UPES SAP ID No.: _____

UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Examination, July 2020

Programme: B. Sc. (Hons) Physics
Course Name: Radiation Physics
Course Code: PHYS 2019
No. of page/s: 7

Semester : IV
Max. Marks : 100
Attempt Duration : 3 Hrs.

Note:

1. Read the instruction carefully before attempting.
2. This question paper has two section, Section A and Section B.
3. **Section A** consists of 32 multiple choices based questions and has the total weightage of 60%.
4. **Section A** will be conducted online on BB Collaborate platform
5. **Section B** consists of 5 long answer based questions and has the total weightage of 40%. The questions for section B shall also appear in BB Collaborate
6. **Section B** is to be submitted within 24 hrs from the scheduled time i.e. if the examination starts at 10:00 AM, the long answers must be submitted by 09:59:59 AM next day. Similarly, if the examination starts at 2:00 PM it must be submitted by 01:59:59 PM next day. (*Exceptional provision due extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
7. No submission of **Section B** shall be entertained after 24 Hrs.
8. **Section B** should be attempted after **Section A**
9. **Section B** should be attempted on blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sap id at the top (as in the format) and signature at the bottom (right hand side bottom corner)
10. Both section A & B should have questions from entire syllabus.
11. The COs mapping, internal choices within a section is same as earlier

Section – A (Attempt all the questions)
(60 marks; 18 questions X 1 mark and 14 questions X 3 marks)

SECTION A: 18 QUESTIONS @ 1 MARK (18 MARKS)

Que. 1 LASER stands for; CO1

a. Light amplification by spontaneous emission of radiation
b. Light amplification by stimulated emission of radiation
c. Light absorption by sun-earth radiation
d. Name of a scientist

Que. 2 Ratio of probability of spontaneous emission and probability of stimulated emission is; CO2

a. Proportional to ν^2
b. Proportional to ν^3
c. Proportional to ν
d. Independent of ν

Que. 3 Laser is used in alignment of pipes because; CO1

a. They are coherent.
b. They are highly directional.
c. Both i & ii.
d. None of these.

Que. 4 In he-Ne laser, the most favorable ratio of helium to neon for satisfactory laser action is; CO2

a. 1:4
b. 4:1
c. 1:7
d. 7:1

Que. 5 An optical fibre is based on the principle of; CO1

a. Refraction of light.
b. Dispersion of light.
c. Total internal reflection.
d. None of these.

Que. 6 For an optical fibre, if $\eta_1$is the refractive index of core and η_2 is the refractive index of cladding, then; CO2

a. $\eta_1 > \eta_2$
b. $\eta_1 < \eta_2$
c. $\eta_1 = \eta_2$
d. None of the above

Que. 7 The maximum angle that a ray of light can have relative to the axis of the fibre and propagate down the fibre is known as; CO1

a. Critical angle
b. Acceptance angle
c. Bragg's angle
d. None of the above

Que. 8 An optical fibre is used to transmit; CO1

a. Optical signals
b. Electrical signals
c. Radio waves
d. None of the above

Que. 9 Annihilation is related to; CO1

a. Conversion of mass into energy
b. Conversion of energy into mass
c. Both the phenomena
d. None of the above

Que. 10 Relative stopping power is 1 in case of; CO1

a. Standard air
b. iron
c. Hydrogen
d. lead

Que. 11 The value of Compton shift is; CO2

a. 0.484 A^0
b. 0.0484 A^0
c. 4.84 A^0
d. 0.00484 A^0

Que. 12 If the kinetic energy of the incident particles passing through matter is comparable to rest mass energy, then the energy loss by the emission of electromagnetic radiation is called as; CO1

a. Compton effect
b. Bremsstrahlung
c. Straggling
d. Cherenkov radiation

Que. 13 In photo-electric emission, the recoil electron has energy; CO1

a. Less than the incident photon
b. Equal to the energy of incident photon
c. More than the energy of incident photon
d. All ranges of energy

Que. 14 The saturation current in the graph between voltage and current is called; CO1

a. Ionization region
b. Proportional region
c. Plateau region
d. None of the above

Que. 15 To get the high resolving power and low noise background, the semiconductor detector should be kept at; CO1

a. Low temperature
b. High temperature
c. Any temperature
d. None of the above

Que. 16 Cerenkov radiation is electromagnetic radiation that lies in; CO1

a. Infra-red region
b. Visible region
c. Ultra violet region
d. All above mentioned regions

Que. 17 Population growth is largely influenced by factors (apply all correct answers); CO1

a. Birth.
b. Death.
c. Migration.
d. All of the above.

Que. 18 July 11 is; CO1

a. World Environment Day
b. World Population Day
c. World AIDS Day
d. World Education Day

SECTION A: 14 QUESTIONS @ 3 MARKS (42 MARKS)

Que. 19 A laser beam of pulse power 10^{12} W is focused on an object of area $10^{-4}\ cm^2$. The energy flux in W/cm^2 at the point of focus is; CO2

a. 10^{16}
b. 10^{20}
c. 10^{24}
d. 10^{28}

Que. 20 Fractional refractive index change (Δ) is; CO3

a. $\frac{\mu_1+\mu_2}{\mu_1}$
b. $\frac{\mu_1-\mu_2}{\mu_1}$
c. $\frac{\mu_1-\mu_2}{\mu_2}$
d. $\frac{\mu_1+\mu_2}{\mu_2}$

Que. 21 The light gathering capacity of the optical fibre is; CO3

a. $NA = \sin i_{max} = \sqrt{\mu_1^2 + \mu_2^2}$
b. $NA = \sin i_{max} = \sqrt{\mu_1 - \mu_2}$
c. $NA = \sin i_{max} = \sqrt{\mu_1^2 - \mu_2^2}$
d. $NA = \sin i_{max} = \sqrt{\mu_1 + \mu_2}$

Que. 22 In terms of fractional refractive index change (Δ), numerical aperture can be given as; CO2

a. $\mu_{1\sqrt{2\Delta}}$
b. $\mu_{2\sqrt{2\Delta}}$
c. $\mu_{1\sqrt{2\mu_2\Delta}}$
d. $\mu_{2\sqrt{2\mu_1\Delta}}$

Que. 23 The Normalized frequency parameter (V) given by; CO3

a. $\frac{2\pi a}{\lambda}\sqrt{\mu_1^2 - \mu_2^2}$

b. $\frac{2\pi a}{\lambda}\sqrt{\mu_1^2 + \mu_2^2}$
c. $\frac{2\pi\lambda}{a}\sqrt{\mu_1^2 - \mu_2^2}$
d. $\frac{2\pi\lambda}{a}\sqrt{\mu_1^2 + \mu_2^2}$

Que. 24 If Φ is the angle of scattering then Compton shift $\Delta\lambda$ is given by; CO3

a. $\frac{h}{m_0 c^2}(1 + cos\phi)$
b. $\frac{h}{m_0 c^2}(1 - cos\phi)$
c. $\frac{h}{m_0 c}(1 + cos\phi)$
d. $\frac{h}{m_0 c}(1 - cos\phi)$

Que. 25 The scintillation counters are highly suitable for detection of; CO2

a. $\alpha - rays$
b. $\beta - rays$
c. $\gamma - rays$
d. None of the above

Que. 26 Quality Factors for converting RAD to REM (or Gy to Sv) for gamma radiation is; CO2

a. 1
b. 2
c. 3
d. 4

Que.27 One Seivert (Sv) is equal to; CO2

a. 1 rem
b. 10 rem
c. 100 rem
d. 1000 rem

Que. 28 In a proportional counter, the electric field E at a distance r around the wire (or anode) is; CO3

a. $E = \frac{a}{b\ log_e(V/r)}$
b. $E = \frac{V}{r\ log_e(b/a)}$
c. $E = \frac{b}{a\ log_e(V/r)}$
d. $E = \frac{r}{V\ log_e(b/a)}$

Where **a** is the radius of the thin wire and **b** is the radius of cathode.

Que. 29 In G. M. Counter, if N particles enter the tube per second and the counter shows n particles per second then dead time can be written as; CO3

a. T = n – N
b. T = N – n
c. T = 1/N – 1/n
d. T = 1/n – 1/N

Que. 30 The energy band gap of Diamond/Silicon/Germanium is; CO2

a. 5.5, 1.12, 0.66 eV

b. 1.12, 5.5, 0.66 eV
c. 0.66, 1.12, 5.5 eV
d. 5.5, 0.66, 1.12 eV

Que. 31 The average energy to produce an electron/hole pair for Diamond /Silicon / Germanium is; CO2

a. 2.9, 3.6, 13 eV.
b. 13, 3.6, 2.9 eV.
c. 3.6, 2.9, 13 eV.
d. 3.6, 13, 2.9 eV.

Que. 32 According to 2011 census, what is the annual exponential growth rate in India? CO2

a. 1.34%
b. 1.45%
c. 1.64%
d. 1.75%

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Section – B (Attempt all the questions)
(40 marks; 5 questions X 8 marks)

Que. 33 Describe the principle, construction and working of ionization chamber. CO1

Que. 34 The photoelectric work function of Potassium is 2.0 eV. If light having a wavelength 3600 A^0 fall on Potassium, find (i) the kinetic energy in eV of the most energetic electrons ejected (ii) the stopping potential (iii) the velocity of these electrons. CO2

Que. 35 What is nuclear waste? Explain briefly the main types of nuclear waste and their disposal methods. CO1

Que. 36 Derive the Bethe- Bloch formula for the energy loss of a heavy charged particle moving through matter. CO2

Que. 37 Show that in Compton Scattering, the recoil angle of an electron is given by CO3

$$\phi = tan^{-1}\left(\frac{\cot\frac{\theta}{2}}{1+\frac{h\nu}{m_0 c^2}}\right)$$

Where, θ and φ are scattering angle of scattered photon and electron respectively.