REG.NO.

VIT
Vellore Institute of Technology

SCHOOL OF ADVANCED SCIENCES
CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2025-2026

SLOT: F1+TF1

Programme Name & Branch : B.Tech
Course Code and Course Name : BAPHY105 - Engineering Physics
Faculty Name(s) : Dr. Dhritiman Gupta, Dr. Suresh Kumar V, Dr. Vijaya Chamundeeswari , Dr. Anuj Ram Baitha, Dr. Pankaj Sheoran, Dr. Krishna Chandar, Dr. Sangem Rajesh, Dr. Balakrishnan S, Dr. Abhishek Kumar Singh, Dr. Kanhaiya Lal Pandey, Dr. Dhanoj Gupta,
Class Number(s) : 3668, 3672, 3674, 3676, 3678, 3647, 3682, 3670, 6714, 3680, 3684
Date of Examination : 01-02-2026
Exam Duration : 90 minutes
Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes: 1 - Identify limitations of classical physics through experimental observations. 2 Apply matrix algebra and Dirac notation for the understanding of quantum mechanical problems involving linear operators, eigenvalues and eigenvectors.

Q. No	Question	M	CO	BL
1.	What is a blackbody? Describe the experimental spectrum of blackbody radiation for three different temperatures ($T_1 > T_2 > T_3$) with the help of a well-labelled diagram. Explain the failure of classical theories of radiation, with special reference to the Rayleigh–Jeans law. Hence, show how Planck's quantum hypothesis resolves this difficulty and write Planck's radiation law. (1+4+3+2 marks)	10	1	2
2.	Describe the Stern–Gerlach experiment with a neat diagram. Explain the observations and show how the experiment provides evidence for spin quantization. (3+2+5 marks)	10	1	2
3.	a) Determine the wavelength of a muon ($m_\mu = 1.88 \times 10^{-28}$ kg and $q_\mu = 1.6 \times 10^{-19}\ C$) accelerated from rest through a potential difference of 100 volts.	5	1	3
	b) The wavelength of light coming from a sodium vapour lamp is close to 589 nm. Find the energy of a photon corresponding to this wavelength.	5		
4.	a) Calculate the inner and outer product for the given quantum states $\lvert\psi\rangle = \begin{pmatrix}1\\ i\end{pmatrix}, \quad \lvert\phi\rangle = \begin{pmatrix}2\\ 1\end{pmatrix}$.	5	2	3
	b) Consider the following vectors in a three-dimensional vector space: $\vec{v}_1 = \begin{pmatrix}1\\0\\0\end{pmatrix}, \quad \vec{v}_2 = \begin{pmatrix}1\\1\\0\end{pmatrix}, \quad \vec{v}_3 = \begin{pmatrix}1\\1\\1\end{pmatrix}$ Check whether the given vectors are linearly independent and justify your answer.	5		

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5.	(a) Define the tensor product of vector spaces and write its importance in quantum mechanics. (b) Given the orthonormal basis states $\|0\rangle$ and $\|1\rangle$ of a two-level quantum system, represented by the column vectors: $$\|0\rangle = \begin{pmatrix}1\\0\end{pmatrix}, \quad \|1\rangle = \begin{pmatrix}0\\1\end{pmatrix},$$ evaluate the following tensor product states $\|00\rangle$, $\|01\rangle$, $\|10\rangle$, and $\|11\rangle$ where tensor product state $\|0\rangle \otimes \|0\rangle = \|00\rangle$.	5+ 5	2	2