe briefly the steady-state model of the Universe.   8

(5)

OPTION—B

Course No. : PHYOC–203 (B)

(World of Nano)

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. (a) What are nanomaterials and nano-technology? Mention a few reasons why nanomaterials are so special.   4+4=8

   (b) What is quantum confinement? Explain briefly the ideas of strong confinement and weak confinement.   2+4=6

2. (a) What are the semiconductors and metal nanomaterials? Discuss their properties.   4+4=8

   (b) Explain in short many-body Finnis and Sinclair(FS) potential and many-body embedded atom (EAM) potential.   6

UNIT—II

3. What are the top and bottom-up approaches to prepare nanomaterials? Discuss in detail the advantages and disadvantages of the two approaches.   8+3+3=14

4. Write different synthesis techniques of nanomaterials. Discuss in brief the vapour deposition and sol-gel methods for nanomaterial synthesis.   4+5+5=14

(6)

UNIT—III

5. (a) Name a few different characterization techniques of nanomaterials.   4

   (b) How is the UV-VIS spectroscopy technique used to determine the band gap of nanomaterials?   10

6. (a) Discuss in detail the X-ray diffraction technique to determine the nanocluster size.   8

   (b) How are SEM and TEM useful to characterize nanomaterials?   6

UNIT—IV

7. (a) What is swift-ion irradiation? Explain in detail its mechanism.   3+6=9

   (b) Mention a few applications of swift-ion irradiation.   5

8. (a) What is Gibbs' phase rule? Discuss the comparison of phase transitions between small and large systems.   2+6=8

   (b) Write short notes on the following :   3+3=6
   (i) Micellization
   (ii) Crystallization

UNIT—V

9. *(a)* What are the applications of nanomaterials? How are nanomaterials risky in human health? 6+2=8

(b) How are nanomaterials used in light emitting and detecting devices? 6

10. *(a)* Explain in detail how some nanomaterials are antibacterial elements. Discuss the role of nanomaterials in drug-delivery system. 4+4=8

(b) What are carbon nanotubes? Mention in short the uses of carbon nanotubes. 2+4=6

OPTION—C

Course No. : PHYOC–203 (C)

(Electronic Devices and Circuits)

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* What is semiconductor? Discuss some important properties of semiconductor. 2+5=7

(b) Distinguish between n-type and p-type semiconductors. How are they formed? 2+5=7

2. Define 'hole-electron pair' in semiconductor. Give the mechanism of hole current flow in semiconductor. Why does semiconductor behave as insulator at ordinary temperature? 3+7+4=14

UNIT—II

3. What is a photodiode? Explain the working principle of a photodiode and hence discuss its current-voltage characteristics. How does a photodiode differ from a rectifier diode? 2+4+6+2=14

4. *(a)* Discuss the input and output characteristics of a transistor in CE configuration. 5+5=10

(b) Show that the base current amplification factor in CE transistor is

$$\overline{}$$
$$1$$

where   is the current amplification factor in CB configuration. 4

UNIT—III

5. *(a)* Explain the working of a full-wave rectifier. Give proper circuit diagram. 7

(b) Define rectifier efficiency and ripple factor. 3

(c) Show that the maximum rectifier efficiency of half-wave rectifier is 40·6%. 4

6. *(a)* State the Barkhausen criteria for sustained oscillation. 2

(b) With a neat circuit diagram, discuss the working of a Hartley oscillator. How does it differ from Colpitts oscillator? 4+6+2=12

UNIT—IV

7. *(a)* Simplify the following using Boolean laws : 3½×2=7

(i) $Y = AB + ABC + \overline{A}B + A\overline{B}C$

(ii) $Y = (A + B + C)(A + B)$

(b) Realize NOT operation in a circuit using transistor. Give circuit diagram. 7

8. *(a)* State and prove De Morgan's theorem. 6

(b) Convert the following : 4+4

(i) From binary to decimal number system—1011, 1101·1010

(ii) From decimal to binary number system—88, 55·66

UNIT—V

9. *(a)* Distinguish among amplitude, frequency and pulse modulation. 6

(b) Derive the expression for the FM voltage wave. 8

10. *(a)* Write short notes on any *two* of the following : 4×2=8

(i) Sampling theorem

(ii) PAM

(iii) PWM

(b) Discuss the working of a single-channel analyser. 6

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