

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086
(For candidates admitted from the academic year 2023 – 2024)

B.Sc. DEGREE EXAMINATION, APRIL 2026
BRANCH III - PHYSICS
SIXTH SEMESTER

COURSE: MAJOR CORE
PAPER: ATOMIC AND NUCLEAR PHYSICS
SUBJECT CODE: 23PH/MC/AN64
TIME: 3 HOURS **MAX. MARKS: 100**

Q. No.	SECTION A Answer ALL the questions (20 x 1 = 20 marks)	CO	KL
1	If two electrons occupy the same orbital their spins must be (a) parallel (b) anti parallel (c) both positive (d) both negative	1	1
2	Stern-Gerlach experiment demonstration directly the existence of (a) space quantisation (b) electron spin (c) both space quantisation and electron spin (d) neither space quantisation nor electron spin.	1	1
3	Which quantum number takes (2l + 1) different values? (a) Orbital quantum number (b) Magnetic orbital quantum number (c) Spin quantum number (d) Magnetic spin quantum number.	1	1
4	One Bohr Magneton is equal to (a) 9.28×10^{-24} amp.m ² (b) 9.28×10^{-24} amp/m ² (c) 9.28×10^{-24} amp.cm ² (d) 9.28×10^{-24} amp/cm ²	1	1
5	Continuous x-ray do not depend on the (a) Target material (b) accelerating voltage (c) both (a) and (b) (d) none	1	1
6	Photoelectric current will be zero at (a) Zero potential (b) stopping potential (c) Negative potential (d) at very high potential	1	1
7	A photoelectric cell is a device which (a) Converts light into electricity (b) Stores light energy (c) Converts light into electricity (d) Stores electrical energy	1	1
8	The splitting of spectral lines emitted by an atom in an external magnetic field is called _____ effect (a) Zeeman (b) photo electric (c) Compton (d) stark	1	1
9	The binding energy of a nucleus is a measure of its (a) stability (b) momentum (c) heaviness (d) none	1	1

10	What is the SI unit of radioactivity? (a) Curie (b) Rutherford (c) Becquerel (d) Roentgen	1	1
11	A neutrino is emitted in _____ decay. (a)Alpha (b) beta (c)gamma (d) all the above	1	1
12	β - particles are identical with a) protons b) neutrons c) helium nucleus d) electrons	1	1
13	Thermal neutrons are (a)slow moving neutrons (b) fast moving neutrons (c) delayed neutrons (d) protons	1	1
14	The reaction taking place in stellar atmosphere is a) fission (b) thermonuclear (b)ionic (d)covalent	1	1
15	One of India's earliest nuclear power stations is (a)Tarapur Atomic Power Station(b) Kudankulam Nuclear (c)Madras Atomic Power Station (d) none	1	1
16	In a nuclear reactor, if multiplication factor $k=0.98$, the reactor is (a) supercritical (b) critical (c) subcritical (d) explosive	1	1
17	Which one is not a fundamental particle? (a)Proton (b) meson (c) neutrino (d) alpha particle	1	1
18	Strange particles are (a)baryons and leptons (b)Photons (c) leptons and mesons (d) neutrons and baryons	1	1
19	The carrier particle of strong interaction is _____ a) photon b) quark c) graviton d) gluon	1	1
20	Cosmic rays are primarily composed of which of the following particles (a) Electrons and neutrons (b) protons and atomic nuclei (c)photons and gamma rays (d)neutrinos and mesons	1	1
Q. No.	SECTION B Answer ALL the questions (10 x 2 = 20 marks)	CO	KL
21	State the laws of photoelectric emission.	2	2
22	State Braggs law.	2	2
23	List out the selection rules in electronic transition.	2	2
24	What is J-J Coupling?	2	2
25	State Geiger nuttal law.	2	2
26	Write a brief note on internal conversion.	2	2
27	What is a nuclear magnetic bottle?	2	2
28	List out the applications of radioisotopes.	2	2
29	Write a brief note on van allen belts	2	2
30	Explain the origin of cosmic rays.	2	2
Q. No.	SECTION C Answer any TWO questions (2 x 10 = 20 marks)	CO	KL
31	Explain continuous and characteristic spectrum.	3	3
32	Describe stern Gerlach experiment.	3	3

33	Explain Fermi Neutrino theory of beta decay.	3	3
34	Explain the working of a Nuclear power reactor with a relevant diagram.	3	3
Q. No.	SECTION D Answer any TWO questions (2 × 10 = 20 marks)	CO	KL
35	Describe the construction of Aston's mass spectrograph with necessary theory and show how it can be used in the detection of isotopes.	4	4
36	Explain vector atom model.	4	4
37	Explain carbon-nitrogen cycle and proton-proton cycle as source of stellar energy.	4	4
38	Discuss the quark model and the properties of quarks.	4	4
Q. No.	SECTION E Answer any FOUR questions (4 x 5 = 20 marks)	CO	KL
39	The distance between traces corresponding to masses 12 and 16 in an Aston's mass spectrograph is 4.8 cm. Calculate the mass of the particle whose trace is at a distance of 8.4 cm from the trace of mass 16.	5	5
40	X-rays of wavelength 0.7080 \AA are scattered from a carbon block through an angle of 90° and are analysed with a calcite crystal, the interplanar distance of whose reflecting planes is 3.13 \AA . Determine the angular separation, in the first order, between the modified and the unmodified rays.	5	5
41	A reactor is developing energy at the rate of 3000 kW. How many atoms of U^{235} undergo fission per second? How many kilograms of U^{235} would be used in 1000 hours of operation, assuming that on an average energy of 200 MeV is released per fission?	5	5
42	Which of the following reactions can occur? State the conservation laws violated by the others. (a) $p + p \rightarrow n + p + \pi^+$ (b) $p + p \rightarrow p + \Lambda^0 + \Sigma^+$ (c) $e^+ + e^+ \rightarrow \mu^+ + \pi^-$ (d) $\pi^- + p \rightarrow n + \pi^0$	5	5
43	A carbon specimen found in a cave contained $1/8$ as much C^{14} as an equal amount of carbon in living matter. Calculate the approximate age of the specimen. Half-life period of C^{14} is 5568 years.	5	5
44	Find the threshold energy for the reaction ${}^7N^{14} (n, \alpha) {}^5B^{11}$.	5	5
