离散数学 教学大纲

Discrete Mathematics Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100213020	开课学期: Semester	6
课程分类: Category	专业教育 PA	所属课群: Section	专业基础 MF
课程学分: Credit Points	3	总学时/周: Total Hours/Weeks	48/12
理论学时: LECT. Hours	48	实验学时: EXP. Hours	0
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	东北大学 悉尼智能科技学院 Sydney Smart Technology College Northeastern University	适用专业: Stream	计算机科学与技术 CST
课程属性: Pattern	选修 Elective	课程模式: Mode	自建 NEU
中方课程协调人: NEU Coordinator	赵媛 Zhao Yuan	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	高等数学建模（一）Advanced mathematical modeling (1), 高等数学建模（二）Advanced mathematical modeling (2)		
英文参考教材: EN Textbooks	无 None		
中文参考教材: CN Textbooks	王新心等，《离散数学》，东北大学出版社，2011 年，第一版		
教学资源: Resources	https://www.mhhe.com/rosen		
课程负责人(撰写人): Subject Director	赵媛	提交日期: Submitted Date	4/10/2023
任课教师(含负责人): Taught by	赵媛		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	4/10/2023

二、教学目标 Subject Learning Objectives (SLOs)

注：毕业要求及指标点可参照悉尼学院本科生培养方案，可根据实际情况增减行数

Note: GA and index can be referred from undergraduate program in SSTC website. Please add/reduce lines based on subject.

整体目标: Overall Objective		离散数学是研究计算机科学的基本数学工具。离散数学具有概念较多、理论性较强、应用性较广的特点。主要包括集合论、代数系统、图论、数理逻辑四方面内容。通过本门课程学习培养学生概括及逻辑推理的能力，使用所学知识分析和解决实际问题的能力，为学习后续课程打下良好的基础。培养学生具备一定的科学思维、科学精神和科学素质，树立科学思想以及正确的世界观和方法论。 Discrete mathematics is a basic mathematical tool for the study of computer science. Discrete Mathematics has many characteristics, strong theoretical and wide applicability. It mainly includes four aspects: set theory, algebra system, graph theory and mathematical logic. This course cultivates students' ability of generalization and logical reasoning, as well as their ability to analyze and solve practical problems with what they have learned, thus laying a good foundation for subsequent courses. Train students to have certain scientific thinking, scientific spirit and scientific quality, establish scientific thought and correct world outlook and methodology.
（1）专业目标: Professional Ability	1-1	掌握离散数学的基本概念和基本原理。 Master the basic concepts and principles of discrete mathematics.
	1-2	初步掌握处理离散结构所必须的描述工具和方法，为学习后续课程打下基础。 To master the description tools and methods of dealing with discrete structure, and lay the foundation for learning the follow-up courses.
	1-3	培养学生抽象思维、提高概括及逻辑推理的能力 Cultivate students' abstract thinking, improve the ability of generalization and logical reasoning
	1-4	使学生具有良好的开拓专业理论的素质，及使用所学知识分析和解决实际问题的能力。 To enable students to have a good quality of developing professional theory, and the ability to use the knowledge to analyze and solve practical problems.
（2）德育目标: Essential Quality	2-1	理解离散数学知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the discrete mathematics in depicting the practical engineering problems.
	2-2	认知大国工匠精神的内涵及时代意义，增强专业认同感、民族责任感。 Understand the connotation and significance of the craftsman spirit of a great country and enhance our professional identity and sense of national responsibility.

课程教学目标与毕业要求的对应关系 Matrix of GA & SLOs		
毕业要求 GA	指标点 GA Index	教学目标 SLOs
2、问题分析：能够应用数学、自然科学和工程科学的基本原理、方法和手段，识别、表达、并通过文献研究分析复杂工程问题，以获得有效结论。	指标点 2-1：能够应用数学、自然科学和工程科学的基本原理、方法和手段，分析、识别、表达本专业相关的复杂工程问题。	1-1，1-2，1-3，1-4，2-1
3、设计/开发解决方案：能够设计针对复杂工程问题的解决方案，设计满足特定需求的系统、单元或流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	指标点 3-1：能够设计针对本专业相关复杂工程问题的解决方案，能够设计和开发实现特定功能、满足特定需求的计算机、软件或网络系统。	1-3，1-4，2-1、2-2
4、研究：能够基于科学原理并采用科学方法对复杂工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	指标点 4-1：能够基于科学原理并采用科学方法，在本专业相关理论指导下对复杂工程问题设计实验进行研究。	1-3，1-4，2-1，2-2
9、个人与团队：能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色。	指标点 9-1：能够认识团队协作的重要性，具有强烈的团队协作意识和能力、卓越的组织管理能力、较强的表达能力和人际交往能力。	1-4，2-1，2-2
10、沟通：能够就本专业复杂工程问题与业界同行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	指标点 10-1：能够就计算机领域相关复杂工程问题与业界同行及社会公众进行有效沟通和交流，能够通过口头或书面方式实现有效表达。	1-4，2-1，2-2

三、教学内容 Content (Topics)

注：以中英文填写，各部分内容的表格可根据实际知识单元数量进行复制、扩展或缩减

Note: Filled in both CN and EN, extend or reduce based on the actual numbers of knowledge unit

(1) 理论教学 Lecture

知识单元序号: Knowledge Unit No.	1		支撑教学目标: SLOs Supported	1-1,1-2,1-4,2-1
知识单元名称 Unit Title	集合论 Set Theory			
知识点: Knowledge Delivery	集合的基本概念和运算：集合的概念及其表示、集合的基本运算、包含排斥原理 Basic concepts and operations of set: concept and representation of set, basic operations of set, inclusion exclusion principle			
	二元关系：序偶与笛卡尔乘积、关系及关系表示、关系的性质、复合关系和逆关系、关系的闭包运算、等价关系与等价类、序关系 Binary relations: product of order pairs and Descartes, relations and their representations, properties of relations, composite relations and inverse relations, closure operations of relations, equivalence relations and equivalence classes, and order relations			
学习目标: Learning Objectives	了解: Recognize	集合的定义与表示方法，序偶与笛卡尔积，复合关系和逆关系 The definition and representation of set, ordered pair and Cartesian product, composite relation and inverse relation		
	理解: Understand	包含排斥定理，关系的性质，等价关系与等价类，偏序关系 Inclusion exclusion theorem, properties of relation, equivalence relation and equivalence class, partial order relation		
	掌握: Master	集合的基本运算，关系矩阵与关系图的表示方法，闭包的求法，哈斯图表示方法 The basic operation of set, the representation of relation matrix and graph, the solution of closure and the representation of Hass diagram		
德育目标 Moral Objectives	理解离散数学知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the discrete mathematics in depicting the practical engineering problems.			
重点: Key Points	集合的基本运算； The basic operation of set; 包含排斥定理； Inclusion exclusion theorem; 关系的性质； Properties of relation; 等价类； Equivalence class; 闭包的求法； The solution of closure; 哈斯图。			

	Hass diagram.
难点: Focal points	包含排斥定理； Inclusion exclusion theorem; 关系矩阵与关系图的表示方法； The representation of relation matrix and relation graph; 闭包的求法； The solution of closure; 哈斯图。 Hass diagram.

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1,1-2,1-3,2-1

知识单元名称 Unit Title	代数系统 Algebraic System		

知识点: Knowledge Delivery	代数系统的一般概念和性质：二元运算及性质、二元运算的特殊元素、代数系统、代数系统的同态与同构 General concepts and properties of algebraic systems: binary operations and properties, special elements of binary operations, algebraic systems, homomorphism and Isomorphism of algebraic systems		
	几个典型的代数系统：半群、群、子群、循环群和置换群、陪集与拉格朗日定理、环与域 Several typical algebraic systems: semigroup, group, subgroup, cyclic group and permutation group, coset and Lagrange theorem, ring and field		

学习目标: Learning Objectives	了解: Recognize	二元运算及性质，代数系统，代数系统的同态与同构，各种典型代数系统在构成上的差异 Binary operation and properties, algebraic system, homomorphism and Isomorphism of algebraic system, differences in composition of various typical algebraic systems
	理解: Understand	二元运算的特殊元素，群及子群的概念及其基本性质，元素的阶，拉格朗日定理 Special elements of binary operation, concepts and basic properties of groups and subgroups, order of elements, Lagrange theorem
	掌握: Master	半群的证明，不同代数系统的判定，陪集的求法 The proof of semigroup, the determination of different algebraic systems, and the solution of coset

德育目标 Moral Objectives	理解离散数学知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the discrete mathematics in

	depicting the practical engineering problems.
重点: Key Points	二元运算的特殊元素； Special elements of binary operation; 半群的证明； The proof of semigroup; 群的一般概念； The general concept of group; 群的基本性质； The basic properties of groups; 元素的阶； The order of elements; 陪集的求法； The solution of coset; 拉格朗日定理。 Lagrange theorem.
难点: Focal points	群的概念及其基本性质； The concept of group and its basic properties; 元素的阶； The order of elements; 整环与域的判定。 The determination of integral ring and field。

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1,1-2,1-4,2-2
知识单元名称 Unit Title	图论 Graph Theory		

知识点: Knowledge Delivery	图的一般概念与性质：图的基本概念、图的连通性、赋权图的最短路径、图的矩阵表示 General concepts and properties of graph: basic concepts of graph, connectivity of graph, shortest path of weighted graph, matrix representation of graph
	几种特殊的图：欧拉图、哈密尔顿图、二部图、平面图、树 Several special graphs: Euler graph, Hamiltonian graph, bipartite graph, planar graph, tree

学习目标: Learning Objectives	了解: Recognize	图论的教学内容及其在计算机领域中的应用，简单图的主要特征，图的连通，点割集与边割集，图的同构，二部图 The teaching content of graph theory and its application in computer field, the main characteristics of simple graph, graph connectivity, vertex cut set and edge cut set, graph isomorphism, bipartite graph
	理解: Understand	握手定理，图的矩阵表示，欧拉回路与欧拉图，哈密尔顿回路与哈密尔顿图，欧拉公式，平面图与树的概

		念及性质
		Handshake theorem, matrix representation of graph, Euler circuit and Euler graph, Hamilton circuit and Hamilton graph, Euler formula, planar graph and tree
	掌握: Master	赋权图的最短路径的求法,欧拉图与哈密尔顿图的判定方法,最小生成树和最优树的求取方法。 The method of finding the shortest path of weighted graph, the method of determining Euler graph and Hamilton graph, the method of finding the minimum spanning tree and the optimal tree.
德育目标 Moral Objectives	认知大国工匠精神的内涵及时代意义,增强专业认同感、民族责任感。 Understand the connotation and significance of the craftsman spirit of a great country and enhance our professional identity and sense of national responsibility.	
重点: Key Points	握手定理的应用; The application of handshake theorem; 赋权图的最短路径的求法; How to find the shortest path of weighted graph; 图的各种矩阵表示方法; Various matrix representations of graphs; 欧拉图、哈密尔顿图的判定方法; The judgment method of Euler graph and Hamilton graph; 最小生成树和最优树的求取方法。 The method to get the minimum spanning tree and the optimal tree.	
难点: Focal points	赋权图的最短路径的求法; How to find the shortest path of weighted graph; 最小生成树和最优树的求取方法。 The method to get the minimum spanning tree and the optimal tree.	

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1,1-2,1-3,2-2
知识单元名称 Unit Title	数理逻辑 Mathematical Logic			
知识点: Knowledge Delivery	命题逻辑:命题与联接词、命题公式及其分类、等值演算、其他联接词、对偶与范式、推理理论 Propositional logic: propositions and connectives, propositional formula and its classification, equivalent calculus, other connectives, duality and paradigm, reasoning theory			
	谓词逻辑:谓词公式及其解释、谓词公式的等值式与蕴含式、前束范式、谓词逻辑推理理论 Predicate logic: predicate formula and its explanation, equivalent			

		formula and implication formula of predicate formula, toe in paradigm, reasoning theory of predicate logic
学习目标: Learning Objectives	了解: Recognize	命题逻辑的基本概念，命题联结词的概念，谓词逻辑的基本概念 The basic concepts of propositional logic, propositional connectives and predicate logic
	理解: Understand	命题逻辑的等值式与蕴涵式，命题公式的真值表，主合取范式及主析取范式 Equivalence and implication of propositional logic, truth table of propositional formula, principal conjunctive paradigm and principal disjunctive paradigm
	掌握: Master	等值公式的证明方法，命题逻辑的推理过程，谓词逻辑等值演算，谓词逻辑推理过程 The proof method of equivalent formula, reasoning process of propositional logic, equivalent calculus of predicate logic, reasoning process of predicate logic
德育目标 Moral Objectives	认知大国工匠精神的内涵及时代意义，增强专业认同感、民族责任感。 Understand the connotation and significance of the craftsman spirit of a great country and enhance our professional identity and sense of national responsibility.	
重点: Key Points	命题公式的真值表； The truth table of propositional formula; 等值公式的证明方法； The proof method of equivalent formula; 主合取范式及主析取范式； Main conjunctive paradigm and main disjunctive paradigm; 命题逻辑的推理过程； The reasoning process of propositional logic; 谓词逻辑等值演算； Predicate logic equivalent calculus; 谓词逻辑推理规则。 Inference rules of predicate logic.	
难点: Focal points	主合取范式及主析取范式； Main conjunctive paradigm and main disjunctive paradigm; 命题逻辑的推理过程； The reasoning process of propositional logic; 谓词逻辑推理规则。 Inference rules of predicate logic.	

四、教学安排 Teaching Schedule

注：可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

教学内容 Teaching Content	学时(周) Hour(Week)			
	理论 LECT.	实验 EXP.	课外实践 PBL	集中实践 PRAC.
集合论 Set Theory	12			
代数系统 Algebraic System	12			
图论 Graph Theory	12			
数理逻辑 Mathematical Logic	12			
总计 Total	48			

五、教学方法 Teaching Methodology

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
☑	多媒体教学：基于信息化设备的课堂教学 Multi-media-based lecturing
☑	实践能力传授：理论与行业、实际案例相结合 Combining theory with industrial practical problems
☑	课程思政建设：知识讲授与德育相结合 Knowledge delivery with ethic education
☐	PBL 教学：问题驱动的分组学习与交流 Problem-based learning
☐	其他: Other:

六、成绩评定 Assessment

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	赵媛
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50

考核方式: Measures	平时成绩以学生出勤和学生作业完成情况综合评定，其中，学生出勤占平时成绩的 40%，学生作业完成情况占平时成绩的 60%。 According to attendance and assignments performance of the students, the mark is evaluated, where attendance accounts for 40%, assignments performance accounts for 60%.

考核环节: Assessment Content	期末 Final	环节负责人: Director	赵媛
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	考试，2 小时答题。 Examination, two hours.		

七、改进机制 Improvement Mechanism

注：未尽事宜以教学团队以及学院教学指导委员会商定为准。

Note: Matters not covered in this file shall be determined by TAB of SSTC, NEU.

教学大纲改进机制 Subject Syllabus Improvement Mechanism			
考核周期(年): Check Period (YR)	4	修订周期(年): Revise Period (YR)	4
改进措施: Measures	课程负责人根据课程教学内容与人才培养目标组织课程团队讨论并修改教学大纲，报分管教学工作副院长审核后由执行院长批准。 The subject coordinator shall be responsible for the syllabus discussion and improvement, and the revised version shall be submitted to deputy dean (teaching affairs) for reviewing then to executive dean for approvement.		
成绩评定改进机制 Assessment Improvement Mechanism			
考核周期(年): Check Period (YR)	1	修订周期(年): Revise Period (YR)	1
改进措施: Measures	课程负责人根据课程教学内容、课堂教学效果以及成绩分布，对课程教学方法和成绩评定环节进行改进，并同步优化评定办法。 The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.		