University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4VACPHY200**				
Course Title	**INTRODUCTORY COURSE ON PHYSICS IN FINANCIAL MARKET**				
Type of Course	**VAC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	This course is a fascinating interdisciplinary field that combines principles from economics and physics to study the behaviour of financial markets. By applying scientific methods and theories, econophysicists analyse the complex dynamics of economic systems, offering insights into market fluctuations and trends. This innovative approach sheds light on the intricate interactions between various economic variables, shaping our understanding of global financial phenomena.				

BOOKS FOR STUDY:

1. R. Mantegna and H.E. Stanley, An Introduction to Econophysics, Cambridge
2. Introduction to Econophysics, Contemporary Approaches with Python Simulations, Carlo Requião da Cunha, CRC Press, Taylor & Francis Group, LLC
3. P.R. Bevington and D.K. Robinson, Data Reduction and Error Analysis for the Physical Sciences, McGraw-Hill
4. Sitabhra Sinha, Arnab Chatterjee, Anirban Chakraborti, Bikas Chrakrabarti, Econophysics - An Introduction, Wiley
5. Self-Organised Criticality in Astrophysics - Statistics of nonlinear processes in universe, M Aschwanden, Springer - Praxis publishing

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Introduction to Econophysics (Chapters 1 and 2 of Book 1, Chapter 1 of Book 2)**		5	
	1	Motivation and Approach	1	1
	2	Arbitrage, Supply & demand	1	1
	3	Stochastic processes	1	1
	4	Efficient market hypothesis	1	1
	5	Stock, bond and derivative	1	1
II	**Basic Statistical methods (Chapter 1 of Book 3, Sec 4. 1 of Book 1)**		12	
	6	Uncertainties in measurements: Mean, Mode, Median	2	2
	7	Measures of Dispersion: Standard Deviation, Variance	2	2
	8	Statistical Distributions: Binomial , Poisson, Gaussian and Lorentzian Distributions	2	2
	9	Central limit theorem (only statement, no proof)	2	2
	10	Power spectral density	2	2
	11	Two stable distributions: Gaussian and Lorentzian	2	2
III	**Random walk in physics and economics (Sec 2.1, 2.2 of Book 4; Sec 3.2 of Book 1)**		11	
	12	Bernoulli process, random walk	2	3
	13	Binomial distribution, Gaussian distribution	3	3
	14	Wiener process and Langevin equation	2	3
	15	Brownian motion	2	3
	16	Market and random walk: Time series and normal distribution	2	3
IV	**Temporal correlations of stochastic processes (Sec 6.1 to 6.4 and 7.1 to 7.4 of Book 1)**		8	
	17	Stationary stochastic process and autocorrelation function	1	4
	18	Integral of autocorrelation function and time scale	2	4

	19	Short-range and Long-range correlated random processes: Exponentially decaying autocorrelation - white noise and Wiener process. The $1/f^{\eta}$ noise.	2	4
	20	Stochastic dynamics of the logarithm of stock price and random walk.	1	4
	21	Volatility: Definition, significance and power law behaviour.	1	4
	22	Analysis of a dataset containing daily stock prices of a company for the past year.	1	4
V*	**Power law distributions in physics and economics (Sec 1.1, 1.4, 1.5, 1.7 of Book 5, Sec 5.1 of Book 4)**		9	
	23	Self-Organised criticality - SOC (qualitative idea)	1	5
	24	Power law distribution of SOC: Biophysics, Geophysics, Planetary Physics	3	5
	25	Power law in finance: inverse cubic law	2	5
	26	TP statistics TE statistics and their comparison	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand how financial markets operate, including the different types of markets such as stocks, bonds, and derivatives, as well as who participates in them.	U	1,4
CO-2	Apply probability theory and statistics to analyze financial data, make investment decisions, and assess market risk.	Ap	2,4
CO-3	Understand stochastic processes and their use in financial modeling, enabling them to interpret market behavior and make informed decisions based on time series data and probability distributions.	U	2,4

CO-4	Analyze stochastic processes, autocorrelation, and volatility in financial data, gaining insight into market dynamics and random walk models.	An	2,4
CO-5	Comprehend self-organized criticality, power-law distributions across diverse domains, including finance, and gain insight into TP and TE statistics for temporal dynamics analysis.	U	2,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTORY COURSE ON PHYSICS IN FINANCIAL MARKET

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand how financial markets operate, including the different types of markets such as stocks, bonds, and derivatives, as well as who participates in them.	PO 1,2/ PSO 2	U	F	L	-
CO-2	Apply probability theory and statistics to analyze financial data, make investment decisions, and assess market risk	PO 1,2// PSO 1	Ap	P	L, T	-
CO-3	Understand stochastic processes and their use	PO 1,2// PSO 1	U	C	L	-

	in financial modeling, enabling them to interpret market behavior and make informed decisions based on time series data and probability distributions.					
CO-4	Analyze stochastic processes, autocorrelation, and volatility in financial data, gaining insight into market dynamics and random walk models.	PO 1,2// PSO 1	An	P	L	-
CO-5	Comprehend self-organized criticality, power-law distributions across diverse domains, including finance, and gain insight into TP and TE statistics for temporal dynamics analysis.	PO 1,2// PSO 1	U	C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	2	-	-	-	2	3	-	-	-	-	-	-
CO-2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO-3	-	3	-	2	-	-	-	3	3	-	-	-	2	-	-
CO-4	-	3	-	2	-	-	-	2	2	-	-	-	-	-	-
CO-5	-	1	-	2	-	-	-	1	1	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	✓	✓
CO-5	✓	✓	-	-