MOOC APPROVAL REQUEST

As per KTU B.Tech Regulations 2024, Section 17

KTU Course Code:	HNCST509
KTU Course Name:	Object Oriented System Development using UML
NPTEL Course Name:	
Instructor:	Prof. Rajib Mall
Institution:	IIT Kharagpur
Duration:	12 Weeks
Course ID:	noc26-cs46
Semester:	Jan-Apr 2026
Date:	December 02, 2025

This document contains:

1. KTU Course Syllabus (Complete)
2. NPTEL Course Details
3. Syllabus Comparison for 70% Match Verification

Submitted for approval as per R 17.5 of KTU B.Tech Regulations 2024.

SECTION A

KTU COURSE SYLLABUS

CURRICULUM

- **Total Credits: 15**
- Course Distribution:
    - Semester 4: 4 Credits
    - Semester 5: 4 Credits
    - Semester 6: 4 Credits
    - Semester 7: 3 Credits

Honours in Computer Science and Engineering											
Sl. No:	**Semester**	**Course Code**	**Course Title (Course Name)**	**Credit Structure**			**SS**	**Total Marks**		**Credits**	**Hrs./ Week**
				L	**T**	**P**		**CIA**	**ESE**		
1	**4**	HNCST409	Advanced Mathematics for Computer Science	3	1	0	5	40	60	4	4
2	**5**	HNCST509	Object Oriented Design using UML	3	1	0	5	40	60	4	4
3	**6**	HNCST609	Advanced Algorithms	3	1	0	5	40	60	4	4
4	**7**	HNCST709	Advanced Cryptography	3	0	0	4.5	40	60	3	3
Total							**20**			**15**	**15**

XX: Branch/Department Code

SYLLABUS

SEMESTER 4

SEMESTER 4

Advanced Mathematics for Computer Science

Course Code	HNCST409	**CIE Marks**	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAMAT201, PCCST201, GAMAT301	Course Type	Theory

Course Objectives:

1. To provide a rigorous mathematical foundation in number theory, graph algorithms, and information theory for the analysis of secure cryptographic systems and complex network structures.
2. To impart the theoretical and practical principles of convex optimization and Bayesian statistics required to solve parameter estimation problems and design efficient learning algorithms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Modular arithmetic - congruence relations - modular inverses - Euclidean algorithm - Extended Euclidean algorithm - Euler's theorem - Fermat's little theorem – pseudo primes -primality testing (AKS, Miller-Rabin) - RSA cryptosystem: key generation - encryption/decryption - Galois Field (introduction and basic operations) - Hash functions (introduction)	**11**
2	Convex sets - convex functions - convex hull - identification methods - Optimization basics - local vs global minima - role of convexity - Gradient-based methods - multivariate calculus review - gradient descent algorithm - Stochastic gradient descent - mini-batch variants - learning rate concepts.	**11**
3	Bayesian paradigm - probability as belief - Bayes' theorem revisited - Conjugate priors - Beta-Binomial model - Normal-Normal model - Bayesian parameter estimation - comparison with MLE - credible intervals - Markov Chain Monte Carlo introduction - sampling from posterior distributions.	**11**
4	Graph theory review - shortest path algorithms - Dijkstra's algorithm and its improvement - Network flow - max-flow min-cut theorem - PageRank algorithm - Information theory - entropy - cross-entropy - KL divergence	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Solve modular arithmetic problems and congruence relations using the Extended Euclidean algorithm to execute RSA key generation, encryption, and decryption.	**K3**
CO2	Employ convex functions and gradient-based iterative methods, such as Stochastic Gradient Descent, to determine optimal solutions for multivariate objective functions.	K3
CO3	Use the Bayesian paradigm using conjugate priors to compute posterior distributions and estimate model parameters with associated credible intervals.	K3
CO4	Utilize graph algorithms to solve problems related to network routing, ranking, and understand information theoretic measures.	K3

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**	**3**		**2**	**2**						**3**
CO2	**3**	**3**		**2**	**2**						**3**
CO3	**3**	**3**		**2**	**2**						**3**
CO4	**3**	**3**		**2**	**2**						**3**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A course in number theory and cryptography	Koblitz, Neal.	Springer Science & Business Media,	1994
2	Number theory for computing	Yan, Song Y.	Springer Science & Business Media,	2013
3	Pattern recognition and machine learning.	Christopher M. Bishop	Springer	2009
4	Convex optimization for machine learning	Changho Suh	now Publishers Inc	2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Machine Learning: A Probabilistic Perspective	Murphy, K. P.	MIT Press	2012
2	Python data science handbook: Essential tools for working with data	VanderPlas, Jake.	O'Reilly Media, Inc.	2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs90/preview
2	https://nptel.ac.in/courses/106101466
3	https://onlinecourses.swayam2.ac.in/imb21_mg03/preview
4	https://nptel.ac.in/courses/106106131 https://nptel.ac.in/courses/106105031

SECTION B
NPTEL COURSE DETAILS

OBJECT ORIENTED SYSTEM DEVELOPMENT USING UML, JAVA AND PATTERNS

PROF. RAJIB MALL
Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Programming Using Java, Software Engineering

INTENDED AUDIENCE : CSE, IT

COURSE OUTLINE :
Object-oriented software development has become very popular. Also, UML has been accepted as the standard design language. We discuss use of UML to arrive at a design solution. Skeletal java code generation from UML diagrams will be discussed. Design patterns are reusable solutions. These are good solutions to typical programming problems, that can be understood and applied in a specific design situation to improve the overall design and reduce design iterations.

ABOUT INSTRUCTOR :
Prof. Rajib Mall is Professor, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, West Bengal. He has more than a two decades of teaching experience in the areas of real-time systems, program analysis and testing. He has written five text books and over 150 refereed research papers.

COURSE PLAN :

Week 1**:** Introduction

Week 2**:** Life Cycle Models for OO Development

Week 3**:** Use Case Diagram

Week 4**:** Class Diagram I

Week 5**:** Class Diagram II

Week 6**:** Sequence Diagram

Week 7**:** State chart diagram

Week 8**:** Design process

Week 9**:** Introduction to design patterns

Week 10**:** GRASP patterns

Week 11**:** GoF pattern I

Week 12**:** GoF Pattern II

SECTION C

SYLLABUS COMPARISON

SYLLABUS COMPARISON REPORT

KTU: HNCST509 - Object Oriented System Development using UML
NPTEL: Object Oriented System Development using UML, Java and Patterns

KTU Topics	NPTEL Topics	Match
Module 1	Week 1-2	? Matched
Module 2	Week 3-4	? Matched
Module 3	Week 5-6	? Matched
Module 4	Week 7-8	? Matched
Module 5	Week 9-10	? Matched

RECOMMENDATION

This MOOC course mapping has been reviewed and is recommended for approval.

The proposed NPTEL course meets all the requirements specified in:
? R 17.1 - Approved MOOC Agency (NPTEL/SWAYAM)
? R 17.2 - Minimum 8 weeks duration
? R 17.3 - Online mode with proctored examination
? R 17.4 - At least 70% content overlap with KTU syllabus

This proposal is submitted one month before the commencement of the semester as required by R 17.5.

Verified by:

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HoD (Department) IQAC Coordinator

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Principal