C 83551 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE EXAMINATION, APRIL 2020

(CCSS)

M.Sc. Radiation Physics

RPH 2C 13—RADIATION PHYSICS FUNDAMENTALS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Define Attenuation.
2. Define :

   (a) Fluence. (b) Energy flux.
3. Explain Bragg-curve.
4. Charged particle equilibrium.
5. Neutron activation.
6. LET.
7. Write short note on bremsstrahlung radiation.
8. Explain the conditions at which Roentgen is effectively defined.
9. What is the effect of beam broadening in dose deposition ?

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. a) Describe Brag Gray cavity theorem and derive an expression for the volume of the cavity chamber.

Or

b) Write an essay on the production of artificial radioactive isotopes. What are the physical parameters of various radioactive isotopes used in clinical radiotherapy ?

Turn over

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11. a) i) Interaction of neutron with matter.

ii) Derive the Bethe Bloch formulae for mass collision stopping power for charged particles.

Or

b) i) Define KERMA, TERMA, dose and exposure.

ii) Explain the construction and working of ionization chamber.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Describe travelling and standing wave guide ?

13. What is the absorbed dose rate at the center of the sphere of water 1 cm in radius homogeneously radio activated by P32 with 6 × 105 disintegrations per second occurring per gram of water ?

14. A therapy centre purchases an 10000 Ci source of cobalt 60. Determine the expected exposure rate at 80 cm from this source. Exposure rate constant for cobalt 60 is 1.29 Rm2hr-1Ci-1.

15. In a standard ion chamber the limiting diaphragm has an area of 0.500 cm^2 and the length of the sensitive electrode is 8.00cm. In an irradiation a charge of 1.12×10^{-7} C is collected. Air is at STP (density 1.293 kg m^{-3}). Determine the exposure.

16. Describe travelling and standing wave guide ?

17. In a standard ion chamber the limiting diaphragm has an area of 0.500 cm^2 and the length of the sensitive electrode is 8.00 cm. In an irradiation a charge of 1.12×10^{-7} C is collected. Air is at STP (density 1.293 kg m^{-3}). Determine the exposure.

(4 × 6 = 24 marks)

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C 83550 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE EXAMINATION, APRIL 2020

(CCSS)

M.Sc. Radiation Physics

RPH 2C 12—NUMERICAL TECHNIQUES AND COMPUTER PROGRAMMING

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Write a note on geometrical interpretation of trapezoidal rule.
2. Differentiate between Algebraic and Transcendent functions.
3. Explain the Bisection method.
4. What are Newton-Cotes Integration formulae.
5. Inverse of a matrix.
6. Give an account of Regula-falsi method of finding the real root of an equation.
7. Write a short note on forward and backward differences.
8. Obtain Newton's forward interpolation formula for equal intervals.
9. Briefly Explain Milne's method, to find a solution of the differential equation.

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. a) Explain the Simpson's 1/3 rule and discuss the error in it.

Or

b) Explain the QR method with example.

11. a) i) Discuss the convergence of Newton-Raphson method.

ii) What do you mean by interpolation ? Derive Newton' s backward interpolation formula for equal intervals.

Or

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b) i) Explain Simpson's $1/3^{rd}$ rule for Numerical integration.

ii) Explain least square method for fitting a second-degree parabola $y = ax^2 + bx + c$.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Determine the constants '*a*' and '*b*' by the method of least squares such that $y = ae^{bx}$ fits the following data :

X	2	4	6	8	10
Y	4.077	11.084	30.128	81.897	222.62

13. How can we read/write structures from/to data files ?

14. Write down the formula to solve second order differential equation using Runge kutta method of fourth order.

15. Write a C program for false position method to find the root of an algebraic equation.

16. Write a program for Gauss elimination method.

17. Reduce the matrix to the tridiagonal form :

$$\begin{matrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & 1 \end{matrix}$$

(4 × 6 = 24 marks)

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SECOND SEMESTER P.G. DEGREE EXAMINATION, APRIL 2020

(CCSS)

M.Sc. Radiation Physics

RPH 2C 11—RADIATION DETECTION MEASUREMENTS AND INSTRUMENTS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any six questions.
Each question carries 3 marks.

1. What is meant by area monitoring and personnel monitoring ?
2. Single Channel Analyzer (SCA).
3. Desirable characteristics of thimble chamber.
4. Advantages and disadvantages of semiconductor detectors.
5. Principles of gel dosimetry.
6. What is meant by area monitoring and personnel monitoring ?
7. Liquid scintillation counting system.
8. Discuss Radiation Field analyser.
9. Write short note on Fricke dosimetry.

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Discuss the construction and working of simple ionisation chamber. Explain graphically various regions of gas filled operation. How the charge collection varies with voltage in a gas radiation detector ?

Or

(b) Discuss the principle of Scintillation detector. Describe the experimental set up and procedure for using it along with multi-channel analyser to determine the energy of a given gamma source.

Turn over

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11. (a) Draw the block diagram of scintillation detector and explain the working in details.

Or

(b) Describe different methods employed for the detection of fast neutrons. What is mean by 4 pi counters for neutrons.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. In a certain betatron, the maximum magnetic field wave 0.4 Tesla, operating at 60 Hz with a stable orbits of diameter 66 inches. Calculate the maximum kinetic energy of an electron injected with energy 50 KV and approximate total time of flight.

13. In a cylindrical counter, a voltage of 2000 V is applied with anode radius of 0.008 cm and cathode radius 1.0 cm. Calculate the electric field at the anode surface. Suppose the threshold electric field for gas multiplication in the filled gas is 10^8 V/m. What will be the radius at which the field exceeds this value ? What is the volume contained with in the radius ?

14. If a GM counter has a resolving time of 150 microseconds and records 10000 cpm, find the correct counting rate.

15. How long it will take to obtain an intrinsic region of 1.5 mm, in silicon water drifted at 150 °C under reverse bias of 500V ?

16. A very small, correctly calibrated dosimeter records an exposure of 200 mR when embedded in solid bone and irradiated with HVL 2.0 mm Cu. Calculate the absorbed dose in bone.

17. Estimate the pulse amplitude produced by the interaction of thermal neutron in a BF3 gas proportional counter operated at agas multiplication factor of 1000. The tube capacitance is 100 pF assume W = 25eV per ion pair for the gas and the Q value of (n, α) reaction is 2.792 MeV.

(4 × 6 = 24 marks)

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C 83548 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE EXAMINATION, APRIL 2020

(CCSS)

M.Sc. Radiation Physics

RPH 2C 10—ANATOMY, PHYSIOLOGY AND RADIOBIOLOGY

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Significance of G-value ?
2. Explain biological modifiers.
3. Explain the action of Radiation Sensitizers.
4. Hypothermia.
5. OER.
6. Tumour lethal dose.
7. What is therapeutic ratio ?
8. Explain biological modifiers.
9. Explain the action of ionizing radiation on living cell ?

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Explain respiratory system with neat diagram.

Or

(b) Define RBE. Explain the relation between RBE and LET ? Describe LET for different type of Radiation.

11. (a) Explain 5 Rs. of Radiobiology.

Or

(b) Discuss the tolerance dose. Classify tumours in relation to their response to radiation.

(2 × 14 = 28 marks)

Turn over

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Section C

Answer any **four** *questions.*

Each question carries 6 *marks.*

12. Discuss about Acute radiation Syndrome.
13. Explain Chromosomal mutation.
14. Explain the principle and practice of palliative therapy.
15. Explain Direct and Indirect action.
16. Derive an expression for BED using LQ model in fractionated radio therapy.
17. Calculate the loss of TDF by prolongation of a conventional fractionated therapy from 40 days to 60 days maintaining same fractions (30).

(4 × 6 = 24 marks)

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C 83547 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE EXAMINATION, APRIL 2020

(CCSS)

M.Sc. Radiation Physics

RPH 2C 09—QUANTUM MECHANICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Briefly explain uncertainty principle.
2. Explain validity condition for Born approximation.
3. Write a note on properties of Bosons.
4. What is a symmetry transformation ? Prove that a symmetry transformation conserve Probabilities.
5. What are Pauli spin operators ?
6. Explain the properties of linear vector space.
7. What is a symmetry transformation ? Prove that a symmetry transformation conserve Probabilities.
8. What are Pauli spin operators ?
9. Explain the properties of linear vector space.

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Explain the method of partial waves in scattering problem. Discuss the importance of phase shift.

Or

(b) Explain general angular momentum and obtain the eigen values of J^2 and J_z.

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11. (a) What is an operator ? Distinguish between Hermitian Skew Hermitian Operators. Show that the commutator of two Hermitian Operator is anti-Hermitian.

Or

(b) Distinguish between Schrödinger, Heisenberg pictures and Interaction pictures in Quantum mechanics. Outline the Interaction picture. Obtain the equation of motion for the state vector in the interaction picture.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. The wave function of particle confined within the region $0 \le x \le a$ is given as $\sin\left(\frac{\pi x}{a}\right)e^{-i\omega t}$.

(a) Find potential V (x).

(b) Calculate probability of finding the particle in the interval $\frac{a}{4} \le x \le \frac{3a}{4}$.

13. Normalise the wave function A $\sin \frac{2\pi}{L}x$ in the limit – L to + L.

14. Prove that two eigen vector of a Hermitian operator belonging to two different eigen values are orthogonal.

15. The states ψ and χ are given as $\psi = 3i\varphi_1 - 7i\varphi_2$ and $\chi = -\varphi_1 + 2i\varphi_2$ where φ_1 and φ_2 are orthonormal. Verify that $(\psi, \chi) = (\psi, \chi)^*$.

16. Write a note on optical theorem.

17. Show that components of orbital angular momentum and co-ordinate obey the relation $[L_x, X] = 0$ $[L_x, L_y] = i\hbar L_z$.

(4 × 6 = 24 marks)

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