复杂网络建模　　　　教学大纲

Complex Network Modeling　　Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100313007	开课学期: Semester	5
课程分类: Category	专业教育 PA	所属课群: Section	专业平台 MT
课程学分: Credit Points	3	总学时/周: Total Hours/Weeks	48/8
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	0/0
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	应用统计学 AS
课程属性: Pattern	必修 Compulsory	课程模式: Mode	互认 EQV
中方课程协调人: NEU Coordinator	郭静梅 Guo Jingmei	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	3100313005 量化管理优化技术		
英文参考教材: EN Textbooks	1. Wayne L. Winston, Operations Research Applications and Algorithms, 4nd Edition, Wadsworth Publishing Company, 2003.		
中文参考教材: CN Textbooks	Wayne L. Winston 著, 杨振凯等译, 运筹学应用范例与解法, 清华大学出版社, 2006		
教学资源: Resources	无		
课程负责人(撰写人): SubjectDirector	郭静梅 Guo Jingmei	提交日期: Submitted Date	单击或点击此处输入日期。
任课教师(含负责人): Taught by	郭静梅 Guo Jingmei		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期:	单击或点击此处输

	Approved Date	入日期。

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		复杂网络建模为应用统计学专业本科生开设的专业方向课。通过学习，使学生掌握运输问题和网络优化问题的描述工具和求解方法，可以提高学生的数学建模和设计算法解决问题的能力，为将来参与创新性的研究和开发工作打下坚实的基础。 Complex network modeling is a major course for undergraduates majoring in applied statistics. Through learning, students can master the describing tools and solving methods of transportation problems and network optimization problems, which can improve their mathematical modeling and problem-solving ability of designing algorithms, and lay a solid foundation for participating in innovative research and development work in the future.
（1）专业目标: Professional Ability	1-1	具备利用图论解决实际优化问题的能力，系统掌握项目管理与决策及其相关领域专门知识与技能。 Students have the ability to use graph theory to solve practical optimization problems, and are capable of creatively solving complex engineering problems in information and communication and related fields through scientific and technological theories and engineering practical methods.
	1-2	具有设计算法求解问题的能力，理解现代优化方法的原理及应用。 Students have the ability to design algorithms to solve problems and understand the principles and applications of modern optimization methods.
（2）德育目标: Essential Quality	2-1	理解复杂网络理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the fuzzy network in depicting the practical engineering problems.
	2-2	认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.
	2-3	培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神。 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning.

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
1、理学知识：具有扎实的数学基础，能够将数学、自然科学和专业知识用于解决复	1-1 具有较强的演绎推理能力、准确计算能力、分析归纳能力、抽象思维能力，掌握数学、自然科学和相关专业知识，	1-1, 2-1

杂实际问题。 **GA1. Science Knowledge**: Apply knowledge of mathematics, natural science, fundamentals and an engineering specialization to the solution of complex engineering problems.	并使用其建立正确的数学、物理学等模型以解释复杂实际问题； 1-1: Capable of deductive reasoning, accurate calculation, analysis and induction and abstract thinking. Establishing correct mathematical and physical models with the professional knowledge of mathematics, natural science, etc. to solve complex practical problems;	
2、问题分析：能够借助应用统计学的基本原理、方法和手段，识别、表达、并通过文献研究分析复杂实际问题，以获得有效结论。 **GA2. Problem Analysis**: Identify, formulate, research literature and analyze complex practical problems reaching substantiated conclusions using first principles of mathematics and sciences.	2-2：能够借助应用统计学的基本原理、方法和手段，针对复杂实际问题设计针对性的方案，并综合运用文献、科学理论和技术手段予以解决。 2-2: Capable of drawing on the basic principles of applied statistics to design targeted schemes for complex practical problems, and using literature, scientific theories and technical means to solve them.	1-2, 2-3
3、设计/开发解决方案：能够设计针对复杂实际问题的解决方案，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。 **GA3. Design/Development of Solutions**: Design solutions for complex practical problems and design systems, components or processes that meet specified needs with appropriate consideration for public health, and safety, cultural, societal and environmental considerations.	3-2：能够对不同设计方案进行比较和优化，在工作各环节中具有创新意识和批判意识，善于发现、分析、系统表述和解决实际问题； 3-2: Capable of comparing and optimizing different design schemes, having a sense of innovation and criticism in all aspects of work, and be good at discovering, analyzing, systematically elaborating and solving practical problems;	1-2, 2-2, 2-3

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

知识单元序号: Knowledge Unit No.	1		支撑教学目标: SLOs Supported	1-1，2-2，2-3
知识单元名称 Unit Title	运输问题 Transportation Problems			
知识点: Knowledge Delivery	运输问题的建立和转化 Formulation and conversion of Transportation Problems			
	运输问题的求解 Solution of Transportation Problems			
	运输问题的灵敏度分析 Sensitivity Analysis for Transportation Problems			
学习目标: Learning Objectives	了解: Recognize	指派问题 Assignment Problems		
	理解: Understand	运输问题模型结构，运输单纯形法的原理 Structure of the LP model of Transportation Problems, Theory of Transportation Simplex Method		
	掌握: Master	初始基可行解的求法，运输单纯形法，灵敏度分析，转运问题建模 Basic Feasible Solutions，Transportation Simplex Method，Sensitivity Analysis，Formulation of Transshipment Problems		
德育目标 Moral Objectives	2-2 认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.			
	2-3 培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神。 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning.			
重点: Key Points	初始基可行解的求法，运输单纯形法 Basic Feasible Solutions，Transportation Simplex Method			
难点: Focal points	运输单纯形法 Transportation Simplex Method			

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1，2-1，2-3
知识单元名称 Unit Title	网络模型 Network Models		
知识点: Knowledge Delivery	最短路径问题 Shortest-Path Problems		
	最大流问题 Maximum-Flow Problems		
	关键路径和网络分析法 CPM and PERT		
	最小生成树 Minimum spanning tree problems		
	最小费用最大流问题 Minimum-Cost Network Flow Problems		
学习目标:	了解:	图论基本概念	

Learning Objectives	Recognize	Basic definition of graph
		中国邮递员问题 Chinese Postman Problem
	理解: Understand	最大流算法的理论 Theory of Maximum-Flow Algorithms
		网络单纯形法 Network Simplex Method
	掌握: Master	Dijkstra 算法 Dijkstra's Shortest-Path Algorithm
		Ford-Fulkerson 算法 Ford-Fulkerson Algorithm
		创建网络图，求关键路径 Construct an AOA network，find the CPM
		普林算法和 Kruskal 算法 Prim's algorithm and Kruskal's algorithm
		网络单纯形法 Network Simplex Method
德育目标 Moral Objectives	2-1 理解复杂网络理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the fuzzy network in depicting the practical engineering problems.	
	2-3 培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning	
重点: Key Points	Ford-Fulkerson 算法 Ford-Fulkerson Algorithm	
难点: Focal points	网络单纯形法 Network Simplex Method	

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-2，2-2，2-3
知识单元名称 Unit Title	现代优化方法 Modern Heuristic Techniques		
知识点: Knowledge Delivery	局部搜索 Local Search		
	禁忌搜索 Tabu Search		
	模拟退火 Simulated Annealing		
学习目标: Learning Objectives	了解: Recognize	遗传算法 Genetic Algorithms	
		算法的复杂度 Concepts of Complexity Theory	
	理解: Understand	禁忌搜索 Tabu Search	
		模拟退火 Simulated Annealing	
	掌握: Master	局部搜索 Local Search	
		禁忌搜索 Tabu Search	
德育目标 Moral Objectives	2-2 认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core		

		competitiveness in the area of the China engineering in the world.
		2-3 培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning
重点: Key Points	局部搜索 Local Search	
	禁忌搜索 Tabu Search	
难点: Focal points	禁忌搜索 Tabu Search	
	模拟退火 Simulated Annealing	

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.	实践 PRAC.	PBL
运输问题 Transportation Problems	14	0	0	0
网络模型 Network Models	22	0	0	0
现代优化方法 Modern Heuristic Techniques	12	0	0	0
总计 Total	48	0	0	0

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 linesor 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:单击或点击此处输入文字。 Other:单击或点击此处输入文字。

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 linesor revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	郭静梅 Guo Jingmei
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
考核方式: Measures	平时成绩，以学生平时课堂表现、课堂教师随机提问，学生平时作业完成情况综合评定，其中，学生平时课堂表现、课堂教师随机提问占比 10%，学生平时作业(课前预习作业、课后作业)完成情况占比 90%. According to instant answer to the teacher's questions, comprehensive report and question performance, the mark is evaluated, where question performance and instant answer accounts for 10%, assignments performance (pre-lecture and post-lecture) accounts for 90%.		

考核环节: Assessment Content	期末 Final	环节负责人: Director	郭静梅 Guo Jingmei
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	70
考核方式: Measures	考试，2 小时答题时间 Examination, and the examinations lasts for two hour time.		

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 approval		
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.		