QP Code: R264G012 | Reg. No | | | | | | | | | | | AY 24

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET UNIVERSITY)

M.Sc. (Fourth Semester – Regular/ Supplementary) Examinations, April – 2026

24MPHPC24001 – Relativistic Quantum Mechanics & Field Theory

(Physics)

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

		CO #	Blooms Level
Q.1.	Answer ***ALL*** questions		
a.	Discuss the drawbacks of K.G equation.	CO1	K1
b.	Discuss the properties of Gamma matrices.	CO2	K1
c.	Define field, field strength and field function.	CO3	K1
d.	Compare a neutral scalar meson field and a complex scalar meson field.	CO4	K1
e.	Explain the creation, annihilation and number operators.	CO5	K1

PART – B **(10 x 5 = 50 Marks)**

	Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a.	What is K.G equation? Derive the Klein-Gordan equation for a free particle.	10	CO1	K1
	(OR)			
b.	Discuss about the Dirac's hole theory. Explain about the positive and negative energy states?	10	CO1	K1
3.a.	Derive the expression for the Klein Gordan equation in an Electromagnetic field for a zero spin particle.	10	CO1	K2
	(OR)			
b.	Show that , $(\alpha.B)\ (\alpha.C) = B.C + i\sigma' (B \times C)$, where α represents three Dirac matrices and B and C are usual three dimensional matrices and σ' is a 4x4 matrix related to Pauli matrices.	5	CO1	K2
c.	Discuss about properties of the Dirac's matrices and gamma matrices.	5	CO1	K2
4.a.	Derive Dirac equation for a particle in a central force field and discuss about the spin of the particle.	10	CO2	K2
	(OR)			
b.	What is Spin orbit coupling? Derive the expression for the spin orbit interaction energy.	10	CO2	K1
5.a.	What are the important steps towards field quantization? Explain Noether theorem and its consequence.	10	CO3	K1
	(OR)			
b.	Derive the Lagrangian in terms of field functions for a neutral scalar field.	5	CO4	K1
c.	Derive the Lagrangian in terms of field functions for a complex scalar field.	5	CO4	K1
6.a.	What is a field? Formulate the Hamiltonian for the field. Derive the Poisson bracket formulation for the fields.	10	CO4	K1
	(OR)			
b.	Express Energy in terms of creation, annihilation and number operators for a neutral scalar field.	10	CO5	K1

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