BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC/MSC **SEMESTER : IX/III**
BRANCH: PHYSICS **SESSION : MO/2022**

SUBJECT: PH502 ADVANCED QUANTUM MECHANICS

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a)	Distinguish between non-degenerate and degenerate level of a system. [CO1, BT-IV]	[2]
Q.1(b)	Applying non-degenerate perturbation theory Derive unperturbed, first order perturbation and second order perturbation equations. [CO1, BT-III]	[3]
Q.1(c)	Evaluate the first order energy. [CO1, BT-V]	[5]
Q.2(a)	What is the origin of fine structure of atomic line spectra? [CO1, BT-I]	[2]
Q.2(b)	Explain with a diagram spin-orbit interaction. [CO1, BT-V]	[3]
Q.2(c)	Develop the Hamiltonian of an electron incorporating relativistic mass correction. [CO1, BT-III]	[5]
Q.3(a)	Interpret the Dirac Hamiltonian for a free particle. [CO5, BT-V]	[2]
Q.3(b)	Starting from the Dirac Hamiltonian, construct Dirac relativistic equation for a free particle. [CO5, BT-VI]	[3]
Q.3(c)	Determine suitable form of Dirac matrices. [CO5, BT-V]	[5]
Q.4(a)	Explain the quantization of radiation field? [CO3, BT-II]	[2]
Q.4(b)	Develop an expression for vector potential of pure radiation field using method of separation of variables. [CO3, BT-III]	[3]
Q.4(c)	Find also the Hamiltonian of the radiation field due to electric field only. [CO3, BT-I]	[5]
Q.5(a)	What is the wave function of a two level perturbed system. [CO4, BT-I]	[2]
Q.5(b)	Discuss the importance of Born-Oppenheimer approximation? [CO2, BT-VI]	[3]
Q.5(c)	Show that the electronic, vibrational and rotational energy levels of molecules can be obtained as successively higher order in an approximation based on the small value of (m/M). [CO2, BT-II]	[5]

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