



27521

**B.Sc. V Semester Degree Examination, Sept./Oct. 2023**  
**PHYSICS**

**5.1 : Atomic, Molecular Physics and Special Theory of Relativity (New)**

Time : 3 Hours

Max. Marks : 80

- Instructions :** 1) *Section – I is compulsory.*  
2) *Answer any five questions each from Section – II and Section – III.*

**SECTION – I**

1. Answer **any ten** of the following questions.

**(10×1=10)**

- i) What are cathode rays ?
- ii) What is the value of charge of an electron ?
- iii) What are  $\alpha$ -particles ?
- iv) What is excitation energy ?
- v) Mention the two essential features of the vector atom model.
- vi) State Paulis exclusion principle.
- vii) Mention any four properties of X-rays.
- viii) Write Daone and Hunt equation.
- ix) Mention the types of molecular spectra.
- x) What is luminescence ?
- xi) What is coherent scattering ?
- xii) What are stokes and antistokes lines ?
- xiii) What is Zeeman effect ?
- xiv) Define proper time.

P.T.O.





## SECTION – II

(5×4=20)

2. Mention the properties of cathode rays.
3. Describe Stern-Gerlach experiment.
4. State and explain Moseley's law. Mention its applications.
5. Write a note on Tyndall scattering of light.
6. Explain briefly fluorescence and phosphorescence.
7. Deduce the energy momentum relation according to special theory of relativity.
8. Mention the main features of continuous X-rays.

## SECTION – III

(5×10=50)

9. a) Describe J. J. Thomson's method for determining  $e/m$  of an electron.  
b) A charged oil drop is suspended in a uniform field of  $30 \text{ Vm}^{-1}$  so that it neither falls or rises. Find the charge on the drop, given its mass as  $9.75 \times 10^{-15} \text{ kg}$ . (7+3=10)
10. a) State and explain the postulates of Bohr's theory of hydrogen atom. Obtain an expression for energy of electron in  $n^{\text{th}}$  orbit of hydrogen atom.  
b) The wavelength of the first member of Balmer series of hydrogen is  $6563 \times 10^{-10} \text{ m}$ . Calculate the wavelength of its second member. (7+3=10)
11. a) Write a note on LS and JJ coupling schemes for two electron system.  
b) Calculate the Zeeman shift observed in the normal Zeeman effect when a spectral line of wavelength  $5000 \times 10^{-10} \text{ m}$  is subjected to the magnetic field of  $0.4 \text{ Wbm}^{-2}$ , given  $e/m = 1.76 \times 10^{11} \text{ C kg}^{-1}$ . (7+3=10)





12. a) Give the theory of origin of pure rotational spectra of diatomic molecules mention its importance.  
b) What is the minimum voltage applied to an X-ray tube to produce X-ray of  $1 \text{ \AA}$  ?  
Given  $e = 1.6 \times 10^{-19} \text{ C}$   
 $h = 6.625 \times 10^{-34} \text{ J-S.}$  **(7+3=10)**
13. a) What is Raman effect ? Explain the experimental arrangement of Raman effect.  
b) Explain quantum theory of Raman effect. **(5+5=10)**
14. a) Explain normal Zeeman effect using classical ideas and obtain an expression for Zeeman shift.  
b) Calculate the wavelength of monochromatic X-rays selected in the first order from a calcite crystal at  $13^\circ$   $d = 3.0357 \times 10^{-10} \text{ m.}$  **(7+3=10)**
15. a) Derive Lorentz transformation equations.  
b) Calculate the velocity of an elementary particle whose mass is 10 times its rest mass. **(7+3=10)**
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27521

**B.Sc. V Semester Degree Examination, February/March 2022**

**PHYSICS (New)**

**Paper – 5.1 : Atomic Molecular Physics and Special Theory of Relativity**

Time : 3 Hours

Max. Marks : 80

- Instructions :** 1) Section – I is **compulsory**.  
2) Answer **any five** questions **each** from Section – II and Section – III.

**SECTION – I**

1. Answer **any ten** of the following questions. **(10×1=10)**
- i) What is the value of specific charge of an electron ?
  - ii) What type of oil is used in Millikan's oil drop method ?
  - iii) What is the value of ground state energy of the hydrogen atom ?
  - iv) Define ionisation potential.
  - v) What are the two essential features of vector atom model ?
  - vi) What is anomalous Zeeman effect ?
  - vii) What are soft X-rays ?
  - viii) What is Duane and Hunt's law ?
  - ix) What is phosphorescence ?
  - x) What is rotational spectrum ?
  - xi) What is meant by scattering of light ?
  - xii) What are Stokes lines ?
  - xiii) What is meant by time dilation ?
  - xiv) What is inertial frame of reference ?

**SECTION – II**

**(5×4=20)**

2. Explain with neat diagram the construction of Dempster's mass spectroscope.
3. Explain spectral series of hydrogen atom according to Bohr.
4. State and explain Pauli's exclusion principle.
5. Explain the phenomenon of fluorescence.

P.T.O.





6. Mention the application of Raman effect.
7. Mention the properties of X-rays.
8. Derive the energy momentum relation according to the special theory of relativity.

## SECTION – III

9. a) Describe Millikan's experiment for measuring the charge of an electron.  
b) In Millikan's oil-drop experiment a potential difference of 5085 volts is applied to the two plates which are separated by a distance of  $1.6 \times 10^{-2}$  m. What is the smallest charge of a drop of  $8.1 \times 10^{-14}$  kg can have and still be maintained in the field ? (Neglect the Bouyant force of air). **(7+3=10)**
  10. a) State Bohr's postulates. Obtain an expression for the energy of electron in  $n^{\text{th}}$  orbit of hydrogen atom and frequency of an emitted spectral line based on Bohr's theory.  
b) The wavelength of the first member of Balmer series of hydrogen is  $6563 \times 10^{-10}$  m. Calculate the wavelength of its second member. **(7+3=10)**
  11. a) What is Zeeman effect ? Obtain an expression for Zeeman shift.  
b) In a normal Zeeman experiment the Calcium  $4228\text{\AA}$  line splits into 3 lines separated by  $0.25\text{\AA}$  in a Magnetic field of 3T. Calculate the specific charge of the electron. **(7+3=10)**
  12. a) Describe Stern-Gerlach experiment with necessary theory.  
b) Explain briefly coupling scheme. **(7+3=10)**
  13. a) Obtain an expression for the rotational energy levels of a diatomic level and the frequency of rotational spectra.  
b) An X-ray tube operates at 100 kV. Calculate the shortest wavelength of X-rays. **(7+3=10)**
  14. a) What is Raman effect ? Describe the experimental study of Raman effect.  
b) Mention the characteristics properties of Raman lines. **(7+3=10)**
  15. a) State the postulates of special theory of relativity hence derive Lorentz transformation equation.  
b) Atomic particles in the form of a beam have a velocity 85% of the speed of light. What is their relativistic mass as compared to their rest mass ? **(7+3=10)**
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27521(New)

B.Sc. V Semester Degree Examination, March - 2021

PHYSICS

Atomic Molecular Physics & Special Theory of Relativity

Paper - 5.1

(New)

Time : 3 Hours

Maximum Marks : 80

Instructions to Candidates:

1. Section - I is compulsory.
2. Answer any **Five** questions each from Section - II and Section - III.

**SECTION - I**

1. Answer any **Ten** of the following questions. (10×1=10)

- i) What is the value of charge of an electron?
- ii) What is the S.I. unit of specific charge?
- iii) What is the value of Rydberg's constant?
- iv) Define excitation potential.
- v) What is Zeeman effect?
- vi) State Larmor's theorem.
- vii) What is a characteristic spectra of X - rays?
- viii) Write Duane and Hunt relation.
- ix) What is electronic spectrum?
- x) What is luminescence?
- xi) Mention the types of scattering of light.
- xii) What are stokes lines?
- xiii) What is meant by proper length?
- xiv) What is meant by time dilation?

**SECTION - II**

2. Mention the properties of Cathod rays. (5×4=20)
3. Explain spectral series of hydrogen atom according to Bohr.

[P.T.O.]





4. Describe Franck - Hertz experiment to demonstrate the existence of discrete energy state of atoms.
5. Mention the main features of continuous X - rays.
6. State and explain Pauli's exclusion Principle.
7. Mention the characteristics properties of Raman lines.
8. Obtain Einstein's mass - energy relation.

### SECTION - III

9. a) Describe Millikan's experiment for Measuring the charge of an electron. (7+3=10)  
b) A waterdrop of 0.1mm radius is singly ionized. Calculate the electricfield required to keep the drop stationary. Assume  $g = 9.8 \text{ ms}^{-2}$ .
10. a) State and explain the postulates of Bohr's theory of hydrogen atom. obtain an expression for the radius of the electron. (7+3=10)  
b) Calculate the velocity of the electron in the first Bohr orbit of the hydrogen atom and compare it with the velocity of light.
11. a) What is Zeeman effect? Give the quantum theory of normal Zeeman effect. (6+4=10)  
b) Explain briefly coupling schemes.
12. a) Describe Stren - Gerlach experiment with necessary theory. (6+4=10)  
b) Explain Stark effect.
13. a) Give the theory of pure rotational vibrational spectra of a diatomic molecule. (7+3=10)  
b) Calculate the wave length of monochromatic X - rays selected in the first order from a calcite crystal of  $23^\circ$ ,  $d = 3.0365 \times 10^{-10} \text{m}$ .
14. a) What is Raman effect? Describe an experimental arrangement for studying it. (6+4=10)  
b) Explain the Quantum theory of Raman effect.
15. a) Derive an expression for variation of Mass with velocity. (7+3=10)  
b) At what speed a body will have a mass 2 times that of its rest mass?





27521(New)

B.Sc. V Semester Degree Examination, March - 2021

PHYSICS

Atomic Molecular Physics & Special Theory of Relativity

Paper - 5.1

(New)

Time : 3 Hours

Maximum Marks : 80

Instructions to Candidates:

1. Section - I is compulsory.
2. Answer any **Five** questions each from Section - II and Section - III.

**SECTION - I**

1. Answer any **Ten** of the following questions. (10×1=10)
- i) What is the value of charge of an electron?
  - ii) What is the S.I. unit of specific charge?
  - iii) What is the value of Rydberg's constant?
  - iv) Define excitation potential.
  - v) What is Zeeman effect?
  - vi) State Larmor's theorem.
  - vii) What is a characteristic spectra of X - rays?
  - viii) Write Duane and Hunt relation.
  - ix) What is electronic spectrum?
  - x) What is luminescence?
  - xi) Mention the types of scattering of light.
  - xii) What are stokes lines?
  - xiii) What is meant by proper length?
  - xiv) What is meant by time dilation?

**SECTION - II**

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3. Explain spectral series of hydrogen atom according to Bohr.

[P.T.O.]





4. Describe Franck - Hertz experiment to demonstrate the existence of discrete energy state of atoms.
5. Mention the main features of continuous X - rays.
6. State and explain Pauli's exclusion Principle.
7. Mention the characteristics properties of Raman lines.
8. Obtain Einstein's mass - energy relation.

### SECTION - III

9. a) Describe Millikan's experiment for Measuring the charge of an electron. (7+3=10)  
b) A waterdrop of 0.1mm radius is singly ionized. Calculate the electric field required to keep the drop stationary. Assume  $g = 9.8 \text{ ms}^{-2}$ .
  10. a) State and explain the postulates of Bohr's theory of hydrogen atom. obtain an expression for the radius of the electron. (7+3=10)  
b) Calculate the velocity of the electron in the first Bohr orbit of the hydrogen atom and compare it with the velocity of light.
  11. a) What is Zeeman effect? Give the quantum theory of normal Zeeman effect. (6+4=10)  
b) Explain briefly coupling schemes.
  12. a) Describe Stern - Gerlach experiment with necessary theory. (6+4=10)  
b) Explain Stark effect.
  13. a) Give the theory of pure rotational vibrational spectra of a diatomic molecule. (7+3=10)  
b) Calculate the wave length of monochromatic X - rays selected in the first order from a calcite crystal of  $23^\circ$ ,  $d = 3.0365 \times 10^{-10} \text{m}$ .
  14. a) What is Raman effect? Describe an experimental arrangement for studying it. (6+4=10)  
b) Explain the Quantum theory of Raman effect.
  15. a) Derive an expression for variation of Mass with velocity. (7+3=10)  
b) At what speed a body will have a mass 2 times that of its rest mass?
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27521(New)

B.Sc. V Semester Degree Examination, September - 2021

**PHYSICS**

**Atomic Molecular Physics and Special Theory of Relativity**

**Paper : 5.1**

**(NEW)**

**Time : 3 Hours**

**Maximum Marks : 80**

**Instructions to Candidates :**

- i) Section - I is compulsory.
- ii) Answer any five questions each from Section - II and Section III.

**Section - I**

1. Answer any ten of the following questions. (10×1=10)

- i) What type of oil is used in Millikan's oil drop method?
- ii) Write the SI unit of specific charge.
- iii) Who proposed the orbits of the electron in the atoms are elliptical?
- iv) What is the value of ground state energy of the hydrogen atom?
- v) What are the two essential features of vector atom model?
- vi) What is anomalous zeeman effect?
- vii) What are hard x-rays?
- viii) What is continuous spectra of x-rays?
- ix) Mention the types of molecular spectra.
- x) What is electronic spectrum?
- xi) Mention the types of scattering of light.
- xii) Mention any two characteristics of Raman lines.
- xiii) Define proper length.
- xiv) What is non inertial frame?

**Section - II**

2. Explain with neat diagram the construction of Dempster's mass spectroscope. (5×4=20)
3. Write a note on JJ Thomson's atom model.

[P.T.O.]





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4. Write a note on quantum numbers.
5. Explain LS coupling.
6. Explain the phenomenon of phosphorescence.
7. Explain the concept of time dilation.
8. Mention the applications of Raman effect.

**Section - III**

9. a) Explain the theory and experimental set up of Dunnington method to determine  $e/m$  of electron.  
b) Electrons move at right angles to a magnetic field of  $2 \times 10^{-2} \text{ Wm}^{-2}$  and enter it with a velocity of  $10^7 \text{ ms}^{-1}$ . Find the radius of the circular path. Given  $e = 1.6 \times 10^{-19} \text{ C}$  and  $m = 9.1 \times 10^{-31} \text{ kg}$  (7+3=10)
10. a) State and explain the postulates of Bohr's theory of hydrogen atom. Obtain an expression for the radius of the electron and the velocity of the electron.  
b) An electron transition occurs from  $n = 4$  to  $n = 2$  energy level in hydrogen atom. Find the wavelength of emitted radiation, if the energy of the electron in ground state is  $-13.6 \text{ eV}$ . (7+3=10)
11. a) Give the quantum theory of normal zeeman effect.  
b) Calculate the zeeman shift of line of wavelength  $6000 \text{ \AA}$ . When a magnetic field of  $1 \text{ Wb m}^{-2}$  is applied in normal zeeman effect? (7+3=10)
12. a) Describe the construction and working of coolidge tube.  
b) Explain Frank-Hertz experiment. (6+4=10)
13. a) Give the theory of rotation vibration spectra of a diatomic molecule.  
b) Explain the phenomenon of fluorescence. (7+3=10)
14. a) What is Raman effect? Give the quantum theory of Raman effect.  
b) Write a note on Rayleigh's scattering. (6+4=10)
15. a) Describe Michelson and Morley experiment with necessary theory.  
b) How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of its length at rest.





11521Old

B.Sc. V Semester Degree Examination, September - 2021

PHYSICS

Atomic Molecular Physics and Special Theory of Relativity

Paper : 5.1

(Old)

Time : 3 Hours

Maximum Marks : 80

*Instructions to Candidates :*

- i) Section - I is compulsory.
- ii) Answer any four questions each from Section - II and Section III.

SECTION - I

1. Answer any Twelve of the following.

(12×1=12)

A) Choose the correct answer

i) Cathode rays are deflected by

- |                     |                   |
|---------------------|-------------------|
| a) Electric field   | b) Magnetic field |
| c) Both (a) and (b) | d) None of these  |

ii) P fund series occurs in the region

- |                |                   |
|----------------|-------------------|
| a) Ultraviolet | b) Visible        |
| c) Infrared    | d) None of these. |

iii) According to Rayleigh scattering intensity of scattered radiation is

- |                          |                                    |
|--------------------------|------------------------------------|
| a) $I \propto \lambda$   | b) $I \propto \frac{1}{\lambda^2}$ |
| c) $I \propto \lambda^2$ | d) $I \propto \frac{1}{\lambda^4}$ |

iv) The idea of electron spin was introduced by

- |                           |                 |
|---------------------------|-----------------|
| a) Uhlenbeck and Goudsmit | b) Bohr         |
| c) Plank                  | d) Schrodinger. |

[P.T.O.]





B) Fill in the blank

- i) The value of specific charge of electron is \_\_\_\_\_
- ii) Stern - Gerlach experiment provides proof for \_\_\_\_\_
- iii) In fluorescence, the emitted wavelength is \_\_\_\_\_
- iv) Accelerated frames are called \_\_\_\_\_ frames.

C) State true or false

- i) The nuclear atomic model was proposed by Rutherford.
- ii) Pure vibrational spectra are observed only in liquids.
- iii) Antistokes lines are always more intense than stokes lines.

D) Answer the following in one or Two sentences.

- i) Write an expression for force experienced by an electron of charge 'e' in an electric field E.
- ii) Define coherent scattering.
- iii) What is Duane - Hunt limit?
- iv) Define proper length.

### SECTION - II

2. Explain Dunnington's method to determine the specific charge of electron. (4×4=16)
3. Explain Rutherford's  $\alpha$  -ray scattering experiment.
4. State and explain Moseley's law.
5. Explain stark effect.
6. Discuss briefly Rayleigh scattering and explain blue and red colour of sky.
7. Explain the concept of relativity of simultaneity.

### SECTION - III

8. a) Describe an experiment to determine the charge of an electron by Millikan's oil drop method.
- b) What is the magnitude of acceleration of electron of speed  $2.5 \times 10^6 \text{ ms}^{-1}$  in a magnetic field of  $2 \times 10^{-4} \text{ T}$ ? Given  $\frac{e}{m} = 1.76 \times 10^{11} \text{ Ckg}^{-1}$  (9+4=13)





(3)

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9. a) State and explain the postulates of Bohr's theory of hydrogen atom. Obtain an expression for radius of the electron.
- b) The series limit wavelength of Balmer series in hydrogen spectrum is  $3646 \text{ \AA}$ . Calculate the wavelength of the first member of this series. (9+4=13)
10. a) What is zeeman effect? Give the quantum theory of zeeman effect.
- b) Explain fluorescence and phosphorescence. (9+4=13)
11. a) Give the theory of pure rotational vibrational spectra of a diatomic molecule.
- b) Write a note on selection rule. (9+4=13)
12. a) What is Raman effect? Give the quantum theory of Raman effect.
- b) Explain intensity and polarization of Raman lines. (9+4=13)
13. a) Derive lorentz transformation equations.
- b) Calculate the velocity of the particle whose mass is 10 times its rest mass. (9+4=13)
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5.1-14  
5.2-11





B.Sc. V Semester Degree Examination, Oct/Nov. - 2019

PHYSICS

ATOMIC, MOLECULAR PHYSICS & THEORY OF RELATIVITY

PAPER- 5.1

Time : 3 Hours

Maximum Marks : 80

**Instructions to Candidates:**

1. Section - I is compulsory.
2. Answer any FOUR questions each from Section - II and Section - III.

**SECTION - I**

Answer any Twelve of the following questions.

(12×1=12)

1. A) Choose the correct answer:
  - i) A strong argument for the particle nature of cathod ray is
    - a) Produce fluorescence
    - b) Travel through vacuum
    - c) Gets deflected by electric & magnetic fields
    - d) To cast shadow
  - ii) P -fund series occurs in the region
    - a) uv -region
    - b) Vissible
    - c) IR- region
    - d) None of these
  - iii) The frequency of a spectral line is X-ray spectrum varies
    - a) Directly as the square of z
    - b) Inversely as the square of z
    - c) Directly as the cube of z
    - d) Directly as the square root of z

[P.T.O.]





- iv) In fluorescence, the emitted wavelength is
- Equal to absorbed wavelength
  - Greater than absorbed wavelength
  - Smaller than absorbed wavelength
  - None of the above
- B) Fill in the blanks:
- According to Pauli's exclusion principle the maximum number of electrons in the d- sub shell is -----
  - In normal Zeeman effect, when the spectral lines are viewed longitudinally, the number of lines observed are -----
  - The idea of electron spin was introduced by -----
  - Pure rotational spectrum appears in ----- region.
- C) State True or False:
- The maximum number of electrons in are orbit is  $n^2$ .
  - The stokes lines are always more intense than antistoke's lines.
  - All clocks in the space ship will go slow by a factor  $\sqrt{\frac{C^2 - u^2}{V^2}}$ .
- D) Answer the following in one or two sentences:
- State Mosely's law.
  - What is stark effect?
  - Define coherent scattering.
  - Define concept of proper time.

### SECTION - II

- Mention the properties of cathod rays.
- Explain Rutherford's  $\alpha$ -ray scattering experiment.
- State Pauli's exclusion principles. Illustrate the principle for K & L shell.
- Explain the main features of continuous X - ray spectrum.
- What are different kinds of molecular spectra? Explain them.
- Deduce the formula for relativistic variation of mass with velocity.

(4×4=16)

[P.T.O.]



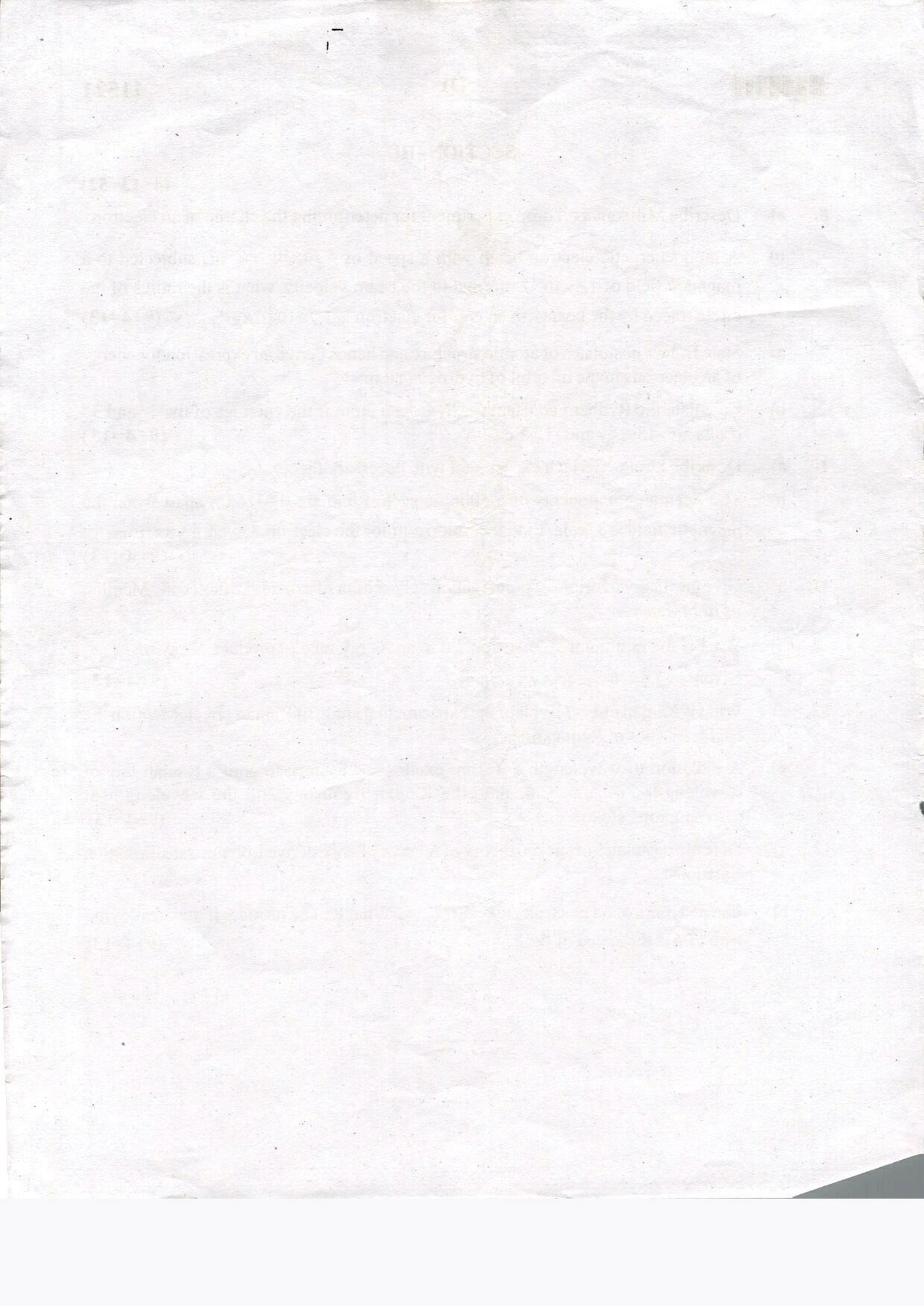


## SECTION - III

(4×13=52)

8. a) Describe Millikan's oil drop experiment for determining the charge of an electron.  
b) A monoenergetic electron beam with a speed of  $5.20 \times 10^{-6} \text{ ms}^{-1}$  is subjected to a magnetic field of  $1.5 \times 10^{-3} \text{ T}$  normal to the beam velocity, what is the radius of the circle traced by the beam, given  $e/m$  for electron is  $1.7 \times 10^{11} \text{ CKg}^{-1}$ . (9+4=13)
9. a) State Bohr's postulates of atomic structure and hence derive an expression for energy of an electrons in the  $n^{\text{th}}$  orbit of hydrogen atom.  
b) Calculate the Rydberg constant for hydrogen atom if the energies of the 1<sup>st</sup> and 3<sup>rd</sup> orbits are -13.6 eV and -1.51 eV. (9+4=13)
10. a) Describe Strem- Gerlach experiment with necessary theory.  
b) The Zeeman components of a 500nm spectral line are 0.0116nm apart when the magnetic field is 1 tesla. Find the ration  $e/m$  for the electron. Given  $c = 3 \times 10^8 \text{ ms}^{-1}$ . (9+4=13)
11. a) Give the theory of origin of pure rotation as spectrum of a diatomic molecule. Mention its importance.  
b) What is the minimum voltage applied to an X- ray tube to produce X-ray of  $1\text{Å}$ ? .  
Given  $e = 1.6 \times 10^{-19} \text{ C}$   $h = 6.625 \times 10^{-34} \text{ Js}$ . (9+4=13)
12. a) What is Raman effect? Explain the experimental study of Raman effect. Mention the characteristics of Raman lines.  
b) A radiation of wavelength 546.1nm excites a substance to emit a Raman line of wavelength 538.2nm. Calculate the Raman frequency and the wavelength of corresponding stoke's line. (9+4=13)
13. a) State the postulates of special theory of relativity hence derive Lorentz transformation equations.  
b) The rest mass of an electron is  $9.1 \times 10^{-31} \text{ Kg}$ . What will be its mass if it were moving with  $(3/5)^{\text{th}}$  the speed of light. (9+4=13)
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27522

B.Sc. V Semester Degree Examination, September/October 2023

PHYSICS (New)

Paper – 5.2 : Quantum Mechanics, Nuclear Physics and Energy Physics

Time : 3 Hours

Max. Marks : 80

**Instructions :** 1) Section – I is **compulsory**.

2) Answer **any five** questions from Section – II and Section – III.

SECTION – I

1. Answer **any ten** of the following questions.

(10×1=10)

- i) Define wave function.
- ii) Define zero point energy.
- iii) What are magic numbers ?
- iv) Define binding energy of nucleus.
- v) Define half-life of radioactive element.
- vi) State radioactive decay law.
- vii) What is dead time of G. M. Counter ?
- viii) Define mean life of radioactive element.
- ix) Write an antiparticle of an electron.
- x) Name the four basic interactions in nature.
- xi) What are conventional energy sources ?
- xii) Define uncontrolled chain reaction.

SECTION – II

Answer **any five** of the following.

(5×4=20)

2. Explain Compton scattering theory.
3. Explain shell model.
4. Describe construction and working of cyclotron.

P.T.O.





5. Define transient and secular equilibrium.
6. Explain classification of elementary particles.
7. Write a note on solar energy.
8. Write a note on P-P cycle of thermo-nuclear reactions.

### SECTION – III

Answer **any five** of the following.

**(5×10=50)**

9. a) Explain construction and working of gamma ray microscope.  
b) Calculate the energy in eV of a photon of wavelength  $2\text{\AA}$ . **(7+3=10)**
10. a) Derive Schrodinger's time-dependent equation.  
b) Mention any three failures of classical mechanics. **(7+3=10)**
11. a) Describe how range of an  $\alpha$ -particle is determined by Bragg's experiment.  
b) Calculate the range of  $\alpha$ -particle at initial energy 4 MeV in aluminium. **(7+3=10)**
12. a) Explain construction and working of G. M. Counter.  
b) Write a note on Quark model of elementary particles. **(7+3=10)**
13. a) Explain origin of gamma rays.  
b) Write any three applications of nuclear radiations. **(7+3=10)**
14. a) Write brief description about
  - i) Wind energy
  - ii) Tidal energy.  
b) Distinguish between conventional and non-conventional energy sources. **(7+3=10)**
15. a) Explain construction and working of nuclear power reactor.  
b) Write the difference between nuclear fission and fusion. **(7+3=10)**





27522

**B.Sc. V Semester Degree Examination, February/March 2022**  
**PHYSICS (New)**

**Paper – 5.2 : Quantum Mechanics, Nuclear Physics and Energy Physics**

Time : 3 Hours

Max. Marks : 80

**Instructions :** 1) Section – I is compulsory.

2) Answer **any five** questions from Section – II and Section – III.

**SECTION – I**

1. Answer **any ten** of the following.

**(10×1=10)**

- i) What is de-Broglie wave ?
- ii) What is wave function ?
- iii) Define specific binding energy.
- iv) What happens when neutron emits  $\pi^-$  ?
- v) Mention two units of radioactivity.
- vi) Define half life of radioactive element.
- vii) What is an accelerator ?
- viii) Define avalanche in G.M. counter.
- ix) Write the four basic interaction in the nature.
- x) What is the antiparticle of an electron ?
- xi) What is meant by renewable source of energy ? Give examples.
- xii) Mention the instruments used to measure solar constant.
- xiii) What is nuclear chain reaction ?
- xiv) What are the functions of the control rods in a nuclear power reactor ?

**SECTION – II**

Answer **any five** of the following.

**(5×4=20)**

2. Derive an expression for the de-Broglie wavelength.
3. Write a short note on mass defect and binding energy of nucleus.
4. Define mean life of a radioactive substance and derive an expression for it.
5. Explain the classification of elementary particles.
6. Describe the construction, working of betatron.
7. Write a note on solar energy.
8. Write a note on C-N cycle of thermonuclear reactions.

P.T.O.





## SECTION – III

Answer **any five** of the following.

(5×10=50)

9. a) Derive an expression for Compton shift.  
 b) Calculate the de-Broglie wavelength of an electron carrying an energy of 1.5 eV. (7+3)
10. a) Discuss the basic properties of nucleus.  
 b) Calculate the binding energy per nucleon of  ${}^7_7\text{N}^{14}$ . Assume nuclear mass of  ${}^7_7\text{N}^{14} = 13.99934$  a.m.u.  
 Given : Mass of proton is 1.007284 a.m.u. and  
 Mass of neutron is 1.008674 a.m.u. (7+3)
11. a) Describe how range of an  $\alpha$ -particle is determined by Bragg's experiment.  
 b)  $10^{-3}$  kg of radioactive sample takes 50s to lose  $10^{-2}$  gram. Calculate its half life period and decay constant. (6+4)
12. a) Describe the construction and working of Geiger-Muller counter.  
 b) A cyclotron in which the magnetic flux density is 1.8 T is used to accelerate protons. How rapidly should the electric field between the dees be reversed.  
 Mass of proton =  $1.67 \times 10^{-27}$  kg and charge =  $1.6 \times 10^{-19}$  C. (7+3)
13. a) Explain the four basic interactions in nature.  
 b) Write a note on Quark model of elementary particles. (6+4)
14. a) Write a note on (i) solar energy (ii) wind energy.  
 b) Explain the prospects of renewable energy sources. (7+3)
15. a) What is Q-value of nuclear reaction? Obtain an expression for Q-value of a reaction.  
 b) Calculate the Q-value of the reaction  
 ${}^7_7\text{N}^{14} + {}^2_2\text{He}^4 \rightarrow {}^8_8\text{O}^{17} + {}^1_1\text{H}^1$   
 Given : mass of  ${}^7_7\text{N}^{14} = 14.007515$  a.m.u.  
 mass of  ${}^2_2\text{He}^4 = 4.003837$  a.m.u.  
 mass of  ${}^8_8\text{O}^{17} = 17.004533$  a.m.u.  
 and mass of  ${}^1_1\text{H}^1 = 1.008142$  a.m.u. (7+3)





27522(New)

B.Sc. V Semester Degree Examination, March - 2021

PHYSICS

Quantum Mechanics, Nuclear Physics and Energy Physics

Paper - 5.2

(New)

Time : 3 Hours

Maximum Marks : 80

*Instructions to Candidates:*

- 1) **Section - I** is compulsory.
- 2) Answer any **Five** questions from **Section - II** and **Section - III**.

**SECTION - I**

1. Answer any **TEN** of the following. (10×1=10)
  - i) What is wave function?
  - ii) Define zero point energy.
  - iii) Define specific binding energy.
  - iv) What are magic numbers?
  - v) Define half life of a radioactive substance.
  - vi) What is Radioactivity?
  - vii) What is Betatron condition?
  - viii) What is internal quenching?
  - ix) Write four basic interaction in nature.
  - x) What is the antiparticle of positron?
  - xi) What are conventional energy sources?
  - xii) Give one application & tidal energy.
  - xiii) What is the function of control rods in a nuclear power reactor?
  - xiv) What is plasma state?

**SECTION - II**

2. Obtain the Schrodinger's time independent wave equation. (5×4=20)
3. What are nuclear forces? Write its characteristics.
4. What is mean life? Obtain an expression for it.
5. Write a note on Quark model of an elementary particles.

[P.T.O.]





6. Write a note on solar energy.
7. Describe construction and working of linear accelerator.
8. Explain C-N cycle and P-p cycle.

### SECTION - III

9. a) State and explain Heisenberg's uncertainty Principle and describe the diffraction of electrons by a single slit to illustrate the Principle.  
b) Find the de-broglie wavelength of neutron of energy 12.8 Mev given mass of neutron is  $1.675 \times 10^{-27}$  kg. (7+3)
10. a) Explain failure of proton electron hypothesis.  
b) Explain Yukawa meson theory of nuclear forces. (7+3)
11. a) What is range of an  $\alpha$ -particle? Determine the range of an  $\alpha$ -particle by Bragg's method.  
b) Calculate the time required for 30% of a radioactive sample to disintegrate. Half life of sample is  $1.4 \times 10^{10}$  years. (7+3)
12. a) Explain construction and working of cyclotron.  
b) The magnetic field 0.7 T is applied to accelerate deuterons in a cyclotron. What is the frequency of the electric field applied between these?  
 $m = 3.4 \times 10^{-27}$  kg, charge =  $1.6 \times 10^{-19}$  c (7+3)
13. a) Describe the construction and working of Scintillation counter.  
b) Write a note on classification of elementary particles. (6+4)
14. a) What is chain reaction? Explain controlled and uncontrolled chain reaction.  
b) Explain transmutation equation and Q-value of a nuclear reaction.  
c) Calculate the Q-value of the reaction  ${}_4\text{Be}^9 + {}_2\text{He}^4 \rightarrow {}_2\text{C}^{12} + {}_0\text{n}^1$ .  
Given : mass of  $\text{Be}^9 = 9.01506$  a.m.u  
mass of  $\text{He}^4 = 4.008879$  a.m.u  
mass of  ${}_0\text{n}^1 = 1.008986$  a.m.u  
mass of  $\text{C}^{12} = 12.003316$  a.m.u. (7+3)
15. a) Write brief description about.
  - i) Utilization of wind energy
  - ii) Tidal energy.b) Write a note on biomass energy. (7+3)





11522

B.Sc. V Semester Degree Examination, September - 2020

PHYSICS

Quantum Mechanics, Nuclear physics and Energy Physics

Paper : 5.2

Time : 3 Hours

Maximum Marks : 80

**Instructions to Candidates:**

- 1) Section - I is compulsory.
- 2) Answer any **Four** questions from section - II and any **Four** questions from Section - III.

**SECTION - I**1. Answer any **Twelve** of the following:

(12×1=12)

A) Choose the correct answer

i) According to Heisenberg's uncertainty principle.

a)  $\Delta x \cdot \Delta p = \hbar$

b)  $\Delta x \cdot \Delta t = \hbar$

c)  $\frac{\Delta E}{\Delta t} = \hbar$

d)  $\Delta p \cdot \Delta t = \hbar$

ii) The nuclear radius is proportional to

a)  $A$

b)  $A^{1/3}$

c)  $A^3$

d) None

iii) The condition for secular equilibrium is

a)  $N_1 \lambda_1 = \lambda_2 N_2$

b)  $N_1 \lambda_2 = N_2 \lambda_1$

c)  $N_1 N_2 = \lambda_1 \lambda_2$

d) None

iv) The radiant energy of the sun results from

a) Nuclear fission

 b) Nuclear fusion

c) Combustion

d) cosmic radiation

[P.T.O.]





B) Fill in the blanks:

- i) The Compton shift increases with scattering angle.
- ii) The energy of a particle in a box is given by  $\frac{n^2 h^2}{8 m a^2}$
- iii) The device betatron depends on the principle of transformer
- iv) If  $Q < 0$ , the reaction is endothermic

C) State True or False:

- i) In a blackbody distribution curve, Wein's law is applicable to large temperature. **F**
- ii) Alpha particles are doubly ionised helium atoms. **T**
- iii) G.M counter is used to accelerate the particles. **F**

D) Answer the following in one or two sentences:

- i) What are matter waves?
- ii) What is Radioactivity?
- iii) What is chain reaction?
- iv) What are conventional energy sources?

### SECTION - II

(4×4=16)

2. Describe  $\gamma$ -ray microscope experiment to illustrate Heisenberg's uncertainty principle.
3. Give the physical significance of  $\psi$ .
4. Define mean life. Obtain an expression for it.
5. Write the characteristics of Nuclear forces.
6. Explain the working of linear accelerator.
7. Write a note on solar energy.





## SECTION - III

8. a) Describe Davisson & Germer experiment to demonstrate the wave nature of electrons.  
b) Calculate the wavelength of an electron having a velocity of  $2 \times 10^6 \text{ ms}^{-1}$ . Assume mass of electron to be  $9.1 \times 10^{-31} \text{ kg}$ . (9+4=13)
9. a) Obtain Schrodinger's time dependent and time - independent wave equation.  
b) An electron is constrained in a one dimensional box of side 1 nm. Obtain the first three eigenvalues in ev. (9+4=13)
10. a) Explain failure of proton- electron hypothesis and success of proton- neutron hypothesis of nuclear constitution.  
b) When a proton capture a neutron to produce a deuteron nucleus a  $\gamma$  - ray of energy 230 Mev based on the following reaction.  ${}_1^1\text{H} + {}_0^1\text{n} \rightarrow {}_1^2\text{H} + h\nu$  is emitted Mass of  ${}_1^1\text{H} = 1.008142$  amu mass of  ${}_1^2\text{H} = 2.014735$  amu calculate the mass of neutron. (9+4=13)
11. a) Give the theory of successive disintegration and obtain the condition for secular equilibrium.  
b) How long will it take for a sample of radium -D to decreases to 10% if its half life is 22 years. (9+4=13)
12. a) Describe the construction working and theory of cyclotron.  
b) The magnetic field 0.7T is applied to accelerate deuteron in a cyclotron. What is the frequency of the electric field applied between the dees?  $m_n = 3.4 \times 10^{-27} \text{ kg}$ . (9+4=13)
13. a) Write brief description about.  
i) Utilization of Tidal energy  
ii) Thermo nuclear reaction  
b) Distinguish between Nuclear fusion & Nuclear fission. (9+4=13)
-





B.Sc. V Semester Degree Examination, Oct./Nov.- 2019

**PHYSICS**

**Quantum Mechanics Nuclear Physics & Energy Physics**

**Paper : 5.2**

**Time : 3 Hours**

**Maximum Marks : 80**

**Instruction to Candidates:**

- 1) Section - I is compulsory.
- 2) Answer any **Four** questions each from Section - II and Section - III.

**SECTION - I**

1. Answer any **Twelve** of the following:

**(12×1=12)**

A) Choose the correct answer.

i) In compton scattering change in wavelength is maximum when  $\theta$  is

- a)  $90^\circ$       b)  $0^\circ$       c)  $180^\circ$       d)  $45^\circ$

ii) The uncertainty relation cannot hold the following pairs:

- a) Position and Momentum  
b) Energy and time  
c) Linear momentum and angle  
d) Angular momentum and angle

iii) When a radioactive atom decay with the emission of a  $\beta$ -particle a new atom is formed whose atomic number:

- a) is decreased by 1                      b) is increased by 2  
c) Remains unchanged                  d) is increased by 4

**[P.T.O]**









6. Write a note on C-N cycle of thermonuclear reactions.
7. Write a note on solar energy.

### SECTION - III

Answer any **four** of the following:

(4×13=52)

8. a) Describe Davisson & Germer experiment to demonstrate the wave character of electrons.
- b) An electron has a speed of  $600 \text{ ms}^{-1}$  with an accuracy of 0.005%. Calculate the certainty with which we can locate the position of the electron

Given  $h=6.625 \times 10^{-34} \text{ J-S}$

$m=9.1 \times 10^{-31} \text{ kg}$  (9+4)

9. a) Derive energy expression & normalised eigen functions for a particle in one dimensional box of finite height.
- b) The period of linear harmonic oscillator is 1ms. Find its Zero point energy in ev. (9+4)

10. a) Give a short account of the

- i) Size
- ii) Charge
- iii) Mass
- iv) Density
- v) Magnetic moment of the Nucleus.

- b) A neutron breaks into a proton & an electron. Calculate the energy produced in this reaction in Mev.

Mass of electron =  $9 \times 10^{-31} \text{ kg}$

Mass of proton =  $1.6725 \times 10^{-27} \text{ kg}$

Mass of neutron =  $1.6747 \times 10^{-27} \text{ kg}$

Speed of light =  $3 \times 10^8 \text{ ms}^{-1}$ .

(9+4)

[P.T.O]





11. a) Describe the determination of range of an  $\alpha$ -particles by Bragg's method.  
b) Derive radio active decay law.  
c) Calculate the time required for 10% of a sample of thorium to disintegrate. T for thorium is  $1.4 \times 10^{10}$  years. (6+3+4)
12. a) Describe the construction working & theory of cyclotron.  
b) A cyclotron in which the magnetic flux density is 20T is used to accelerate the  $\alpha$ -particles. How rapidly should the electric field between the dees be reduced. Mass of  $\alpha$  - particle is  $6.64832 \times 10^{-27}$ kg. (9+4)
13. a) What is Q-value of Nuclear reaction? Obtain an expression for Q-value of a reaction.  
b) Distinguish between Nuclear fusion & fission. (9+4)
-





B.Sc. V Semester Degree Examination, Oct./Nov.- 2019

PHYSICS

Quantum Mechanics Nuclear Physics & Energy Physics

Paper : 5.2

Time : 3 Hours

Maximum Marks : 80

*Instruction to Candidates:*

- 1) Section - I is compulsory.
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SECTION - I

1. Answer any **Twelve** of the following:

(12×1=12)

A) Choose the correct answer.

i) In Compton scattering change in wavelength is maximum when  $\theta$  is

- a)  $90^\circ$       b)  $0^\circ$       c)  $180^\circ$       d)  $45^\circ$

ii) The uncertainty relation cannot hold the following pairs:

- a) Position and Momentum  
b) Energy and time  
c) Linear momentum and angle  
d) Angular momentum and angle

iii) When a radioactive atom decays with the emission of a  $\beta$ -particle a new atom is formed whose atomic number:

- a) is decreased by 1      b) is increased by 2  
c) Remains unchanged      d) is increased by 4

[P.T.O]





iv) Protons are

a) Leptons

b) Mesons

c) Baryons

d) None

B) Fill in the blanks

i) The idea of quantum nature of light has emerged in an attempt to explain \_\_\_\_\_

ii) The normalisation condition for wave function is \_\_\_\_\_.

iii) Alpha rays are emitted from radioactive substances are \_\_\_\_\_

iv) Antiparticle of positron is \_\_\_\_\_

C) State True or False

i) De Broglie wavelength is inversely proportional to square root of absolute temperature.

ii) Nuclear forces are charge dependent.

iii) Fission reaction takes place only at high temperature.

D) Answer the following in One or Two sentences.

i) Define Zero point energy

ii) Define decay constant.

iii) What is quenching?

iv) What are non conventional energy sources?

## SECTION - II

Answer any **four** of the following:

(4×4=16)

2. Describe Gamma Ray microscope to illustrate Heisenberg's uncertainty principle.

3. Derive Schrodinger's time dependent wave equation.

4. What are Nuclear forces? Write its characteristics.

5. Define mean life of a radioactive substance & derive an expression for it.





6. Write a note on C-N cycle of thermonuclear reactions.
7. Write a note on solar energy.

### SECTION - III

Answer any **four** of the following:

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- b) The period of linear harmonic oscillator is 1ms. Find its Zero point energy in ev. (9+4)

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- i) Size
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- iii) Mass
- iv) Density
- v) Magnetic moment of the Nucleus.

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Mass of neutron =  $1.6747 \times 10^{-27} \text{ kg}$

Speed of light =  $3 \times 10^8 \text{ ms}^{-1}$ .

(9+4)

[P.T.O]