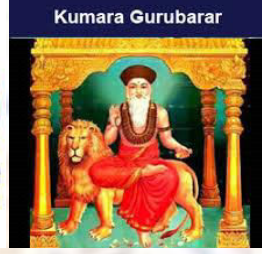ஸ்ரீ-ல-ஸ்ரீ காசிவாசி சுவாமிநாத சுவாமிகள் கலைக் கல்லூரி

திருப்பனந்தாள் – 612504

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QUESTION BANK

Title of the Paper

NUCLEAR PHYSICS

Course: B.Sc Physics III

Prepared by

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CORE COURSE VIII

NUCLEAR PHYSICS

Objective: To emphasize the understanding of nuclear forces and models, elementary particles and Accelerators.

UNIT I

General Properties of Nuclei and Nuclear Models Constituents of nuclei-Classification of nuclei - Nuclear mass and binding energy - Binding energy and stability of nucleus, Mass defect and Packing fraction, Binding fraction Vs Mass number curve - Nuclear size - Nuclear spin-nuclear energy levels - Nuclear magnetic moment --Parity of nuclei - Nuclear forces - Yukawa's model of nuclear force. Nuclear Models - Liquid drop model, Semi-empirical mass formula - Shell model- Salient features of shell model.

UNIT II

Radioactivity Radioactive decay law-Half life and Average life - Activity or strength of a radio – sample - Successive transformation - Radioactive chain- Radioactive equilibrium - Radioactive dating - α- decay - Geiger-Nuttall law - Tunnel effect - Gamow's theory of α decay - β-decay - Energetics of β-decay - Continuous β-spectrum - Inverse β-decay - Parity violation in β-decay - Neutrino hypothesis - Properties of neutrino - Gamma rays- origin of the gamma rays - Internal conversion.

UNIT III

Particle Accelerators and Detectors Linear accelerator – Cyclotron – Betatron - Electron synchrotron - Accelerators in India. Radiation Detectors - Ionisation Chamber - Proportional counter – G.M. Counter-Cloud chamber - Scintillation counter - Solid state track detector – Semiconductor detector.

UNIT IV

Nuclear Reactions and Nuclear Reactors Nuclear reactions - Types of nuclear reactions – Conservation laws in nuclear reactions -Energetic of nuclear reactions - Kinematics of nuclear reactions -Threshold energy of nuclear reactions - Solution of the Q- value equation - Cross-section of nuclear reactions. Nuclear fission - fission of light nuclei - Prompt and delayed neutrons - Neutron speed , classifications - Nuclear chain reaction - Neutron cycle - Nuclear reactor - Types of reactor -Fission bomb - Nuclear power in IndiaFusion-Thermonuclear reaction - Hydrogen bomb -Possibility of fusion reactor. 23

UNIT V

Elementary Particles Classification of elementary particles – Pions and Muons - K-mesons – Hyperons- Conservation laws - Exact laws - Approximate conservative lawsFundamental interactions – Antiparticles -Resonance particles – Hypernucleus - Symmetry classification of elementary particles - Quark model.

Books for Study:

1. Gupta & Roy., Physics of the Nucleus, Books and Allied (P) Ltd. Kolkatta, 2011 .

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1. S. N. Ghoshal,Nuclear Physics , S. Chand & Co., Edition ,2003.

2. M L Pandya& R. P .S .Yadav, Elements of Nuclear Physics,KedaarNath& Ram Nath ,2000.

3. SatyaPrakash, Nuclear Physics, APragatiPrakasan Publication, 2011.

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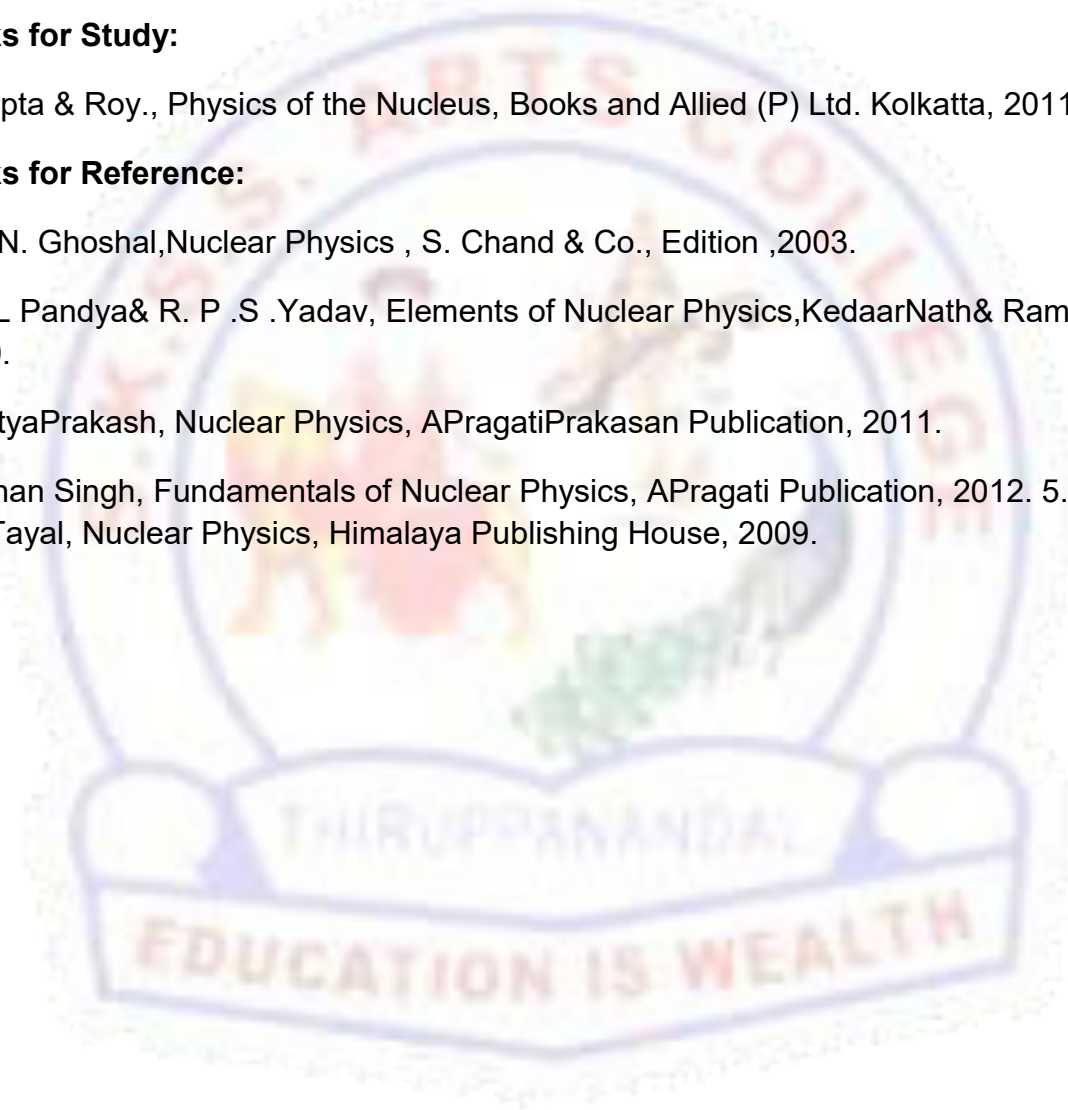
UNIT-I

CHOOSE THE CORRECT ANSWER

1. The nucleus consists of

   a. neutrons
   b. protons
   c. neutrons and protons
   d. electrons and neutrons

2. The nucleus is

   a. positive charge
   b. negative charge
   c. neutral
   d. charge keeps on changing

3. In neutral atom, the electron are bound to the nucleus by

   a. magnetic force
   b. electrostatic force
   c. friction force
   d. centripetal force

4. The different in the mass of the resultant nucleus and the sum of the masses of two parent nuclear particle is known as

   a. mass defect
   b. solid defect
   c. weight defect
   d. nucleus defect

5. when the nuclei of U^{235} is splitted into approximately two equal nuclei, the amount of energy released per nucleon is

   a. 0.45 Mev
   b. 0.9Mev
   c. 1.35 Mev
   d. 1.7 Mve

6.The quantity which is not conserved in a nuclear reaction is

   a. momentum
   b. charge
   c. mass
   d. none of these

7.The half-life of a radioactive nucleus is 3hours,in 9 hours,its activity will be reduced to a factor of

   a. 1\9
   b. 1\27
   c. 1\6
   d. 1\8

8.A radioactive element has half-life period 1600 years,after 6400 years what amount will remain?

   a. 1\2
   b. 1\16
   c. 1\8
   d. 1\4

9.A radioactive nucleus emits a beta particle,the parent and daughter nuclei are

   a. isotopes
   b. isotones
   c. isomers
   d. isobars

10.The mass number of iron nucleus is 56 the nuclear density is
   a. 2.29×10^{16} kg m^{-3}
   b. 2.29×10^{17} kg m^{-3}
   c. 2.29×10^{18} kg m^{-3}
   d. 2.29×10^{15} kg m^{-3}

ANSWERS : 1 c 2 a 3 d 4 a 5 b 6 c 7 d 8 b 9 d 10 b

SHORT QUESTIONS (2MARKS)

11.What is a nuclei?

12.Write the classification of nuclei?

13.What is a nuclear mass?

14.What is a nuclear binding energy?

15.Write a nucleus stability?

16.What is a mass defect?

17.What is a packing fraction?

18.What is a nuclear size?

19.Write the nuclear spin?

20.What is a nuclear force?

PARAGRAPH QUESTIONS(5 MARKS)

21.Describe the classification of nuclei?

22.Explain the binding energy and stability of nucleus?

23.Explain the mass defect and packing fraction?

24.Describe the binding fraction vs mass number curve?

25.Explain the nuclear magnetic moment?

26.Explain the Yukawas model of nuclear force?

27.Explain the liquid drop model and applications?

28.Describe the semi-empirical mass formula

29.Explain the briefly about shell model?

30.Explain the salient features of shell model?

ESSAY TYPE QUESTIONS(10 MARKS)

31.Explain the details above liquid drop model and applications?

32.Explain the semi-empirical mass formula derived the conditions?

33.Describe the types of nuclear models and details?

34.Explain the shell model and applications?

35.Describe the salient features of shell model?

36.Explain the Yukawa's model of nuclear force?

37.Explain the parity and force of nuclear?

38.Describe the nuclear magnetic moment and energy levels?

39.Write the notes

a.Nuclear size

b.Nuclear mass

40.Describe the binding energy and stability of nucleus?

UNIT-II

CHOOSE THE CORRECT ANSWERS

1.The atomic number is equivalent to which of the following?

    a. the number of neutrons in the atom
    b. the number of proton in the atom
    c. the number of nucleons in the atom

2.Which of the following particles has the smallest mass?

    a. proton
    b. electron
    c. neutron
    d. nucleus

3.Which of the following is correct for the number of neutrons in the nucleus?

    a. N=A-Z
    b. N=Z-A
    c. N=Z+A
    d. N=Z

4.How many electron are in the C_6^{12} atom

    a. 12
    b. 6
    c. 18
    d. 3

5.What law did emest Rutherford use to estimate the size of the nucleus?

    a. conservation of nucleon number
    b. conservation of angular momentum
    c. conservation of liner momentum
    d. conservation of energy

6.What force is responsible for the radioactive decay of the nucleus?

    a. gravitational force
    b. weak nuclear force
    c. strong nuclear force
    d. electromagnetic force

7.When nucleons from a stable nucleus binding energy is

    a. created from nothing
    b. destroyed into nothing
    c. transformed into visible light
    d. released as high energy photons or particles

8.when a nucleus is divided into its constituents energy is

    a. created from nothing
    b. destroyed into nothing
    c. transformed into visible light
    d. absorbed by the nucleus which then breaks it apart

9.Which type of radiation is stopped by a sheet of paper?

    a. alpha particle
    b. beta particle
    c. gamma ray
    d. X-ray

10.A reaction that releases more energy then is put into it is called

    a. endothermic
    b. exothermic
    c. nuclear
    d. chemical

ANSWERS : 1 b 2 b 3 a 4 b 5 d 6 b 7 d 8 d 9 c 10 b

SHORT QUESTIONS (2 MARKS)

11. What is radioactive decay law?

12. What is a half life?

13. What is a average life?

14. Draw the radioactive chain?

15. Write the notes of α-decay?

16. Write the notes of β-decay?

17. What is a neutrino hypothesis?

18. Given the two properties of neutrino?

19. What is a gamma rays?

20. What is a internal conversion?

PARAGRAPH QUESTIONS(5 MARKS)

21. Describe the radioactive decay law –half life and average life?

22. Describe the activity or strength of a radio process?

23. Explain the successive transformation of radioactive?

24. Explain details above the radioactive chain process?

25. Describe the Geiger-Nuttall law?

26. Describe the Gamow's theory of α decay?

27. Explain the energetic of β decay and continue β-spectrum?

28. Explain the gamma rays-origin of the gamma rays?

29. Explain the internal convertion process?

30. Describe the neutrino hypothesis and their properties?

ESSAY TYPE QUESTION(10 MARKS)

31. Explain the radioactive equilibrium process?

32. Explain the radioactive dating and α decay?

33. Describe the Geiger- Nuttall law ?

34. Describe the tunnel effect process?

35. Explain the short notes

      a. Radioactive chain

      b. Radioactive equilibrium

36. Explain the Gamow's theory of α decay?

37. Describe parity violation in β- decay?

38. Explain the radioactive decay law-half life?

39. Explain the notes

      a. continuous β-spectrum

      b. inverse β-decay

40. Explain the process of successive transformation?

UNIT-III

CHOOSE THE CORRECT ANSWERS

1. How much of our universe is made of matter or energy, which we do not know about?

    a. 0.001%
    b. 10%
    c. 45%
    d. 96%

2. How do we see "quarks" in a detector?

    a. not at all
    b. by their characteristic spiral trajectory
    c. via "jets" of hadrons they generate
    d. as two individual straight tracks

3.The particles carrying the strong force are the

    a. photons
    b. gluons
    c. Z- or W-bosons
    d. none of the above

4.Which was the first particle discovered which is still today believed to be elementary?

    a. electron
    b. gluon
    c. proton
    d. photon

5.How much times do the proton in the LHC fly around the accelerator ring in 1 second?

    a. 1
    b. 100
    c. 10000
    d. 1000000

6.Which of the following technological innovations was invented at CERN?

    a. mobile phone
    b. teleporter
    c. mp 3 format
    d. world wide wed

7.Which of the following is not a type of radiation detectors?

    a. Geiger muller counter
    b. proportional counter
    c. semiconductor detector
    d. flame emission detector

8.Which of the following acts as quenching gas in Geiger muller counter/

    a. alcohol
    b. argon gas
    c. krypton
    d. hydrogen

9.Scintillation detector is a large flat crystal of which of the following materials?

   a. sodium chloride
   b. sodium iodide
   c. sodium sulphate
   d. sodium carbonate

10.Liquid scintillators are used for which of the following materials?

   a. low energy beta materials
   b. high energy beta material
   c. low energy gamma material
   d. high energy gamma material

ANSWERS : 1 d 2 c 3 b 4 a 5 c 6 d 7 d 8 b 9 a 10a

SHORTS QUESTION(2 MARKS)

11.What is a linear accelerator?

12.What is a cyclotron?

13.What is a betatron?

14.What is a electron synchrotron?

15.What is a acceleration in india?

16.What is a ionization chamber?

17.Write the notes on cloud chamber?

18.What is a detectors?

19.What is a acceleration?

20. What is semiconductor detector?

PARAGRAPH QUESTIONS(5 MARKS)

21.Describe the Linear accelerator and their working process?

22.Describe the cyclotron principal working and uses?

23.Explain the betatron process and their uses?

24.Explain the electron synchrotron and types?

25.Descuss the Acceleration in india?

26.Explain the radiation detectors and types?

27.Explain the notes on Ionisation chamber?

28.Describe the proportional counter given example?

29.Explain the scintillation counter?

30.Describe the solid state track detector?

ESSAY TYPE QUESTIONS(10 MARKS)

31.Explain the briefly about cyclotron process?

32. Describe the linear accelerator given examples?

33.TheBetatron working principal and uses explain briefly?

34.Explain the electron synchrotron and their types?

35.Explain the notes on Ionisation chamber?

36.Describe the proportional counter given examples?

37.Explain the G.M counter and their details?

38.Explain solid state track detector?

39.Explain the semiconductor detector details?

40. Explain the notes

     a.radiation detectors

     b.cloud chamber

UNIT-IV

CHOOSE THE CORRECT ANSWER

1. In nuclear power station which nuclear reaction is performed?

   a. nuclear fission
   b. nuclear fusion
   c. 90% fission and 10% fusion
   d. 90% fusion and 10% fission

2. Which particle is bombarded on heavy nucleus of nuclear fuel?

   a. electron
   b. proton
   c. neutron
   d. photon

3. The critical mass for U235 fission reaction is above_____

   a. 100 kg
   b. 200 kg
   c. 50 kg
   d. 10 kg

4. The fuel mainly used in nuclear fission reactors are

   a. U235
   b. U239
   c. U233
   d. U238

5. Which fissionable nuclear fuel occur in nature?

   a. plutonium
   b. thorium
   c. uranium
   d. 94239 pu

6. Which of the following has high fission percentage?

   a. pu239
   b. U233
   c. U235
   d. U234

7.Reactors used for converting fertile materials to fissile materials are called_____

    a. research and development reactor
    b. production reactor
    c. power reactors
    d. slow reactors

8.In which of the following process are neutrons emitted?

    a. inverse beta decay
    b. nuclear fission
    c. spontaneous fission
    d. nuclearfusion

9.Heavy nuclei must be such that they can be fissioned by neutrons of energy such substance are called?

    a. fission fragments
    b. fission neutrons
    c. fission species
    d. fission element

10.Who invented nuclear fission?

    a. rutherford
    b. hansbethe
    c. otto Hahn
    d. marie curie

ANSWERS : 1 a 2 c 3 d 4 a 5 c 6 c 7 b 8 b 9 c 10 c

SHORT QUESTIONS(2 MARKS)

11.What is a nuclear reactions?

12.What is a conservation law in nuclear reaction?

13.Write the types of nuclear reactions?

14.What is a cross-section of nuclear reactions?

15.What is nuclear fission?

16.What is a nuclear fusion?

17.Write the neutron cycle?

18.What is threshold energy of nuclear reaction?

19.What is solution of the Q-value equations?

20.Describe the thermonuclear reactions?

PARAGRAPH QUESTIONS(5 MARKS)

21.Describe the types of nuclear reactions?

22.Explain the energetic of nuclear reactions?

23.Describe the kinematics of nuclear reactions?

24.Explain the notes

    a.prompt

    b.delayed neutrons

25.Describe the cross –section of nuclear reactions?

26.Explain the threshold energy of nuclear reactions?

27.Explain the nuclear power in india?

28. Describe the types of nuclear reactors?

29.Explain the briefly about Hydrogen bomb?

30.Explain the possibility of fusion reactor?

ESSAY TYPE QUESTIONS(10 MARKS)

31.Explain the Thermonuclear reactions and their details?

32.Describe the types of nuclear reactions?

33.Explain the conservations law in nuclear reactions?

34.Explain the notes

    a.Neutron speed

    b.Neutron cycle

35.Explain the nuclear chain reaction explain the diagram?

36.Describe the nuclear power in india?

37.Describe the hydrogen bomd and their details?

38.Explain the fission of light nuclei?

39.Describe the possibility of fusion reactor?

40.Describe the kinematics of nuclear reaction?

UNIT-V

CHOOSE THE CORRECT ANSWER

1.A conservation law that is not universal but applies only to certain kinds of intraction is conservation of

    a. lepton number
    b. baryon number
    c. spin
    d. strangeness

2.Conservation laws that describe events involving the elementary particles include the conservation of

    a. energy
    b. linear and angular momentum
    c. electric charge
    d. all of these are correct

3.An antiproton is an atomic partical that has

    a. the mass of a proton
    b. the mass of a electron
    c. the mass of a neutron
    d. the mass of a photon

4. A certain radioactive element has a half-life of 20 d. the time it will take for 7\8 of the atoms originally present to disintegrate is

    a. 20 d
    b. 40 d
    c. 60 d
    d. 80 d

5. In quantum electrodynamics, electromagnetic force are mediated by

    a. the intraction of electron
    a. hadrons
    b. action at a distance
    c. the exchange of virtual photons

6. The moderator is used to slow

    a. protons
    b. alpha particales
    c. neutrons
    d. beta partical

7. According to hubbles law, the age of the universe is

    a. approximately 6000 years
    b. less than 6000 years
    c. too great to estimate
    d. between 10 and 15 billion years

8. The conservation law violated by the reaction

    a. charge
    b. energy
    c. linear momentum
    d. lepton number and baryon number

9. Particles that participate in the strong nuclear interaction are called

    a. neutrinos
    b. hadrons
    c. leptons
    d. electrons

10. Current thought is that all matter is composed of is

   a. six quarks
   b. four quarks and four leptons
   c. six leptons
   d. six quark and six leptons

ANSWERS : 1 d 2 d 3 a 4 c 5 d 6 c 7 d 8 d 9 b 10 d

SHORTS QUESTIONS(2 MARKS)

11. What is a partical?

12. What is a elementary particles?

13. What is a pions?

14. What is a muons?

15. Write the K-mesons?

16. Define conservation law?

17. Define Exact laws?

18. Write a antiparticles details?

19. What is a quark model?

20. What is a hyper nucleus?

PARAGRAPH QUESTIONS(5 MARKS)

21. Explain the classification of elementary particles?

22. Describe the Pions and Muons details?

23. Explain the notes

a. K-mesons

b. Hyperons

24. Describe the conservation law and their details?

25. Describe the approximate conservative laws?

26. Explain the fundamental interactions and their details?

27.Describe the resonance particles ?

28.Explain the symmetry classification of elementary particles?

29.Describe the quark model and their details?

30.Explain the notes on

   a.Hyper

   b.Antiparticles

ESSAY TYPE QUESTIONS(10 MARKS)

31.Describe the classification of elementary particles details?

32.Explain the briefly about pions and muons?

33.Explain the notes

   a.K-mesons

   b.Hyperons

34.Explain conservation law of elementary particles?

35.Explain the types of elementary particals?

36.Describe the approximate conservative laws?

37.Explain the fundamental interactions?

38.Describe the symmetry classification of elementary particles?

39.Explain the notes

   a.Antiparticles

   b.Resonance particles

40.Describe the short notes on

   a.Hyper nucleus

   b.quark model