Course Syllabus

offered by Department of Mathematics
with effect from Semester A 2022/23

Part I Course Overview

Course Title:	Advanced Learning Theory
Course Code:	MA8015
Course Duration:	One Semester
Credit Units:	3
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to introduce mathematical models, important algorithms and advanced analysis techniques for learning theory, and discuss advanced topics of current research interest.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Formulate the problem of estimation under uncertainty in a normal linear space and use techniques of convex analysis to identify worst case optimal estimators	30%	✓	✓	
2.	Elucidate the role of regularization when there are two competing error criterion represent and establish optimality of regularization in a Hilbert space setting	20%		✓	✓
3.	Explain basic mathematical models in machine learning	20%	✓	✓	
4.	Describe the concept of reproducing kernel Hilbert spaces and their use in both single and multitask machine learning problems	30%		✓	✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lectures	Learning through teaching is primarily based on lectures	✓	✓	✓	✓	3 hours/week
Assignments	Learning through take-home assignments helps students implement mathematical theory and techniques of learning theory, as well as applications of which in approximation and classification problems	✓	✓	✓	✓	After-class

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.				Weighting*	Remarks
	1	2	3	4		
Continuous Assessment: 40%						
Test	✓	✓	✓		15-40%	Questions are designed for the first part of the course to see how well the students have formulated mathematical models of learning theory and manipulated related analytic concepts (e.g. reproducing kernel Hilbert spaces).
Hand-in assignments	✓	✓	✓	✓	0-15%	These are skills based assessment to help students manipulate theory and techniques of learning theory, as well as its applications in approximation and classification problems.
Examination: 60% (duration: 3 hours)	✓	✓	✓	✓	60%	Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills and understanding based to assess the student's versatility in theory and techniques of learning models.
					100%	

5. Assessment Rubrics

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-,C+,C)	Failure (F)
1. Test	DEMOSTRATION of the understanding of the first part of the course	High	Significant	Basic	Not even reaching marginal levels
2. Hand-in assignments	DEMONSTRATION of the understanding of the basic materials	High	Significant	Basic	Not even reaching marginal levels
3. Examination	DEMONSTRATION of skills and versatility in learning models	High	Significant	Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	DEMOSTRATION of the understanding of the first part of the course	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	DEMONSTRATION of the understanding of the basic materials	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	DEMONSTRATION of skills and versatility in learning models	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Basic models for machine learning, reproducing kernel Hilbert spaces, regularization schemes, convex analysis, optimal estimation.

2. Reading List

2.1 Compulsory Readings

1.	
2.	
3.	
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2.2 Additional Readings

1.	
2.	
3.	
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