Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): ORBS 7180 Heuristic and Structured Problems in Operational Research (2,2,0)

Course Aims: This course introduces model building and solution techniques for practical problems in mathematical programming, and the methods in the design and analysis of algorithms for solution to large size practical real-life problems.

Prerequisite: No

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Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Describe the fundamental principles combinatorial optimization and models
2	Identify the solution methods of heuristic techniques
3	Apply combinatorial optimization and integer programming skills and techniques
4	Report and interpret findings in a scientific and concise manner
5	Solve problems logically, analytically, critically and creatively

Teaching & Learning Activities (TLAs):

CILO	TLAs will include the following:
1,2,3,5	Lectures with rigorous mathematical discussions and concrete examples. The lecturer will constantly ask questions in class to make sure that the majority of students are following the teaching materials.
1,2,3,4,5	Assignments to monitor both students' learning and mastering of the taught materials. In addition, common mistakes will also be addressed and analyzed.

Assessment:

No.	Assessment Methods	Weighting	CILO Addressed	Remarks
1	Continuous Assessment (assignments, test, reports, or mini-project)	20%	all	Assessments are designed to measure how well the students recognizing of the theory, techniques, and applications of heuristic and structured problems in operational research. The test is conducted to monitor the students' recognizing of the theory, techniques and skills taught in the class. This may involve, but not limited to, in

				class discussions of rigorous technical problems and their solutions.
2	Final Examination	80%	all	Final Examination is designed to see how far students have achieved their intended learning outcomes especially in the knowledge domain. Students should have a thorough recognizing of the knowledge and apply them correctly in different context to do well in the exam.

Course Intended Learning Outcomes and Weighting:

Content	**CILO No.**	**Teaching (in hours)**
1.Introduction to Combinatorial Optimization Problems (COP)	1,2,3	2
2. Formulation of Integer Programming Problems	1,2,3	2
3. Formulation and applications of COP models	1,2,3	6
4. Exact Solution Techniques for COP models	1,2,3	6
5. Heuristic Techniques for COP models	1,2,3	6
6. Lagrangean Relaxation Techniques	1,2,3	6

References:

1) Model Building in Mathematical Programming, by H.P. Williams, Wiley, 1990.
2) Model Solving in Mathematical Programming, by H.P. Williams, Wiley, 1993.
3) Operations Research: Applications and Algorithms, by W.L. Winston, PWS-Kent, 1993.
4) Integer Programming, by L.A. Wolsey, Wiley, 1998.
5) Integer and Combinatorial Optimization, by G.L. Nemhauser, L.A. Wolsey, Wiley, 1998.
6) Modern Heuristic Techniques for Combinatorial Problems, by C.R. Reeves, Blackwall Scientific Publisher, 1992.
7) Tabu Search, by F. Glover and M. Laguna, Kluwer Academic Publisher, 1997.

Course Content in Outline:

	Topic	**Hours**
I.	Introduction to Combinatorial Optimization Problems (COP)	2
II.	Formulation of Integer Programming Problems	2
III.	Formulation and applications of COP models A. Set Covering and Packing Problems B. Knapsack Problem C. Generalized Assignment Problem D. Travelling Salesman Problem	6

E. Capacitated Clustering Problem
F. Vehicle Routing Problems, and others

IV. Exact Solution Techniques for COP models 6
A. Branch and Bound
B. Cutting Plane Method

V. Heuristic Techniques for COP models 6
A. Construction heuristics
B. Mathematical Programming based heuristics
C. Improvement heuristics, and others

VI. Lagrangean Relaxation Techniques 6
A. Lagrangean relaxation
B. Lagrangian heuristics
C. Problem reduction
D. Subgredient optimization
E. Multiplier adjustment