Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2023-2024
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Keen Mun Kelvin Yong
Course Author Email	kmyong@ntu.edu.sg
Course Title	Decision Tools for Engineering Business
Course Code	CH3109
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

At the end of the course, you will be able to understand basic engineering business structure and economics, and hence identify and apply the important and common decision tools for engineering business.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Explain the basic business structure, challenges, engineering economics and the importance of the common decision tools used.
ILO 2	List, describe and explain the common decision tools used for engineering business.
ILO 3	Identify and apply the decision tools for related problems.

Course Content

Key topics taught

1. Finance math basics
2. Engineering Economics
3. Project management
4. Data Exploration and data mining
5. Optimization methods for decision making

Reading and References (if applicable)

1. Financial Accounting: Tools for Business Decision Making, 7th Edition, by Paul D. Kimmel, Jerry J. Weygandt, Donald E. Kieso, 2013, Wiley
2. Fundamentals of Engineering Economics, 1st Edition, by Kal Renganathan Sharma, 2011, Cognella
3. Project Management for Business, Engineering, and Technology, 3rd Edition, by Nicholas, J.M. and Steyn, H., 2008, Elsevier.
4. Introduction to Data Mining and its Applications, 1st Edition, by S. Sumathi, S.N. Sivanandam, 2006, Springer
5. Introduction to Optimization, 1st Edition, by Pablo Pedregal, 2004, Springer

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Finance statements and business decisions (Financial reporting and decisions, Account equation, Accounting practices and regulation)	1,2			
2	Finance statements and business decisions (Journals and ledgers, Revenue and matching principles, Performance metrics/indexes)	1,2			
3	Engineering Economics (Introduction, Time value of money, Rate of return analysis)	1,2			
4	Engineering Economics (Inflation, Deflation, Decisions on replacement, Benefit-cost analysis)	1,2			

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
5	Project Management (Introduction, Lifecycle, Stakeholder management, Selection)	1,2			
6	Project Management (Procurement management, Planning, Monitoring and control, Audit, Termination)	1,2			
7	Data Exploration (DE) (Definition, Importance of DE, Visualization)	1,2			
8	Data Mining (DM) (Definition, DM Tasks, Challenges of DM)	1,2			
9	Optimization methods (Decision making problem, Optimization models, Scoring method)	1,2,3			
10	Linear programming (Transformation, Simplex method, Graphical method)	1,2,3			

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Dynamic programming (State space, Recursive equations, Equipment replacement problem)	1,2,3			
12	Dynamic programming (Knapsack problem, Shortest path/minimum cost path problem)	1,2,3			
13	Application and Case Studies	3			

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Lectures are mainly focusing on the principles, concepts and application of decision tools in engineering business.
Tutorial	Tutorial problems are direct applications of the principles and concepts introduced in lectures. The tutorial questions are designed for students to identify, apply and solve the engineering business problems. The questions are also designed to encourage further discussions in class for better learning experience.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination (2hrs; Closed Book))	1, 2, 3	EAB SLO* a, b, d, e, f, g, j, k	60	Individual	Holistic	Multistructural
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 1 (CA1): Quiz)	1, 2, 3	EAB SLO* a, b, d, e, f, g, j, k	20	Individual	Holistic	Relational
3	Continuous Assessment (CA): Test/Quiz(CA2: Continuous Assessment 2 (CA2): Quiz)	1, 2, 3	EAB SLO* a, b, d, e, f, g, j, k	20	Individual	Holistic	Relational

Description of Assessment Components (if applicable)

Formative Feedback

After each CA, the problems will be discussed . Common mistakes and misunderstanding in concepts will also be addressed.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Curiosity	Basic
Information Literacy	Basic
Project Management	Basic
Critical Thinking	Intermediate
Design Thinking	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

Students are responsible for meeting all course requirements, observing all deadlines, examination times, and other course procedures.

Students are responsible for being on time for all lectures and tutorials. Sufficient efforts should be put into solving or attempting the tutorial problems prior to attending the respective tutorial classes.

Student who has been caught cheating will be given an "F" for the component or the course and may be expelled from the University.

Students are responsible for seeking academic help in a timely fashion.

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Last Updated By: Yong Keen Mun Kelvin (Dr)

Appendix 1: EVALUATION RUBRIC: CH2109 Decision tools for Engineering Business
ASSESSMENT FORM (Course Coordinator: Yong Keen Mun Kelvin)

Criteria	**Unsatisfactory: 1**	**Borderline: 2**	**Satisfactory: 3**	**Very good: 4**	**Exemplary: 5**
Create and interpret financial statements, and make use of indexes based on financial statements for business decision	Unable to interpret business transactions information provided, and not able to create the relevant financial statements	Able to interpret business transactions information provided, but do not know how to create the relevant financial statements based on this information	Able to interpret business transactions information provided, and able to create the relevant financial statements based on this information	Good understanding of the business transactions information provided, and able to create the relevant financial statements based on this information. In addition, able to make use of 1 index to make sound business decision based on the statements.	Excellent understanding of the business transactions information provided, and able to create the relevant financial statements based on this information. In addition, able to make use of multiple indexes to make sound business decision based on the statements.
Understand and application of project management techniques in engineering economics environment	Unable to understand engineering economics and project management techniques	Able to understand project management techniques, but fail to apply them in engineering economics environment	Able to understand project management techniques, and apply them in engineering economics environment	Good understanding project management techniques, and apply them in engineering economics environment in a more efficient manner such as using multiple techniques concurrently	Excellent understanding project management techniques, and apply them in engineering economics environment in a more efficient and productive manner such as using multiple techniques concurrently and customizing new techniques whenever required
Understand, interpret and apply data exploration and data mining algorithms	Unable to understand, interpret and apply data exploration and data mining algorithms	Able to understand differences between data exploration and data mining, but not able to fully interpret and apply the algorithms	Able to understand differences between data exploration and data mining, able to fully interpret the technique, but not able to apply the algorithms	Good understanding of the differences between data exploration and data mining, able to fully interpret and apply the algorithms	Excellent understanding of the differences between data exploration and data mining, able to fully interpret and apply the algorithms. In addition, able to customize the algorithms for relevant problems
Interpret decision making problems and solve using optimization methods	Unable to understand decision making problems	Able to understand decision making problems, but failed to solve them using optimization methods	Able to understand decision making problems, and able to solve them using simple optimization methods	Good understanding of decision making problems, and able to solve them using more advance optimization methods such as linear programming and dynamic programming	Excellent understanding of decision making problems, and able to solve them using more advance optimization methods such as linear and dynamic programming. Able to compare the difference between linear and dynamic programming for the same problem

Mapping of Course ILOs to EAB Graduate Attributes

Course Code & Title	CH3109 Decision Tools for Engineering Business
Course Type	Core Module

Overview										
(a)	●	(b)	●	(c)		(d)	●	(e)	●	(f)	●
(g)	●	(h)		(i)		(j)	●	(k)	●		

Legend:

●	Fully consistent (contributes to more than 75% of Student Learning Outcome)
◐	Partially consistent (contributes to about 50% of Student Learning Outcome)
O	Weakly consistent (contributes to about 25% of Student Learning Outcome)
Blank	Not related to Student Learning Outcome

Course ILOs		**EAB Graduate Attributes**
1)	Explain the basic business structure, challenges, engineering economics and the importance of the common decision tools used.	a, b, d, e, f, g, j, k
2)	List, describe and explain the common decision tools used for engineering business.	a, b, d, e, f, g, j, k
3)	Identify and apply the decision tools for related problems.	a, b, d, e, f, g, j, k

EAB Graduate Attributes

a) **Engineering Knowledge**: Apply the knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialisation as specified in WK1 to WK4 respectively to the solution of complex engineering problems.

b) **Problem Analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences with holistic considerations for sustainable development. (WK1 to WK4)

c) **Design / Development of Solutions**: Design creative solutions for complex engineering problems and design systems, components or processes that meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required. (WK5)

d) **Investigation**: Conduct investigations of complex problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern Tool Usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering problems, with an understanding of the limitations. (WK2 and WK6)

f) **The Engineer and the World**: When solving complex engineering problems, analyse and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks and the environment (WK1, WK5, and WK7).

g) **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).

h) **Individual and Collaborative Team Work**: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multidisciplinary, face-to-face, remote and distributed settings (WK9).

i) **Communication**: Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions, taking into account cultural, language, and learning differences.

j) **Project Management and Finance**: Demonstrate knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

k) **Life-long Learning**: Recognise the need for, and have the preparation and ability to (i) engage in independent and life-long learning, and (ii) adapt to new and emerging technologies, and (iii) think critically, in the broadest context of technological change (WK8).

No	Knowledge Profile
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
WK5	Knowledge including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc with mutual understanding and respect, and of inclusive attitudes

Reference: EAB Accreditation Manual