Course Specification

(Postgraduate Programs)

Course Title:	**MSCS 724**
Course Code:	**Stochastic Process**
Program:	**Master of Science in Computer Science**
Department:	**Computer Science**
College:	**Computer Sciences and Information technology**
Institution:	**King Faisal University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3(3-0-6)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒ Elective	
3. Level/year at which this course is offered: Level 2, 3 or 4				
4. Course General Description:				
This course defines and classify stochastic processes, distinguishing between discrete-time and continuous-time processes. The course develops a deep understanding of Markov chains, including their transition probabilities, state classifications, and long-term behavior**.** Explains and apply the Poisson process and renewal theory to model random arrivals and event occurrences. The course also solves the problems involving birth-death processes, queueing models, and Kolmogorov equations and understands Brownian motion and its fundamental role in modeling random behavior in physics, finance, and engineering. The course utilizes martingale properties to analyze gambling strategies, stock price movements, and other stochastic models and Apply stochastic modeling techniques in various fields such as finance, engineering, economics, and biology. Finally develop Problem-Solving Skills – Formulate and solve problems involving stochastic processes using analytical and computational tools.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Pre-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				
The objectives of the course is introducing the fundamental concepts of stochastic processes, which describe systems that evolve with randomness over time. It covers theoretical foundations, practical applications, and modeling techniques across various fields such as finance, engineering, and physics.				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		
2	E-learning		
3	Hybrid • Traditional classroom • E-learning	45	100%
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)……**	
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand and classify different types of stochastic processes.	K3	Lectures	Assignment Quiz
1.2	Use martingale theory in stochastic modeling.	K3	Lectures	Mid Term Final Exam
…				
2.0	**Skills**			
2.1	Analyze Markov chains and their long-term behavior	S2,S3	Lectures	Midterm Final Exam Quiz Project

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Apply continuous-time Markov chains in engineering and queueing models.	S2, S3	Lectures	Midterm Final Exam Quiz Project
2.3				
3.0	**Values, autonomy, and responsibility**			
3.1	Model real-world problems using Poisson processes and renewal theory.	V1, V2	Project	Project presentation
3.2				
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to Stochastic Process : Definition and classification of stochastic processes, Discrete vs. continuous-time processes, Examples: random walk, stock prices, queuing systems	3
2.	Markov Chains: Definition and properties-Transition probability matrices- Chapman-Kolmogorov equations- Classification of states (transient, recurrent, absorbing)-Steady-state behavior	9
3	Poisson Process and Renewal Theory**:** Definition and properties of the Poisson process-Interarrival times and exponential distribution Non-homogeneous Poisson processes- Renewal processes and limit theorems	6
4	Contious Time Markov Chains- Kolmogorov forward and backward equations-Birth-death processes-Queueing models (M/M/1, M/M/c)-Applications in communication and reliability	9
5	Brownian Motion and Diffusion Process- Definition and properties of Brownian motion-Wiener process-Applications in physics and finance (e.g., Black-Scholes model)	6
6	Martingales- Definition and basic properties-Martingale convergence theorems-Applications in finance and gambling theory	6
7	Stochastic Calculus- Itô integral and Itô's Lemma-Stochastic differential equations (SDEs)-Applications in finance and engineering	6

Total	45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignment	Week-3	10
2.	Quiz	Week-5	5
3.	Mid Term	Week-12	25
4	Project	Week-15	20
5	Final exam	End Semester	40

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	Chapman and Hall, "Introduction to Stochastic Process, CRC Press, 2006
Supportive References	Sheldon Ross, "Stochastic Process, Wiley, 1995
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Sufficient seats (typically 20) as per student registration required in the lecture
Technology equipment (Projector, smart board, software)	Sufficient computer terminals with required setup having the necessary software installed and configured for the students to complete assignments and projects. Data show is needed to demonstrate in the class
Other equipment (Depending on the nature of the specialty)	Not Required

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect Assessment through Teaching Evaluation
Effectiveness of students' assessment	Faculty	Indirect assessment through Course Evaluation Survey
Quality of learning resources	Students	Indirect Assessment through Learning Resources Survey
The extent to which CLOs have been achieved	**Faculty**	Direct assessment through Rubrics analyses
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	