Course Specification

(Bachelor)

Course Title:	Search-based Software Engineering
Course Code:	SE4719
Program:	BSc in Software Engineering
Department:	Software Engineering
College:	College of Computing
Institution:	Umm Al Qura University
Version:	1.0
Last Revision Date:	22/04/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (3rd year/ 5th or 6th level) or (4th year/8th level)					
4. Course General Description:					
Many activities in software engineering involve an element of search. Some examples include selection of requirements, localisation and correction of defects, and the optimisation of test coverage. The fast-growing field of Search-Based Software Engineering (SBSE) applies computing resources to these search problems to improve the efficiency and quality of software engineering processes. This course aims to introduce students to a wide range of SBSE terminology, techniques, and processes. The concepts taught in the lectures is practised and reinforced by participation in three projects, and seminars with written essays on a recent SBSE-related conference article.					
5. Pre-requirements for this course (if any)**:**					
AI3011 - Artificial Intelligence and Machine Learning					
6. Co-requisites for this course (if any)**:**					
N/A					
7. Course Main Objective(s):					
On successful completion of this course students will be able to: 1. Develop knowledge of optimisation techniques and methodologies set in the context of search-based software engineering. 2. Gain experience in matching various optimisation methods and algorithms for particular classes of problems. 3. Develop knowledge and experience in developing search-based software engineering approaches for real-world applications. 4. Read and understand scientific research papers and present them in a talk.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning	0	0
3	Hybrid • Traditional classroom • E-learning	0	0
4	Distance learning	0	0

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand the principles of Search-Based Software Engineering (SBSE) and its applications in software development.	K1	Lecture, exercise, and group discussion	Quiz, exams, assignments
1.2	Learn about fitness landscapes and advanced algorithms like local search and multi-objective optimization.	K2	Lecture, exercise, and group discussion	Quiz, exams, assignments

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	Explore techniques for software testing, bug location and fixing, and assessing non-functional properties.	K3	Lecture, exercise, and group discussion	Quiz, exams, assignments
2.0	**Skills**			
2.1	Apply SBSE techniques to optimize software design and perform effective refactoring.	S1	Lecture, exercise, and group discussion	Quiz, exams, assignments
2.2	Utilize optimization algorithms to address multi-objective problems in software engineering.	S1	Lecture, exercise, and group discussion	Quiz, exams, assignments
2.3	Implement SBSE techniques for project management and improve software testing processes.	S2	Lecture, exercise, and group discussion	Quiz, exams, assignments
3.0	**Values, autonomy, and responsibility**			
3.1	Recognize the importance of optimization in improving software quality, performance, and maintainability.	V1	Lecture, exercise, and group discussion	Quiz, exams, assignments
3.2	Appreciate the value of multi-objective decision-making in balancing conflicting software requirements.	V1	Lecture, exercise, and group discussion	Quiz, exams, assignments
3.3				

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to SBSE	**3**
2.	Fitness Landscapes, Local Search Algorithms - Advanced Algorithms	**6**
3.	Multi-Objective Optimisation	**6**
4.	Software Testing	**6**
5.	Bug Location and Fixing	**6**
6.	Non-Functional Properties	**6**

7.	Software Design, Refactoring	6
8.	Project Management	6
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	2-14	15
2.	Projects	2-14	15
3.	Assignments	2-14	10
4.	Mid Term	7	20
5.	Final Exam	16-17	40

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Sarro F, Deb K. Search based Software engineering: 8th International Symposium, SSBSE 2016, Raleigh, NC, USA, October 8-10, 2016, Proceedings. Springer; 2016. • Meyer, B., & Nordio, M. (2012b). *Empirical software engineering and verification: International Summer Schools, LASER 2008-2010, Elba Island, Italy, Revised Tutorial Lectures*. Springer Science & Business Media.
Supportive References	• Arcaini, P., Yue, T., & Fredericks, E. M. (2024). *Search-Based Software Engineering: 15th International Symposium, SSBSE 2023, San Francisco, CA, USA, December 8, 2023, Proceedings*. Springer Nature. • Deb K. Multi-Objective Optimization using Evolutionary Algorithms. John Wiley & Sons; 2001. • Tsai CW, Chiang MC. Handbook of Metaheuristic Algorithms: From Fundamental Theories to Advanced Applications. Elsevier; 2023. • Pressman, R. S., & Maxim, B. R. (2019b). *Software Engineering: A Practitioner's Approach*.
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Traditional Classroom
Technology equipment (projector, smart board, software)	Multimedia Projector
Other equipment (depending on the nature of the specialty)	N/A

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct, Indirect
Effectiveness of Students assessment	Faculty, Peer reviewer	Direct, Indirect
Quality of learning resources	Faculty, Course coordinator	Direct, Indirect
The extent to which CLOs have been achieved	Course coordinator, Program management committee	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**SOFTWARE ENGINEERING DEPARTMENT COUNCIL**
REFERENCE NO.	**THE 17TH MEETING FOR THE ACADEMIC YEAR 1446H**
DATE	**22/04/2025**