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**Roll No. -----**

**PHY-551**

**Nuclear Physics and Analytical Techniques**

**M.Sc. PHYSICS (MSCPHY-12/13/16/17)**

**Second Year, Examination 2021 (Winter)**

**Time: 2 Hours**

**Max. Marks: 80**

**Note :** This paper is of Eighty (80) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

**Section – A**

**(Long Answer – type questions)**

**Note:** Section 'A' contains Five (05) long-answer-type questions of Twenty (20) marks each. Learners are required to answer any two (02) questions only.

**[2 x 20 = 40]**

**Q.1.** Describe the construction and working of scintillation and solid state detectors with diagram.

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- Q.2. Explain different properties of nucleus in detail. Define terms Bohr magneton and magnetic dipole moment.
- Q.3. Describe the theory of shell model and give the difference between liquid drop model and shell model.
- Q.4. What is Q equation? Find out the solution of Q equation. Calculate the Q value of reaction  ${}^{14}_7\text{N}(\alpha, p){}^{17}_8\text{O}$  which occurred in Rutherford's a range in nitrogen experiment.
- Q.5. Give the principle, theory and application of NMR and NMR spectrometers. Explain the NMR spectra of Ethyl alcohol.

## Section – B

### (Short-answer-type questions)

Note: Section 'B' contains Eight (08) short-answer-type questions of Ten (10) marks each. Learners are required to answer any Four (04) questions only.

[4 x 10 = 40]

- Q.1. Explain Fermi theory of  $\beta$  decay and selection rule for  $\beta$  decay.
- Q.2. Define gamma emission and selection rule for gamma decay.
- Q.3. Give the classification of fundamental interactions and elementary particle.
- Q.4. What are the different mechanisms by which gamma ray interacts with matter? Explain the Dirac's theory of Pair production.
- Q.5. Calculate the average binding energy per nucleon for  ${}_{28}^{64}\text{Ni}$  having 63.9280u. Given that  $Z=28$ ,  $A=64$ ,  $m_p = 1.0007825\text{u}$ ,  $m_n = 1.008665\text{u}$ .
- Q.6. Calculate the Q value of the following reactions. Which are endothermic and which are exothermic:
- (i)  $\text{C}^{12}(\text{d}, \text{n})\text{N}^{13}$
  - (ii)  $\text{O}^{16}(\text{d}, \text{n})\text{F}^{17}$
  - (iii)  $\text{Be}^9(\text{p}, \alpha)\text{Li}^6$

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Q.7. Give the principle, theory and application of phase contrast microscopy.

Q.8. Give the principle Mossbauer effect. Explain the origin of magnetic hyperfine splitting of Mossbauer spectral line of Fe<sup>57</sup>.

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