MSc Degree Examination, ……YEAR

I SEMESTER

Faculty of Sciences

Physics – Material Science

PAPER III- PH1MC3- ADVANCED NUCLEAR PHYSICS

Time : 3 Hours. **Maximum Weight : 30**

Part A (Short answer questions-weight 1 each)

Answer any six questions

1. What are quarks? Name the different flavours of quarks.
2. Distinguish between leptons and hadrons.
3. The binding energy per nucleon is low at low mass numbers and high mass numbers. Explain.
4. Explain the ground state of deuteron. Plot the wave function for the deuteron ground state taken as an S-state.
5. Express the Gell-mann-Nishijima formula.
6. What are isomeric transitions?
7. Explain Q value of nuclear reaction.
8. Give the selection rule for forbidden decays.
9. What are power reactors?
10. What are magic numbers?.What are singly and doubly magic nuclei. List magic numbers below 100.

(6x1=6wt)

Part B (Short Essay/Problems-Weight 2 each)

Answer any 4 questions

11. The ground state of $_{55}Cs^{137}$ 7/2+ decays with a half life 33 years,92% by β emission to an excited state of $_{56}Ba^{137}$(which in turn decays by γemission with half life 2.6 minutes to the ground state Ba^{137})and 8%by β emission directly the ground state.Following quantities were measured .

    $(K.E)_{\beta}max(92\%)=0.51MeV$ $(K.E)\beta\ max(8\%)=1.17MeV$

    What is the degree of forbiddenness of each transition?

12. How many α and β particles are emitted when $_{92}U^{238}$decay to Lead ($_{82}\ Pb^{206}$).

13. ^{7}Li (Z=3) and ^{7} Be(Z=4) have the atomic masses 7.016005 and7.016929u. Which of then shows β activity and of what type? Calculate Q for it.

14. Find the energy release of two $_1H^2$ nuclei can fuse together to form $_2He^4$ nucleus. The binding energy per nucleon of H^2 and He^4 is 1.1Mev and 7.0 respectively.

15. Show that nuclear density of $_1H^1$ is about 1014 times greater than atomic density assume the atom have the radius of the first Bohr model.

16. A reactor is developing energy at the rate of 1500KW.How many atoms of U^{235} undergo fission per second? How many Kg of U^{235} would be used in 1000 hours of operation assuming that on an average energy of 200MeV is released per fission.

(4x2=8wt)

Part C (Essay type questions- weight 4 each)

Answer all questions.

17. a) Describe Fermi theory of β decay. Calculate the energy release in β decay process.

Or

b) Derive an expression for scattering and reaction cross sections.

18. a) Describe the types of nuclear fission reactors.

Or

b) Explain p-p scattering. Experimentally the study of p-p scattering is capable of much higher accuracy than n-p scattering. Why? What are the similarities of n-n and p-p forces?

19. a) What is the evidence for shell structure of the nucleus? Sketching the main assumptions, explain the shell model of the nucleus.

Or

b) Give the main assumptions of liquid drop model of the nucleus. Obtain the expression for the binding energy of a nucleus based on liquid drop model. State the semi-empirical formula of Weizacker.

20. a) Describe quark model of elementary particles.

Or

b) Explain electric quadrapole moment for an ellipsoidal charge distribution.

(4 x 4 =16 wt)