OCt-2017

M.Sc. Physics Semester – 4 Examination

Phys-C-402 - {Sub Atomic Physics}

Paper Code: 4753

Time: 2Hours 30Min MM: 70

Note: Answer all questions. Figures to the right indicate marks allotted.
All symbols have their usual meaning.

1	a)	Write detailed note on Aston's mass spectrograph.	08
	b)	Define the followings. (i) Isotope (ii) Parity (iii) Nuclear spin	03
	c)	For nuclear reaction ${}^{A}_{Z}X \rightarrow {}^{A-1}_{Z}Y + {}^{1}_{0}n$ calculate separation energy for liberated neutron.	03
		OR	
1	a)	What is the origin of magnetic moment of nucleus? Give expression for total magnetic moment for the nucleus in terms of Lande–g factor. Applying quantum mechanical treatment, prove that the largest contribution to the magnetic moment comes from dipole moment. Interpret the graph for $4\pi r^2\rho(r) \rightarrow r$ and give the concept of *meson*. Here, $\rho(r)$ represents nuclear density.	10
	b)	Plot and explain the graph of $\frac{Q_0}{ZR^2} \rightarrow$ odd number of nucleons. Here, Z, R and Q_0 denote atomic number, nuclear radius and intrinsic quadrupole moment, respectively.	04
2	a)	Employing square-well potential, deduce an equation for width of the potential, $b = \frac{1}{\kappa_0}\cot^{-1}\left(\frac{\gamma}{\kappa_0}\right)$. Here, $\kappa_0 = \sqrt{\frac{2m}{\hbar^2}(V_0 - E_b)}$ and $\gamma = \sqrt{\frac{2m}{\hbar^2}E_b}$.	10
	b)	Write note on low energy p–p scattering experiment/theory.	04
		OR	
2	a)	For low energy n–p scattering, derive equation for phase shift, $\delta_0 = \frac{1}{\kappa_0}\cot^{-1}\left(-\frac{\gamma}{\gamma'}\right)$; where $\gamma = \sqrt{\frac{2m}{\hbar^2}E_b}$ and $\gamma' = \sqrt{\frac{2m}{\hbar^2}E}$. Binding energy is denoted by E_b.	10
	b)	What are exchange forces? Explain Wigner type of exchange force.	04
3	a)	What is the difference between natural radio activity and artificial activity? Write note on nuclear fission process. Why only two almost equal-mass fission products are produced at the end of fission process? – explain.	07

	b)	What do you mean by self-sustaining nuclear chain reaction? Explain working of nuclear reactor.	07
		OR	
3	a)	Using an example of $^{87}_{35}Br \rightarrow ^{86}_{36}Kr$ nuclear de-excitation process, explain the concept of delayed neutron. Explain in details neutron life cycle and four factor formula.	10
	b)	Why heavy water is preferred compared to ordinary water as moderator?	02
	c)	Assuming that energy released per fission of $^{235}_{92}U$ is 200 MeV, calculate the number of fission processes that should occur per second in a nuclear reactor to operate at a power level of 20 MW. What is the corresponding rate of consumption of $^{235}_{92}U$.	02
4	a)	What are elementary particles? Write note on Hadrons.	06
	b)	Using conservation laws which of the following reactions or decay processes are allowed or forbidden? (i) $^{1}_{1}p \rightarrow ^{1}_{0}n + \beta^{+} + \nu_e$ (ii) $\pi^{+} \rightarrow \beta^{+} + \nu_e$ (iii) $\pi^{0} \rightarrow \gamma + \gamma$.	06
	c)	Give quark structure of Σ^{+} and Σ^{-}.	02
		OR	
4	a)	What is strangeness? Explain the associated production of strangeness. State the Gell-Mann-Nishijima relation for strange particles.	07
	b)	Explain electroweak theory with suitable example.	05
	c)	What are meson? Write types of mesons.	02
5	a)	Explain in details alpha decay process. Explain the meaning of tunnelling.	08
	b)	Write note on GM counter	06
		OR	
5	a)	Write note on Van de Graff generator.	07
	b)	What do you mean by linear accelerators? What is the advantage and limitation of linear accelerator? Explain working of linear accelerator.	06
	c)	In beta decay process, which physical quantity does not conserve?	01