PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

Paper - 6 QUANTUM FIELD THEORY

Offered to : M.Sc.(PHYSICS)	Course Code : 22PH4D5
Course Type : Domain specific elective (DSE)	Course : Quantum Field Theory
Year of Introduction : 2022	Year of offering : 2022
Year of Revision : 2022	Percentage of Revision : Nil
Semester : IV	Credits : 4
Hours Taught : 60 hrs. per Semester	Max.Time : 3 Hours

CourseDescription:
Quantum Field Theory courseisatheoreticalframeworkthatcombinesclassicalfieldtheory,special relativity, and quantum mechanicsthat explains the fundamental structure ofmatterandthe physics of the early universe.

CourseObjectives:

1. Toapplythefundamentalconceptsofclassicalfieldtheory
2. Toemphasizethemathematicalformulationofsecondquantizationproblemsandtophysicallyinterpretthesolutions
3. Tolaythesolidbackgroundofmathematicalmethodstouseinfieldtheories.
4. To make the students understand the reasons for the failure of relativistic quantum mechanics
5. To make the students learn the quantization of dirac field and quantum electrodynamics

Course Outcomes: Attheendofthiscoursethestudentsshouldbeableto:

CO1: Analyse thefoundationformoreadvancedstudiesinquantumfieldtheory
CO2: ApplyFeynmanrulestocalculateprobabilitiesforbasicprocesseswithparticles
CO3: Developcriticalthinkingandproblem-solvingabilities withapplicationtoadiverserangeofpracticalproblemsinquantumfieldtheory
CO4: Identify the relativistic origin of effects such as spin orbit interaction.
CO5: Use effective field theory to develop models at large scales

CO-POMATRIX								
22PH4D5	**CO-PO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
	CO1		H					M
	CO2						H	M
	CO3	H					H	
	CO4							M
	CO5						H	H

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Classical FieldTheory** Reviewofclassicalfieldtheory,Lagrangianfieldtheory,Lorentzinvariance,Noether'st heoremandconservedcurrents,Hamiltonianfieldtheory.	12
II	**CanonicalQuantization** TheKlein-Gordonequation,thesimpleharmonicoscillator,freequantumfields,vacuumen ergy,particles,relativisticnormalization,complexscalarfields,theHeisenberg picture,causalityandpropagators,applications,non-relativisticfieldtheory.	12
III	**InteractingFields** Types of interaction,the interaction picture,Dyson'sformula,scattering,Wick'stheorem,Feynmandiagrams, Feynman rules, amplitudes, decays and cross sections, Green's functions, connected diagramsandvacuumbubbles,reductionformula.	12
IV	**TheDiracEquation** TheLorentzgroup,Cliffordalgebras,thespinorrepresentation,theDiracLagran gian,chiralspinors,theWeylequation,parity,Majoranaspinors,symmetriesand currents,planewavesolutions.	12
V	**QuantizingTheDiracField** A glimpse at the spin-statistics theorem, Fermionic quantization, Fermi-Dirac statistics, propagators,particles and antiparticles, Dirac's hole interpretation, Feynman rules, **Quantum electrodynamics:** gaugeinvariance, quantization, inclusion of matter – QED, Lorentz invariant propagators, Feynman rules, QEDprocesses	12

TextBooks:

1. M.PeskinandD.Schroeder,*AnIntroductiontoQuantumField Theory*,Addison-Wesley,1995.
2. L.Ryder,*QuantumFieldTheory*,2ndEd.,CambridgeUniversityPress,1996.
3. M.Srednicki,*QuantumFieldTheory*,1stEd.,CambridgeUniversityPress,2007.

ReferenceBooks:

1. S.Weinberg,*TheQuantumTheoryof Fields*,Vol.1,1st Ed.,CambridgeUniversityPress,2005.
2. A.Zee,*QuantumFieldTheoryinaNutshell*,2ndEd.,PrincetonUniversityPress,2010.