Dr. R. KESAVAMOORTHI M.Sc., M.Phil., B.Ed., Ph.D.,
Assistant Professor of Physics

ANNAI VAILANKANNI ARTS & SCIENCE COLLEGE, THANJAVUR – 613 007

DEPARTMENT OF PHYSICS

SUBJECT: **NUCLEAR PHYSICS** SUBJECT CODE: **16SCCPH8**

UNIT – I: GENERAL PROPERTIES OF NUCLEI AND NUCLEAR MODELS

PART – A

1. Define ***nucleus***. [323]
2. State the term of ***atomic number (Z)***. [323]
3. State the term of ***mass number (A)***.
4. What are ***isotopes?*** Give an example. [323]
5. Write down the formula for ***nuclear (radius) size***. [324]
6. Define the term of ***nuclear mass*** and ***mass defect***. [325]
7. Define ***nuclear density***. [325]
8. What is called ***nuclear spin***?
9. Define ***nuclear charge***. [325]
10. State ***nuclear magnetic moment***. [331]
11. State ***spin angular momentum***. [325]
12. State ***resultant angular momentum***. [325]
13. What is ***electric quadrupole moment***? [326]
14. What is ***nuclear magnetic dipole moment***? [325]
15. Write the short note on ***nuclear parity***. [326]
16. State ***binding energy***. [327]
17. Define ***packing fraction***. [329]
18. Write short note on ***nuclear stability***. [329]
19. Define ***nuclear force***. [332]
20. What are ***magic numbers***? [346]

PART - B

1. Explain the ***classification of nuclei***. [323]
2. Discuss the ***general properties of nucleus***. [324]
3. Define the ***binding energy***. Explain the variation ***curve of B.E. with mass number***. [328]
4. Define the term of ***nuclear stability***. Explain the ***plot of nuclear stability***. [330]
5. Write the notes on the ***nuclear force***. [332]
6. Discuss the ***Meson (Yukawa's model) theory*** of nuclear forces. [332]
7. Write notes on ***liquid drop model*** of the nucleus. [340]
8. Explain the ***Weizacker semi-empirical mass formula***. [341]

PART - C

1. Describe in detail ***shell model*** of the nucleus. Give short account of magic numbers. [346]

UNIT – II: RADIOACTIVITY

PART – A

1. What is ***radioactivity***? Give an example. [388]
2. Write the short notes on ***units of radioactivity***. [413]
3. Write the fundamental (***Soddy Fajan's Displacement***) laws of radioactivity. [409]
4. Define: ***Alpha decay***. [388]
5. Define: ***Beta decay***. [388]
6. Define: ***Gamma decay***. [388]
7. State: ***Geiger-Nuttal law***. [393]
8. Define ***tunnel effect***. [395]
9. What is meant by ***nuclear isomerism***? [407]
10. Define ***internal conversion***. [407]
11. State ***radioactive disintegration***. [410]

12. Define ***half-life period***. [410]
13. Define ***mean (average) life period***. [412]
14. Define ***activity strength of a radioactive sample***. [414]

PART – B

1. Give the ***properties of α-decay***. [388]
2. Give the ***properties of β-decay***. [389]
3. Give the ***properties of γ-decay***. [389]
4. Derive the expression for ***law of radioactive disintegration***. [410]
5. Derive the expression for the ***half-life*** and ***average-life period***. [410 & 412]
6. Give the account on ***law of successive disintegration*** with ***radioactive equilibrium***. [414]
7. Explain the ***continuous β-ray spectrum***. [399]
8. Discuss the ***neutrino theory of β-decay***. [401]
9. Write the ***properties of neutrino***.
10. Explain the ***parity violation in β-decay***. [403]
11. Explain the ***origin of γ-rays***. [406]
12. Write short notes on ***radioactive dating***.[416]

PART – C

1. Discuss in detail ***Gamow's theory of α-decay***. [395]

UNIT – III: PARTICLE ACCELERATION AND DETECTORS

PART - A

1. State the principle of ***ionization chamber***. [354]
2. Define ***solid state detectors***. [356]
3. Give the principle of ***proportional counter***. [356]
4. What is called ***gas multiplication***? [357]
5. What is ***plateau curve?*** [359]
6. State the principle of ***Wilson cloud chamber***. [361]

7. Give the principle of ***scintillation counter***. [365]
8. Write the short notes on ***semiconductor detector***.
9. State the principle of ***linear accelerator***. [375]
10. Give the principle of ***Cyclotron***. [377]
11. Define ***the Betatron***. [381]
12. What are the ***Betatron conditions***? [383]
13. Define the term of ***counting efficiency of G.M. counter***. [359]
14. What is called ***electron synchrotron***? [384]
15. List out the ***accelerators in India***.

PART – B

1. Explain the working of ***linear accelerator*** with neat diagram. [375]
2. Discuss the construction and theory of ***Cyclotron***. [377]
3. Explain the construction and working of ***Betatron***. [381]
4. Write the note on ***Electron Synchrotron***. [384]
5. Describe the construction and working of ***ionization chamber***. [354]
6. Explain the construction and working of ***solid state detectors***. [356]
7. Discuss the construction and working of ***proportional counter***. [356]
8. Explain the construction and working of ***Wilson cloud chamber***. [361]
9. Explain the construction and working of ***scintillation counter***. [365]
10. Describe the working of ***semiconductor detector***.

PART – C

11. Describe in detail the ***construction*** and ***working*** of ***Geiger-Muller counter*** with neat diagram. Mention its advantages. [358]
12. Describe in detail ***principle, construction*** and ***theory*** of ***Cyclotron***. Mention its limitations. [377]
13. Discuss in detail the ***principle, construction*** and ***theory*** of ***Betatron*** with neat diagram. [381]

14. Explain the ***construction*** and ***working of Wilson cloud chamber***. Mention its advantages. [361]

UNIT – IV: NUCLEAR REACTIONS AND NUCLEAR REACTORS

PART – A

1. Define ***nuclear reactions***. [420]
2. What is ***nuclear reactor***? Give its types. [449]
3. State the term of ***threshold energy***. [422]
4. List out the ***types of nuclear reactions***. [424]
5. Define ***Q-value of a nuclear reaction***. [422]
6. What is ***nuclear fission***? Give an example. [443]
7. What is ***neutron***? Give its types.
8. State ***slow neutrons***. [438]
9. State ***fast neutrons***. [438]
10. What is called ***prompt neutron***? [444]
11. Define ***delayed neutron***. [444]
12. What is ***neutrino***?
13. What is called ***controlled chain reactions***? Give an example. [447]
14. Define ***nuclear chain reaction***. [447]
15. State the term of ***multiplication factor (k)***. [447]
16. What is ***nuclear fusion***? Give an example. [455]
17. Define ***thermonuclear reaction***. [457]
18. Define the term of ***critical mass***. [448]
19. Write the short notes on ***fusion reactors***. [458]
20. What is called ***four-factor formula***? [454]

PART – B

1. Explain the ***types of nuclear reaction*** with examples. [424]
2. Discuss the ***conservation laws*** in nuclear reactions. [424]

3. Explain ***thermonuclear reaction*** and the action of ***Hydrogen (fusion) Bomb***. [457]
4. Derive the expression for ***kinematics of nuclear reactions***. [421]
5. Give the account on ***threshold energy of nuclear reactions***. [423]
6. Explain the ***solution of the Q-value equation*** in nuclear reactions. [422]
7. Discuss the ***Bohr-Wheeler's theory*** of nuclear fission. [444]
8. Explain the ***principle, construction*** and ***working of Atom (fission) Bomb***. [449]
9. Discuss the ***neutron cycle in a thermal nuclear reactor***. [453]
10. What is a ***fusion reactor***? Give the ***conditions (possibility) of fusion reactors***. [458]

PART – C

1. Describe the ***construction*** and ***working of a nuclear reactor***. Mention some of its uses. [449]
2. Discuss in detail ***scattering cross-section of nuclear reaction*** with neat diagram. [427]

UNIT – V: ELEMENTARY PARTICLES

PART – A

1. What are ***Mesons***? [472]
2. What are ***Baryons***? [471]
3. What are ***Hyperons***? [471]
4. Define ***Pions***.
5. State ***Muons***.
6. What are ***antiparticles***? [472]
7. What is meant by ***isospin***? [477]
8. What are ***leptons***? [472]

PART – B

1. Write about the classification of ***hadrons***.
2. Explain how the elementary particles obey ***conservation laws*** namely ***isospin, hypercharge*** and ***strangeness***. [475]

3. Discuss the ***fundamental interactions*** in elementary particles. [473]

PART – C

1. Write detail notes on ***classification of elementary particles***.
2. Describe in detail symmetry classification of elementary particles (***CPT theorem***). [477]
3. Narrate the ***Quark model*** of elementary particles. [478]