Reg. No										

AY 23

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

M. Sc. (Third Semester) Regular Examinations, December – 2024

22PHPC301 – Relativistic Quantum Mechanics and Field Theory

(M.Sc. Physics)

Time: 3 hrs | Maximum: 70 Marks

(The figures in the right hand margin indicate marks.)

PART – A **(2 x 10 = 20 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. What is the basic difference between relativistic and non relativistic quantum mechanics?	CO1	K1
b. What is central potential and give its characteristics?	CO1	K1
c. Discuss the drawbacks of K.G equation?	CO1	K1
d. Discuss the concepts of Relativistic quantum mechanics?	CO1	K1
e. If $\boldsymbol{\alpha}$ *and* $\boldsymbol{\beta}$ are the Dirac matrices, then prove that, $\alpha_x\alpha_y\alpha_z = \frac{1}{2}[\alpha_x\alpha_y\alpha_z\beta, \beta]$	CO2	K2
f. Show that $\gamma_\mu\gamma_\nu + \gamma_\nu\gamma_\mu = 2\delta_{\mu\nu}$	CO2	K2
g. Define field, field strength and field function?	CO3	K1
h. What are the different approaches to formulate ' QFT'?	CO3	K1
i. What are the important steps towards field quantization?	CO4	K1
j. Define a neutral scalar meson field ?	CO4	K1

PART – B **(10 x 5=50 Marks)**

Answer ***ANY FIVE*** questions	Marks	CO #	Blooms Level
2. a. Discuss the properties of Dirac matrices?	5	CO1	K2
b. Show that , (**α.B**) (**α.C**) = **B.C** + i**σ'** (**B x 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
3. Derive Dirac equation for a free particle? Express Dirac equation in covariant form.	10	CO1	K1
4. What is Spin orbit coupling? Derive the expression for the spin orbit interaction energy.	10	CO2	K1
5. Derive Dirac's free particle in the presence of Electromagnetic field.	10	CO2	K1
6. Show that symmetry leads to a conservation using Noether's theorem? Discuss about the space time translation invariance?	10	CO3	K1
7. What is field theory? Formulate the Lagrangian and Hamiltonian for the charged Meson field.	10	CO3	K1
8. Express momentum and energy in terms of creation, annihilation and number operators for a neutral scalar field.	10	CO4	K1