PG Even Semester (CBCS) Exam., May—2017

PHYSICS

(2nd Semester)

Course No. : PHYOC–203

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 : 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 the equatorial system of coordinates. 10

(b) What is the local sidereal time (LST) of a place? Find LST of Silchar on October 23, 2017 at midnight (longitude of Silchar 92 46). 1+3=4

2. *(a)* Define the following : 2×5=10

(i) North celestial pole (NCP)

(ii) Celestial equator

(iii) Constellation

(iv) Greenwich Mean Time

(v) Zenith and Nadir

(b) What do you mean by precession of Earth? 4

UNIT—II

3. Define luminosity and astronomical magnitude of a star. What is the difference between apparent magnitude (m) and absolute magnitude (M)? If the apparent magnitude of a Cepheid variable is 7 and if it has a periodicity of 36 hours, then find out its distance. The Cepheid follows a period luminosity relation $M \quad 2\ 7\log_{10}(P) \quad 4\ 0$; P is in days. 6+8=14

4. List the main important features of an astronomical telescope. Derive the 'plate scale' of a telescope in terms of objective diameter and focal length. A one meter telescope has f /13 beam and a CCD at the focal plane with 20 m pixel size. What will be the angular resolution of the system? 4+6+4=14

UNIT—III

5. Discuss briefly different layers of the solar atmosphere. Also discuss different transient phenomena that take place on solar photosphere. Discuss about sunspot and their cycles. 5+4+5=14

6. What is a comet? How are comets classified? Also discuss how comets are designated? Discuss the origin of comets. 1+3+4+6=14

UNIT—IV

7. *(a)* Discuss different spectral types of stars. 8

(b) Write a short note on HR diagram. 6

8. *(a)* Discuss the structure and morphology of our galaxy. 6

(b) Discuss missing mass problem of galaxies. 4

(c) Write a short note on Neutron star. 4

UNIT—V

9. What is Milky Way? Derive the lower limit of the mass of our galaxy assuming that the sun is at a distance of 8 kpc from galactic center and rotating at a speed of 250 km/sec. Hence discuss about the concept of 'Dark Matter'. 3+8+3=14

10. State Hubble's law and discuss its significance to explain the concept that, there is 'No' central point in our universe from where the expansion of universe is taking place (show all the necessary mathematical steps). List at least four observational features about our universe and make a comparative study between 'Big Bang' and 'Steady State Theory' of the universe based on these observed facts. 6+8=14

OPTION—B

Course No. : PHYOC–203 (B)

(WORLD OF NANO)

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

UNIT—I

1. *(a)* What is Nanoscience? Why the physical property changes as the size of the nanoparticles change from bulk to nanoregime. Explain how the property is dependent upon surface to volume ratio. 2+2+2=6

(b) What do you mean by quantum confinement? Discuss quantum confinement effect on the basis of size of the nanoparticles. What are various applications of Nanotechnology? 2+2+4=8

2. *(a)* What is Finnis and Sinclair potential? Give its physical significance. 4

(b) Write short notes on the following : 5+5=10

(i) EAM potential

(ii) Nanosheet and Nanorod

UNIT—II

3. *(a)* What are the top-down and bottom-up approaches of synthesis of nano-materials? What are their advantages and disadvantages? 3+3+2+2=10

(b) Describe the lithographic technique of synthesis of nanoparticles. 4

4. *(a)* Write with proper diagram, the synthesis of nanoparticles by molecular beam epitaxy. 6

(b) Write short notes on the following : 4+4=8

(i) Vapour deposition

(ii) Laser ablation

UNIT—III

5. *(a)* Describe the working of UV-visible spectrophotometer with proper diagram. Explain why AD converter is needed before the signal is fed to the PV. 7+2=9

(b) Discuss the function of monochromator in UV-visible spectrophotometer. Explain why this equipment (UV-visible spectrophotometer) is called nonzero background type. If the absorbance of a measurement for a particular wavelength is 3, what is the ratio between I_0 and I ? 2+1+2=5

6. *(a)* Describe, with proper diagram, the working of photoluminescence spectro-fluorometer. 6

(b) Write short notes on any *two* of the following : 4+4=8

(i) XRD

(ii) TEM

(iii) SEM

UNIT—IV

7. *(a)* What is swift ion irradiation? Discuss the interaction of matter with swift ion irradiation. 2+6=8

(b) Explain how phase transition between small systems differ from those of large systems. 6

8. *(a)* What do you mean by degree of freedom? Discuss Gibbs phase rule in thermodynamics. 1+5=6

(b) Write short notes on the following : 4+4=8

(i) Micellization

(ii) Crystallization

UNIT—V

9. *(a)* Explain how fluorescent nanomaterials are used for LEDs and other light-emitting devices. What are their importance? What are different nanomaterials commonly used for LEDs? Explain how photoluminescence and electroluminescence are useful in their studies. 3+2+2+1+1=9

(b) Discuss the use of nanomaterials for light-detecting devices. 5

10. Write short notes on any *four* of the following : 3½×4=14

(a) Drug delivery system

(b) Photovoltaic cell

(c) Gas sensor

(d) Carbon nanotubes

(e) Filter

OPTION—C

Course No. : PHYOC–203 (C)

(ELECTRONIC DEVICES AND CIRCUITS)

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

UNIT—I

1. *(a)* Explain briefly the formation of bonds in solids. State the differences among insulator, metal and semiconductor using the bond theory. 2+5=7

(b) Draw energy bond diagrams of *n*-type, *p*-type and intrinsic semiconductor clearly showing VB, CB, donor/acceptor level and position of Fermi energy level. 7

2. *(a)* What is an intrinsic semiconductor? Why is intrinsic semiconductor doped with impurity atoms? Describe briefly how *p*-type and *n*-type semiconductors are created. 2+1+4=7

(b) What are electron and hole? Describe an experiment to determine the type of charge carriers in a semiconductor material. What is Hall effect? 2+3+2=7

UNIT—II

3. *(a)* Write short notes on the following (any *two*) : 3½×2=7

(i) Zener diode

(ii) LED

(iii) Photodiode

(iv) Solar cell

(b) Explain the construction and working of *N-P-N* transistor. 7

4. *(a)* Describe briefly formation of depletion region in a *P-N* junction diode. Explain *I-V* curve of a *P-N* junction diode under forward-bias and reverse-bias connections. 3+4=7

(b) What is the avalanche breakdown in Zener diode? How can a Zener diode operating in avalanche breakdown region be used as voltage regulator? What are the differences between a Zener diode and a *P-N* junction diode? 2+3+2=7

UNIT—III

5. *(a)* How is AC converted into DC? Build a rectifier circuit using two *P-N* junction diodes and explain its working. Compare this circuit with half-wave rectifier circuit. 1+4+2=7

(b) Explain the working of *N-P-N* transistor as a switch. 7

6. *(a)* What is the Barkhausen criterion for oscillation? What are the essential components of a transistor oscillator? What are the advantages of the phase shift oscillator over LC tank oscillator? 2+3+2=7

(b) For a phase shift oscillator

$R_1 \quad R_2 \quad R_3 \quad 1\ \text{M}$

and

$C_1 \quad C_2 \quad C_3 \quad 68\ \text{pF}$

At what frequency does the circuit oscillate? 3

(c) A crystal diode having internal resistance $r_f \quad 20$ is used for half-wave rectification. If the applied voltage is $V \quad 40\sin t$ and load resistance $R_L \quad 400$, find—

(i) I_m, $I_{\text{d.c.}}$, $I_{\text{r.m.s.}}$;

(ii) a.c. power input and d.c. power output. 4

UNIT—IV

7. *(a)* Write a short note on any *one* of the following : 6

(i) AND gate

(ii) OR gate

(iii) NOT gate

(b) Convert the following binary numbers to its equivalent decimal numbers : 4

11001011, 1101·1011

(c) Convert the following decimal numbers to its equivalent binary numbers : 4

77, 59·31

8. *(a)* What are analog and digital signals? What do '1' and '0' represent in a digital system? 3

(b) What is Boolean algebra? Write De Morgan's theorem. 3

(c) Using Boolean techniques, simplify the following expressions : 4+4=8

(i) $Y \quad (A \quad B \quad C)\ (A \quad B)$

(ii) $Y \quad \overline{(B\overline{C} \quad \overline{B}C)}$

UNIT—V

9. *(a)* What are modulation and de-modulation in radio communication? What is a carrier wave? Why is modulation necessary in communication system? 2+1+4=7

(b) What is amplitude modulation? Derive mathematical expression for an amplitude modulated wave and show that it contains upper side band and lower side band frequencies. 7

10. *(a)* What is frequency modulation? Describe briefly. What are the advantages of frequency modulation (FM) over amplitude modulation (AM)? 1+3+3=7

(b) A sinusoidal carrier voltage of frequency 10 MHz and amplitude of 100 volts is amplitude modulated by sinusoidal voltage of frequency 10 kHz producing 50% modulation. Calculate the frequency and amplitude of lower and upper side band terms. 7

★ ★ ★