THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Approval of Undergraduate Course

Section 1: Academic Administration [1]

1.1 Catalog

a) Course to be effective from: Academic Year **2021-22**   Term **Fall**

b) Department Code[3]: **MATH**   Subject Area[3]: *Mathematics*   Course Number [4]: **MATH 4343**

Previous Course Code[5]: **MATH 4821B**

c) Full Title[6] *(max. 100 characters)*: **Introduction to Graph Theory**

d) Abbreviated Title[7] *(max. 30 characters)*: **Intro to Graph Theory**

e) Course Credits[8]:   ☑ Fixed: **4**   ◯ Range: From _____ To _____

f) Catalog Description[9] *(word limit = 150)*:

> This course is to equip students with basic knowledge of graph theory that will be needed in mathematics, computer science, and engineering (in particular network analysis).
>
> Topics include but not restricted to: Euler tours and Chinese postman problem, Hamilton cycles and traveling salesman problem; minimum spanning trees and searching algorithms; block decomposition, ear decomposition, connectivity and edge connectivity; network flows, Ford-Fulkerson (Max-Flow Min-Cut) theorem, augmenting-path algorithm; planar graphs, Euler formula, duality, classification of Platonic solids, Kuratowski (planarity) theorem; maximum matchings and perfect matchings, matchings in bipartite graphs, matchings in general graphs, Tutte-Berge theorem, Petersen theorem; probabilistic method, page rank problem, random walks; cycle spaces and bond spaces, graph Laplace operator, matrix-tree theorem; Four-Color problem, colorings and flows, chromatic number and flow number, chromatic polynomials, flow polynomials, Tutte polynomials; matroids.

g) Grading Type[10]:   ☑ Letter Grades   ◯ Distinction/Credit/Pass/Fail   ◯ Pass/ Fail

◯ Distinction/Pass/Fail   ☐ Others *(please specify)*: _____

h) ☑ Prerequisites[11]:

Course Code / Public Exam	Course Title / Exam Subject and Level / Grade attained
MATH 2343	Discrete Structure

i) ☐ Corequisites[12]:

Course Code	Course Title

j) ☐ Exclusions[13]:

Course Code / Public Exam	Course Title / Exam Subject and Level / Grade attained

k) ☐ Co-listing[14]:   ☐ Multi-coding[14]:

Course Code	Course Title

l)   Other Enrollment Restrictions[15]   ☑ No   ◯ Yes

    ☐ Instructor's approval required

    ☐ Restricted to specified student group(s)
    (please specify, e.g. year and program of study): _____

    ☐ Others *(please specify):* _____

m)   Medium of Instruction/Materials[16]:   ☑ English   ◯ Others, (Pls specify and provide a justification in Section 1.3): _____

n)   Allow course repetition for credit[17]:   ☑ No   ◯ Yes

1.2 Contribution of course to Programs of Study [Check all appropriate boxes below]

☑ Major

Program of Study	As		
BSc(MATH)	☐ Required Course	☑ Elective	☐ Prerequisite
BSc(MAEC)	☐ Required Course	☑ Elective	☐ Prerequisite

☑ Minor

Program of Study	As		
Minor in MATH	☐ Required Course	☑ Elective	☐ Prerequisite

☐ Common Core

☐ Others (pls specify):

Program of Study	As		
	☐ Required Course	☐ Elective	☐ Prerequisite

1.3 Rationale for Introducing this course and other relevant information [18]

Graph is everywhere; network is the most popular example of graphs. With the development network analysis, neural networks, and graph learning, graph theory becomes more and more popular, useful and be needed for students of mathematics, computer science and engineering. Except its traditional applications to computer science and engineering, graph theory also becomes applicable to social sciences such as organization structure, social hierarchy, consistency choice, social networks, etc.

The course has been offered three times under the request of students. Syllabus and contents are relatively fixed. The instructor have had prepared almost all written notes. It's time to have the course regularly offered rather than a seminar course again and again.

The course is targeted to senior undergraduate students and first-year postgraduate students. Exceptional year-2 students need approval of the course instructor to take the course.

Section 2A: Learning Outcomes and Alignment *(for courses not proposed to be Common Core Courses)*

2.1   Key Course Intended Learning Outcomes *(Should not normally exceed six or eight outcomes)*

Upon completion of this course, students are expected to be able to do the following:

	Course ILOs	Nature of the learning outcomes (A - Knowledge/Content Related; B - Academic Skills/Competencies; C - Others)
1	Formulate related problems in graph language and graph models.	A, B
2	Master standard useful matrix methods such as incidence matrix, Laplace matrix, matrix-tree formula, and graph Fourier transforms, etc.	A, B
3	Master basic concepts, ideas, techniques and core theorems of graph theory that may be applicable to network analysis and other practical problems.	A, B
4	Demonstrate abilities in applying algorithms, graph analytic skills, and theoretical thinking for software development.	A, B, C
5	Demonstrate ability in working with unsolved problems and explore new problems for future advanced studies.	A, B, C
6		
7		
8		

2.2   Contribution of Learning Outcomes to Programs of Study identified in Section 1.2
(Please also complete Section 4.1)

	Program of study 1: _BSc(MATH)_____ Program ILOs	To be achieved through these course ILOs *(Write CILO-1, CILO-2, etc.)*
1	Explain knowledge, principles and use of quantitative techniques in mathematical sciences at college level.	CILO-1, CILO-2, CILO-3, CIOL-4
2	Model real-world problems and information mathematically, and make independent judgment by applying structural and analytical approaches.	CILO-1, CILO-2, CILO-4
3	Apply logical, analytic, and highly numerate methods to execute tasks and solve real-world mathematical problems.	CILO-1, CILO-2, CILO-3, CIOL-4
4	Work independently and collaborate effectively in a team.	CILO-4, CILO-5
5	Show appreciation of mathematical sciences and its interface with human activities, and arouse audience's interest in the beauty, logic and precision of mathematical sciences.	CILO-1, CILO-2, CILO-3, CIOL-4, CILO-5
6		

	Program of study 2: _____ Program ILOs	To be achieved through these course ILOs *(Write CILO-1, CILO-2, etc.)*
1		
2		
3		
4		
5		
6		

Section 2B: Additional Information[2] *(for courses not proposed to be Common Core Courses)*

2.3   Planned Teaching & Learning Arrangement

	Teaching & Learning Arrangement	Weekly Scheduled Hours/ Estimated Weekly Learning Hours	Indicate which course ILOs this activity serves to achieve *(Write CILO-1, CILO-2, etc.)*	Additional Information *(optional)*
Face-to face activities	☑ Lecture*	3	CILO-1, CILO-2, CILO-3, CIOL-4	
	☑ Tutorial*	1	CILO-1, CILO-2, CILO-3, CIOL-4	
	☐ Seminar/Small-class*			
	☐ Laboratory*			
	*Does the above scheduled component(s) involve structured active learning activities? [19] ◉ No ○ Yes *If yes, please specify for each scheduled component, the percentage and the type of active learning involved in the "Additional Information" column.*			
	☐ Others (e.g. fieldtrip, visit, etc.), *pls specify:* _____			
Online activities	☐ Online lecture videos			
	☐ Other online learning tasks, *pls specify:* _____			
	The total learning hours of the course# is equivalent to _____120_____ hours [8] *# including both scheduled instructional hours and hours for self-study activities & assessment*			

- For course adopting a pedagogic approach other than lecture, tutorial and laboratory, please indicate the pedagogy used:

  ○ Blended learning [20]   ○ Pure online delivery [21]

  ○ Experiential learning [22]   ○ Others, *pls specify:*_____

2.4   Planned Assessment Weightings

Assessment Task	Proportion of Final Grade (%)	Indicate which course ILOs this task is to assess *(Write CILO-1, CILO-2, etc.)*	Additional Information *(optional)*
☑ In-class test	0		
☑ Mid-term test	30	CILO-1, CILO-2, CILO-3, CIOL-4	
☑ Final exam	50	CILO-1, CILO-2, CILO-3, CIOL-4	
☑ Written assignment	10	CILO-1, CILO-2, CILO-3, CIOL-4	Homework assignment
☐ Project report			
☐ Presentation			
☐ Learning portfolio			
☑ Course participation	10		
☐ Peer evaluation			
☐ Others (e.g. proctored online exam, etc.), *pls specify:* _____			

2.5   *Course Duration*

(●) 1 term   ( ) 2 terms   ( ) Others, *pls specify:* _____

2.6   *Planned Frequency of Offerings* [Check all appropriate boxes]*:*

[ ] Every Fall   [ ] Every Winter

[✓] Every Spring   [ ] Every Summer

[ ] No fixed pattern

[✓] Other (*pls specify*):   Either every Fall or every Spring but not both, avoid the semester with MATH 3343

2.7   *Course outline attached*   (✓) No   ( ) Yes

- **Internationalization:**

Internationalization in a course refers to course content and/or pedagogic approaches which incorporate an intercultural and international perspective. Examples may include:
- Collaboration with overseas institutions to develop and adopt international course content, or to arrange international field trip
- Insertion of international theme as part of the course
- Integrating the course content with international material as examples or case studies
- Elements to provide global diversified perspectives and/or practices around the world

Please briefly list or summarize any component(s) in the course that contributes to internationalizing the curriculum:

NA

2.8   **Resources**

Request extra resources for teaching this course?   (✓) No   ( ) Yes

Section 4: Development, Concurrence and Approval

4.1 Contribution to the Program Learning Outcomes

The course is confirmed by the following Major/Minor program department(s)/unit(s) as indicated in Section 1.2 that it would contribute appropriately to overall program learning outcomes.

Department/Program unit	Position	Name	Date
Dept of Mathematics	UG Coordinator	Dr Tsz Kin LAM	1-Feb-21

4.2 Approvals

Recommendation from offering department(s) and School(s)/IPO

Offering Department/Program Unit	Position	Name	Date
Dept of Mathematics	UG Coordinator	Dr Tsz Kin LAM	1-Feb-21

Recommending School/IPO	Position	Name	Date
School of Science	Associate Dean	Prof Pak Wo LEUNG	19-Feb-21

Concurrence from other Schools or departments/units

School/Dept/Program Unit	Position	Name	Date