# 13. Course Descriptions

The details of all courses including core and elective courses are given in this section. These details include the following:

- Basic information including course name (both in English and Arabic languages), units, contact hours, track, level and pre-requisites (if any)
- A short course description
- Course outcomes
- Grading criteria
- Recommended books

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Advanced Algorithms** | | | الخوارزميات المتقدمة | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS611** | **0911611** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☒ Core ☐ Elective | | | | | | |
| **Level** | 1st | **Prerequisite** | None | | | | |

**Course Description:**

Underlying mathematical theory, Induction and recursion techniques, Asymptotic notations, Divide and conquer technique, Randomized algorithms, Parallel and heuristic algorithms, Brute force approach, Dynamic algorithms, Greedy algorithms, Importance of algorithms in graph theory, Optimization algorithms using graphs and trees, Minimal spanning tree algorithms, Variants of shortest path problem, Matrix operations, Algorithms for solving systems of linear equations, Linear programming algorithms, Numerical approximations, Polynomials and fast Fourier transformation, Number theoretic notations and algorithms, RSA cryptosystems, String matching, Pattern matching, Automata theory in algorithms designing, Computational geometry, NP completeness, NP completeness proofs and reducibility, Approximation algorithms.

**Course Outcomes:** At the end of the course students will be able to

- Develop mathematical models and algorithms of computational problems
- Prove correctness and evaluate efficiency of algorithms
- Analyze and compare the complexities of different algorithms
- Analyze variants of traditional algorithms
- Solve scientific and engineering problems efficiently

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 3rd Edition, MIT Press, 2009. ISBN: 0262033844.

**Reference Book:**

- Algorithms by S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, McGraw-Hill, 2006. ISBN: 0073523402.

| Course Name | Distributed Systems | | | الأنظمة الموزعة | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS612** | **0911612** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☒ Core ☐ Elective | | | | | | |
| **Level** | 1st | **Prerequisite** | None | | | | |

**Course Description:**

Loosely and Tightly Coupled Hardware and Software, Multiprocessing Systems, Network Operating Systems, Distributed and Parallel Time Sharing, Design Issues of Distributed File System, Transparency, Global States and Coordination, Data Sharing and Transactions, Concurrency Control, Replication, Protocols for Replication, Distributed Shared Memory, Designing Distributed Objects, Principles of Object-Oriented Middleware, Object Synchronization, Dynamic Object Requests, Object Security, Locating Distributed Objects, Object Naming, Object Trading, Object Naming Issues, Naming Scheme, Name Servers, Life Cycle of Distributed Objects, Composite Object Life Cycle, Object Persistence, Distributed Shared Memory, Distributed Security, Fault Tolerance, Remote Procedure Calling, Distributed Databases, Grid Computing, Cloud Computing.

**Course Outcomes:** At the end of the course the students will be able to

- Learn building distributed systems, algorithms, protocols and recent advancements
- Describe the problems and challenges associated with these systems
- Explain the design issues and performance of distributed systems
- Evaluate effectiveness and shortcoming of the current solutions for these problems
- Recognize how the principles are applied in modern distributed systems

| Grading (%) | ☒ **Mid-term** | **25** | ☒ **Project** | **20** | ☒ **Quizzes** | **10** |
|---|---|---|---|---|---|---|
| | ☒ **Final** | **40** | ☒ **Assignments** | **5** | ☐ **Review Paper** | |

**Text Book:**

- Distributed Systems: Principles and Paradigms by Andrew S. Tanenbaum and Maarten Van Steen, 2nd Edition, Prentice Hall, 2007. ISBN: 0132392275.

**Reference Book:**

- Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, 5th Edition, Addison Wesley Publications, 2011. ISBN: 0132143011.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Advanced Computer Architecture** | | | معمارية الحواسيب المتقدمة | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CE613** | **0913613** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☐ Information System ☒ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☒ Core ☐ Elective | | | | | | |
| **Level** | 1st | **Prerequisite** | None | | | | |

**Course Description:**

Assessing and evaluating performance of computer, Language of Computer, Operations and operands of hardware, Conversion of higher level to assembly language, Working of compiler, Addressing modes, Processor design, Data paths and control of UP, Single and multi-cycle processor design, Pipelining, Data hazard and forwarding, Branch hazards and solutions, Pentium Systems design, Superscalar processors, Speculation and software pipelining, Hardwired and Micro programmed Control section, Micro-programmed control section, Microprogramming concepts, Memory management, I/O devices, Memory management system, Memory management system of Pentium System, Parallel Processing, Multiple processor organization, Symmetric multiprocessors, Cache coherence and MESI Protocols clusters, Vector computations, VHDL, Design of sequential logic circuit.

**Course Outcomes:** At the end of the course students will be able to

- Analyze general principles affecting performance, and quantify the measurements
- Understand fundamentals of technologies and advanced architectural features
- Visualize complete computer system including processor, memory and I/O
- Relate modern architectural performance and support to programming languages
- Enumerate various methods for enhancing cache and memory performance
- Describe difference between multiprocessor architectures

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☒ **Review Paper** | **15** |

**Text Book:**

- Computer Organization and Design by David A. Patterson and John L. Hennessy, 4th Edition, Morgan Kaufmann, 2008. ISBN: 0123744938.

**Reference Book:**

- Computer Organization & Architecture by William S., 8th Edition, Prentice Hall, 2009. ISBN: 0136073735.

| Course Name | Advanced Software Engineering | | | هندسة البرمجيات المتقدمة | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS614** | **0911614** | **3** | | **3** | **0** | **3** |
| Department | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| Track | ☒ Core ☐ Elective | | | | | | |
| Level | 1st | Prerequisite | None | | | | |

## Course Description:

Requirements Engineering, Functional and Non-Functional Requirements, Procedures for Gathering Requirements, Use Case Model, Functional Specifications, Software Architecture, Deployment Diagrams, Component Based Software Engineering, Reusability and Design Patterns, Anti-Patterns, Abstract Factory, Refactoring Techniques, Software Verification and Validation, Correctness, Formal Methods, Efficiency, Performance and Reliability, Attitude of Industry towards Reliability and Performance, Software Quality, Software Metrics, Function Point Analysis, Cost Constructive Model, Use Case Based Estimation, ISO Quality Assurance and Control, Capability Maturity Model, Project Management, Software Project Planning, Risk Analysis, Project Scheduling and Tracking, Project Evaluation and Review Techniques, Critical Path Method, Inspections and Walkthrough.

**Course Outcomes:** At the end of the course students will be able to

- Learn, use and evaluate a range of software development tools
- Apply a range of software engineering techniques to develop large software systems
- Propose engineering process models and standards
- Refine different techniques and standards for specification and design process
- Criticize object-oriented design, quality metrics and configuration management
- Recognize and correct design flaws in software

| Grading (%) | ☒ Mid-term | 25 | ☒ Project | 15 | ☒ Quizzes | 10 |
|---|---|---|---|---|---|---|
| | ☒ Final | 40 | ☒ Assignments | 10 | ☐ Review Paper | |

## Text Book:

- Software Engineering by Sommerville I., 9th Edition, Pearson, 2010. ISBN: 0321313798.

## Reference Books:

- Software Engineering: A Practitioner's Approach by Roger S. Pressman, 7th Edition, McGraw-Hill, 2009. ISBN: 0073375977.
- Object-Oriented and Classical Software Engineering by Stephen R. Schach, 7th Edition, Irwin, 2006. ISBN: 0073191264.

| Course Name | Research Methodology | | طرق البحث | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **IS615** | **0912615** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☒ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☒ Core ☐ Elective ☐ Pre-Requisite | | | | | | |
| **Level** | 2nd Semester | **Prerequisite** | | | | | |

**Course Description:**

The philosophy of Science, basics of doing research including problem solving and research, defining the research problem, writing a literature review, theory and theory building, conceptual modeling and research design, case study research, survey and observations, primary data collection, experiments, histories and simulations, interventions including benchmarking, action research and pilot studies, sampling and measurement, instrument and questionnaire design, analysis methods including qualitative, quantitative and mixed data analysis, grounded theory, usability evaluations, research ethics, peer review process, reporting and publishing including displaying data and writing up results.

**Course Outcomes:** After completing this course the students will be able to

- Develop and apply fundamental research skills, including literature reviews, collection and analysis of data and designing a research project
- Identify a research topic and justify its worth
- Improve understanding of the research process and creation of knowledge
- Study research approaches, tools, techniques and methodologies used in computing research
- Develop research writing and presentation skills

| Grading (%) | ☒ **Assignments** | **20** | ☒ **Micro Thesis** | **50** | ☐ **Discussions** | |
|---|---|---|---|---|---|---|
| | ☒ **Presentation** | **30** | | | | |

**Text Book:**

- The Craft of Research: Chicago Guides to Writing, Editing and Publishing by Booth, Colomb & Williams, 3rd Edition, University of Chicago Press, 2008. ISBN: 0226065669.

**Reference Book:**

- Statistics for Engineers and Scientists by William Navidi, 2nd Edition, McGraw-Hill, 2007. ISBN: 0073309494.
- Avison, D. and Pries-Heje, J. "Research in Information Systems: A Handbook for Research Students and Their Supervisor", Elsevier Butterworth Heinemann, Oxford, 2005, ISBN: 0750666552

| Course Name | Theory of Computation | | نظرية التحسيب | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS621** | **0911621** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

History and Preliminaries, Determinism and Non-determinism, Checking vs. Computing, Finite State Systems, Deterministic and Non-deterministic Models, Pumping Lemma, Decision Algorithms for Regular Sets, Pushdown Automata, Context-Free Languages (CFL's), Derivation Trees, Simplification of Context-Free Grammars (CFG's), Normal Forms, Properties of CFL's, Pumping Lemma for CFL's, Closure Properties of CFL's, Decision Algorithms for CFL's, Universal Models of Computations, Turing Machines, Computable Languages and Functions, Church's Hypothesis, Properties of Recursive and Recursively Enumerable Languages, Universal Turing Machines, Translation Between Models, Model Independence, Decidability and Un-decidability Problem, Recursive Function Theory, The Chomsky Hierarchy, Computational Complexity Theory, Complexity Classes, Model-independent Complexity Classes, Reduction, Reducibility among Problems, Tractability and Intractability, NP-completeness, Space Complexity, Provably Intractable Problems, Proving Problems Hard and Complete.

**Course Outcomes:** At the end of the course the students will be able to

- Have a comprehensive knowledge of computability and complexity
- Construct abstract models of computation and evaluate these models by formal reasoning that what could be achieved through computing
- Answer the fundamental questions, for example, whether a problem is computable and if it is how efficiently it can be computed

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☒ **Review Paper** | **15** |

**Text Book:**

- Introduction to the Theory of Computation by M. Sipser, Course Technology, 2006. ISBN: 0534950973.

**Reference Book:**

- Theory of computation by A. M. Natarajan and P. Balasubramani, New Age International, 2007. ISBN: 8122414737.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Cryptography** | | التشفير | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS622** | **0911622** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Basic concepts in Number Theory, e.g., Euclidean algorithm, Euler's function, Fermat's theorem and Euler's generalization, Chinese remainder theorem, primitive roots and discrete logarithms, quadratic residues, Legendre and Jacobi Symbols and familiarity with various basic cryptographic concepts, tools and algorithms including DES and differential and linear cryptanalysis, AES, RSA system, Digital signatures, El Gamal signature, digital signature standard, one time undeniable and fail stop signature, hash functions, and coding and information theory, Probability Review, Entropy, Huffman Codes & Perfect Secrecy, The course also covers Error Correcting Codes, Bounds on General Codes, Linear Codes, Hamming Codes, Golay and Cyclic Codes, BCH Codes, Reed-Solomon Codes and Quantum Techniques in Cryptography.

**Course Outcomes:** At end of the course the students will be able to

- Explain encryption, decryption, security and efficiency of various cryptographic techniques and algorithms, number theoretic concepts required for cryptosystems
- Describe digital signature techniques and algorithms
- Describe various error correcting codes and information theory

| **Grading (%)** | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Understanding Cryptography: A Textbook for Students and Practitioners by Christof Paar, Jan Pelzl and Bart Preneel, 2nd Edition, Springer, 2010. ISBN: 3642041000.

**Reference Books:**

- Cryptography and Network Security: Principles and Practice by William Stallings, 5th Edition, Prentice Hall, 2011. ISBN: 0136097049.
- Introduction to Cryptography with Coding Theory by Wade Trappe and Lawrence Washington, 2nd Edition, Prentice Hall, 2002. ISBN: 0131862391.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Image Processing and Analysis** | | معالجة وتحليل الصور | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS623** | **0911623** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Today, much of this information is represented and processed digitally. Digital image processing is ubiquitous, with applications ranging from television to tomography, from photography to printing, from robotics to remote sensing. This course will provide an introduction to the basic techniques of digital image processing. The student will learn modern approaches to image acquisition and display, image enhancement, image compression and image analysis. The course will covers topics such as: sampling and quantization of images, matrix representation of image forming, Filtering, color representation, image restoration, and feature extraction of images. A significant amount of mathematics background is required since a good portion of the course deals with spatial domain and frequency domain image operators, their underpinnings in algebra and calculus, and the understanding of their application.

**Course Outcomes:** At the end of the course students will be able to

- Have basic concepts that are widely used in digital image processing
- Understand image process techniques, e.g., sampling, quantization, enhancement
- Know histogram modification, image restoration, features detection and noise reduction
- Expose the current technologies and issues specific to image processing techniques
- Develop hands-on experience in using computers to process images
- Familiarize with MATLAB Image Processing Toolbox

| **Grading (%)** | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Digital Image Processing Using MATLAB by Richard E. Woods and Steven L. Eddins, 2nd Edition, Gatesmark Publishing, 2009. ISBN: 0982085400.

**Reference Book:**

- Digital Image Processing by R. C. Gonzalez and R. E. Woods, 2nd Edition, Prentice-Hall, 2002. ISBN: 013168728X.

| Course Name | Machine Learning | | التعلم الآله | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS624** | **0911624** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Introduction, Basics of Probability, Examples of Machine Learning Applications, Learning Associations, Concept Learning, Inductive Learning, Find-S Algorithm, Version Spaces, Candidate Elimination, Inductive Bias, Bayes Learning, Decision Trees, ID3 Algorithm, Inductive Bias, Over-fitting, Missing Data, Neural Networks, Perceptrons, Backpropagation, Generalization, Error Functions, Hope Field Networks, Classification, Regression, Unsupervised Learning, Reinforcement Learning, Correct (PAC) Learning, Introduction to Clustering, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters.

**Course Outcomes:** At the end of the course students will be able to

- Distinguish and use different techniques of machines learning
- Understand and differentiate between different concepts of machine learning
- Implement machine learning algorithms on simulated and real world problems
- Evaluate learning algorithms and compare with alternative techniques

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **20** | ☐ **Quizzes** | |
| | ☒ **Final** | **40** | ☒ **Assignments** | **15** | ☐ **Review Paper** | |

**Text Book**:

- Introduction to Machine Learning by Ethem Alpaydin, 2nd Edition, MIT Press, 2009. ISBN: 026201243X.

**Reference Book:**

- Machine Learning by Tom Mitchell, 1st Edition, McGraw Hill, 1997. ISBN: 0070428077.

| Course Name | Applications of Artificial Intelligence | | تطبيقات الذكاء الاصطناعي | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS625** | **0911625** | **3** | | **3** | **0** | **3** |
| Department | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| Track | ☐ Core ☒ Elective | | | | | | |
| Level | | Prerequisite | | | | | |

## Course Description:

This course examines goals, problems, concepts and methods of artificial intelligence, heuristic versus algorithmic methods. It looks into techniques to solve complex problems in a particular domain, typically independent of knowledge used to direct the search for an optimal solution. Approaches include simulated annealing, genetic algorithms etc. It covers modern techniques for computers to represent task-relevant information and make intelligent decisions towards the achievement of goals. It covers advanced topics in artificial intelligence such as Machine Learning, Knowledge Discovery, Neural and Evolutionary Computation, Planning Systems, Perception, Natural Language Processing.

**Course Outcomes:** At the end of the course students will be able to

- Formulate a problem as constraint-satisfaction one
- Solve problems using local search algorithms
- Explain various learning such as supervised, reinforcement, and unsupervised
- Understand decision trees, neural networks, and belief networks
- Define the concept of a planning system

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | | ☐ **Review Paper** | |

## Text Book:

- Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, 3rd Edition, Prentice Hall, 2010. ISBN: 0136042597.

## Reference Books:

- Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition by Jurafsky and Martin, 2nd Edition, Prentice Hall, 2009. ISBN: 0131873210.
- Pattern Recognition and Machine Learning by Christopher M. Bishop, 2nd Edition, Springer, 2007. ISBN: 0387310738.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Formal Software Specification and Design** | | تصميم وتخصيص البرمجيات الرسمية | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS626** | **0911626** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Equivalence of propositional and predicate logic, Formal specification, Transformation specification to code, Specification analysis and proof, Program verification, Equality and definite description, Uniqueness and one point rule, Objects and its types, Sets and set types, Bags and types, Sequence and its type, Modeling with sequences and bags, Tuples and Cartesian product types, Generic and axiomatic definitions, Bindings and schema types, Modeling with relations and functions, Domain/range restrictions and subtractions, Notations and properties of relations and functions, Free types, Primitive recursion and induction, Proof by induction, Schemas: properties, type, declaration, predicate, operators. Generic constructions, The Z language, Syntactic conventions, Schema references, Schema texts, Schema expressions, Sequential systems, Modeling with mappings, Consistency and completeness, Visualization, Systematic testing, Relationships between Z and VDM, Validation and verification techniques/tools.

**Course Outcomes:** After studying this course, the students will be able to

- Specify, validate and verify the software systems in model oriented approaches
- Find a relationship between Z and VDM and apply it in systems development
- Know usage of VDM toolbox and Z/Eves for description and analysis of systems
- Apply the model checking and theorem proving approaches for complex systems construction

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book:**

- Understanding Z: A Specification Language and its Formal Semantics by J. M. Spivey, Cambridge Tracts in Theoretical Computer Science, 2008. ISBN: 0521334292.

**Reference Book:**

- Validated Designs for Object-oriented Systems by John Fitzgerald, Peter Gorm Larsen, Paul Mukherjee, Nico Plat and Marcel Verhoef, Springer Verlag, 2005. ISBN: 1 85233-8814.

| Course Name | Theory of Programming Languages | | نظرية لغات البرمجيات | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS627** | **0911627** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Introduction to the main constructs of contemporary programming languages and criteria used for evaluating programming languages and language constructs: influence on language design, and design tradeoffs; Syntax and Semantics description: problems and formal methods; Lexical and Syntax Analysis; Characteristics of variables: Name bindings, type checking and scopes; Data types: Primitive data, character strings, user defined, arrays, record, union, pointer and reference types; Expression and assignment statements; Statement- level control structures: selection and iterative statements, unconditional branching, guarded commands; Subprograms and their implementation: fundamentals, design issues and implementation of simple subprograms; data abstraction facilities: Abstract data types and encapsulation constructs; Concurrent program units; exception handling and event handling; Alternative programming paradigms: functional programming and logic programming.

**Course Outcomes:** At the end of the course students will be able to

- Understand the structure of programming languages
- Describe the design issues of programming languages
- Develop skills in describing and using the features of programming languages
- Analyze the features of programming languages
- Differentiate logic and imperative and functional programming languages

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☒ **Review Paper** | **15** |

**Text Book:**

- Concepts of Programming Languages by Robert W. S., 9th Edition, Addison-Wesley, 2009. ISBN: 0136073476.

**Reference Book:**

- Theories of Programming Languages by John C. Reynolds, 1st Edition, Cambridge University Press, 2009. ISBN: 0521106974.

| Course Name | Compiler Design and Construction | | تصميم وإنشاء المترجمات | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS628** | **0911628** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

An introduction to Front End of the compiler, Lexical, Syntax and Semantic Analyzers, Intermediate code generator, Code generator, The detail and in-depth discussion will be on the advanced topics of back end including: Issues in the Design of a Code Generator, The Target Language and Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Simple Code Generator. Various optimization techniques and algorithms both machine dependent and machine independent will also be discussed that can be applied to obtain an optimal code generator.

**Course Outcomes:** At the end of the course the students will be able to

- Acquire knowledge on the issues in the design of a code generator
- Develop a simple code generator
- Acquire knowledge on various machine dependent and independent optimization tools and techniques
- Apply these techniques to the simple code generator to make it optimal and hence to obtain an efficient code generator

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book:**

- Compilers: Principles, Techniques, and Tools by Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Addison-Wesley, 2006. ISBN: 0321486811.

**Reference Book:**

- Modern Compiler Design by Dick Grune, Addison-Wesley, 2010. ISBN: 0471976970.

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|---|---|---|---|---|---|---|---|
| **Course Name** | **Software Validation and Verification** | | تصحيح وتحقيق البرمجيات | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS629** | **0911629** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

The validation and verification of software systems is a major issue in the IT industry. The main focus of this course will be proving and ensuring correctness of software systems. The topics include quality assurance, safety, fault tolerance, reliability, Techniques for validation and verification, Research-oriented in-depth study of Verification and Validation, Quality assurance at requirements and design phases, Software testing at unit, module, subsystem and system levels, Automatic and manual techniques for generating and validating test cases, Testing process including static vs. dynamic analysis, functional testing, inspections, and reliability assessment. Some other advanced topics will include Lambda Calculus, Natural Deduction, Term Rewriting, Functional Programming, Sets and Rule Induction, Data types and Recursion, Calculational and Monadic Reasoning, Imperative Program Verification and Hoare Logic, Separation Logic, Proofs.

**Course Outcomes:** At the end of the course students will be able to

- Understand the fundamental approaches and concepts of the state-of-the-art software validation and verification techniques
- Acquire a knowledge of various aspects related to software quality assurance
- Apply fundamental and rigorous principles, and can benefit from for the many years to come regardless of the evolution of technology
- Act as future computer scientists and real software engineers

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Software Testing and Analysis: Process, Principles, and Techniques by M. Pezzè, M. Young, Wiley, 2007. ISBN: 0471455938.

**Reference Books:**

- Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics, Springer, 2010. ISBN: 3642145086.
- Software Testing by Ron Patton, 2nd Edition, Sams Publishing, 2006. ISBN: 0672327988.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Principles of Distributed Computing** | | مبادئ الحوسبة الموزعة | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS630** | **0911630** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

This course covers algorithms and lower-bounds for fundamental problems in distributed computation, e.g., Self–organization, Distributed approximation, Leader election, Information dissemination, Consensus problems, Consistent snapshot computation and atomic actions concepts, distributed graph traversal termination detection, and monitoring distributed systems and garbage collection in distributed systems. This course explores essential and the most significant algorithmic ideas and lower bound techniques, basically the "pearls" of distributed computing.

**Course Outcomes:** At the end of the course students will be able to

- Understand the principles of distributed computing
- Introduce the basic abstractions for modeling distributed systems
- Investigate the algorithms for fundamental problems in distributed computation
- Study the algorithms complexity of different solutions for these problems
- Investigate the optimal or approximations solutions of these problems

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **15** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **5** | ☒ **Review Paper** | **15** |

**Text Book:**

- Distributed Computing: Principles, Algorithm, and System by Ajay D. Kshemkalyani, Mukesh Singhal, Cambridge University Press, 2008. ISBN: 0521876346.

**Reference Books:**

- Distributed Systems: An Algorithmic Approach by Sukumar G., CRC Press, 2006. ISBN: 1584885645.
- Introduction to Reliable Distributed Programming by Rachid Guerraoui and Luis Rodrigues, Springer, 2006. ISBN: 3540288457.

| Course Name | Computer Vision | | الرؤيا بالحاسوب | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS721** | **0911721** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Vision is one of our senses that allow us to build a powerful internal representation of the world. The goal of computer vision is to "discover from images what is present in the world, where things are located, what actions are taking place" (Marr 1982). To achieve this goal, we need to know how light is reflected off surfaces, how objects move, and how this information is projected onto an image. This course is an introduction to basic concepts in computer vision and research topics. First, an introduction to low-level image analysis methods, including image formation & image sensing, edge detection, feature detection, and image segmentation. Image transformations (e.g., warping, morphing, and mosaics) for image synthesis. Methods for reconstructing three-dimensional scene information using techniques such as depth from stereo, structure from motion, and shape from shading. Motion and video analysis. Three-dimensional object recognition.

**Course Outcomes:** At the end of the course students will be able to

- Know the basic concepts in computational vision
- Have an understanding of image processing for computer vision
- Have knowledge of processing of images and determination of various structures
- Reconstruct shape from stereo and shading
- Recognize three dimensional objects

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

. **Text Book**:

- Computer Vision: Algorithms and Applications by Richard Szeliski, 1st Edition, Springer, 2010. ISBN: 1848829345.

**Reference Book:**

- Computer Vision Three-dimensional Data from Images by R. Klette, K. Schluns, A. Koschan, Springer-Verlag, 2001. ISBN: 9813083719.

| Course Name | Software Requirements Engineering | | هندسة متطلبات البرمجيات | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS722** | **0911722** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports and oral presentations will be required.

**Course Outcomes:** At the end of the course students will be able to

- Learn about the requirements engineering process
- Practice requirements analysis, modeling, elicitation, and specification
- Learn to work with a team on requirements elicitation on medium sized projects and practice soft skills such as communication, presentation, and asking questions
- Become familiar with requirements management tools and techniques
- Conduct latest research in requirements engineering area

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Software Engineering: A Practitioner's Approach by Roger S. Pressman, 7th Edition, McGraw-Hill, 2009. ISBN: 0073375977.

**Reference Books:**

- Object-Oriented and Classical Software Engineering by Stephen R. Schach, 7th Edition, Irwin, 2006. ISBN: 0073191264.
- Software Requirements: Styles and Techniques by Soren L., Addison-Wesley, 2002. ISBN: 0201745704.
- Managing Software Requirements: A Use Case Approach by Dean Leffingwell, Don Widrig, 2nd Edition, Addison-Wesley Professional, 2003. ISBN: 032112247X.

| Course Name | Pattern Recognition | | التعرف على الأنماط | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS723** | **0911723** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

A survey of modern methods for computer recognition of patterns in varied applications such as digital images, human speech and sound, and grammar-based sequences. Various approaches are developed, including statistical techniques, heuristic search, Fourier analysis, Markov models, template matching, grammatical inference and neural networks. Computational aspects and efficiency of different methods and algorithms are emphasized. Students must complete a project using methods developed in the course and some software tools like Matlab.

**Course Outcomes:** After completing this course the students will be able to

- Understand modern methods for recognition of patterns in varied applications such as digital images, human speech and sound, grammar-based sequences
- Use different approaches like: statistical techniques, heuristic search, Fourier analysis, Markov models, template matching, grammatical inference and neural networks
- Develop applications of pattern recognition systems with software

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **20** | ☐ **Quizzes** | |
| | ☒ **Final** | **40** | ☒ **Assignments** | **15** | ☐ **Review Paper** | |

**Text Book:**

- Pattern Recognition & Matlab Intro: Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas, 4th Edition, Academic Press, 2008. ISBN: 1597492728.

**Reference Book:**

- Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2007. ISBN: 0387310738.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Stochastic Processes** | | العمليات العشوائية | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS724** | **0911724** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Sample Space and Events, The Notion and Axioms of Probability, Equally Likely Events, Conditional Probability, Independent and Dependent Events, Total Probability, Bayes Rule, Random Variables, Distribution Functions, Discrete Random Variables and Probability Mass Functions, Continuous Random Variables and Probability Density Functions, Mean and Variance, Some Special Distributions, Conditional Distributions, Bivariate Random Variables, Joint Distribution Functions, Covariance and Correlation Coefficient, Functions of Random Variables, Expectation, Moment Generating Functions, The Law of Large Numbers, Central Limit Theorem, Stochastic Processes, Characterization of Stochastic Processes, Markov Processes, Classification of States, Classification of Chains, Discrete-Parameter Markov Chains, Continuous-Time Markov Chains, Birth Processes and Poisson Process, Brownian Motion Processes, Power Spectral Densities, White Noise, Fourier Transform of Stochastic Processes, Queuing Systems, Birth-Death Process, The M/M/1, M/M/s, and M/M/s/K Queuing Systems.

**Course Outcomes:** At the end of the course the students will be able to

- Understand probability and perform for calculating single and joint random variables
- Understand concepts of stochastic processes and essential mathematical tools
- Use stochastic processes for modeling of real world systems
- Apply probabilistic and stochastic methods for engineering problems

| **Grading (%)** | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Introduction to Probability Models by Sheldon M. Ross, 10th Edition, Academic Press, 2009. ISBN: 0123756863.

**Reference Book:**

- Stochastic Processes and Models by David S., 1st Edition, Oxford University, 2005. ISBN: 0198568134.

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|---|---|---|---|---|---|---|---|
| **Course Name** | **Game Modeling and Development** | | نمذجة وتطوير الألعاب | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS725** | **0911725** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

There is a growing demand of the programmers from this industry who can design computer games. This course helps students to understand and learn the technology and programming skills that are required to build a computer game. This class introduces students to an object-oriented game engine scripting language. It covers a range of topics that include: Game Memory Management; Multithreading in Games; Sprites & bitmap animation; Collision detection; Differing game types, modes, & perspectives; Game & level design; Path finding algorithms; Sound & Music; Game input devices; Artificial Intelligence in games; Physics based modeling; Advanced Lighting Techniques; Networked Gaming Algorithms; Special Effects etc.

**Course Outcomes:** At the end of the course students will be able to

- Understand range of possibilities for games engines, including their limitations
- Understand algorithms used in developing games
- Program various input and output devices used in games
- Use game engines to construct a simple game

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book**:

- Introduction to Game Development by Steve Rabin, 2nd Edition, Charles River Media, 2009. ISBN: 1584506792.

**Reference Book:**

- 3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics by David Eberly, 2nd Edition, Morgan Kaufmann, 2006. ISBN: 0122290631.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Computational Geometry** | | الهندسة المحوسبة | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS726** | **0911726** | **3** | | **3** | **0** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

This course will provide an introduction to the fundamental and key concepts of computational geometry. The Problems, techniques and structures within the computational geometry including concepts of points, lines, planes, spheres, duality and subdivisions will be discussed. The line intersections, convex hull, Voronoi diagram, triangulations, Delaunay triangulation, overlay of subdivisions, range searching will be covered. The techniques of sweep-line, randomized incremental construction, fractional cascading will also be discussed. The other topics include double-linked edge-lists, interval trees, segment trees, and priority search trees, Kd-trees, range trees, models of computation, lower bound techniques, geometric primitives, geometric, transforms, Planar convex hulls, higher dimensional convex hulls, randomized, output-sensitive, and dynamic algorithms, applications of convex hull, Intersection detection, segment intersection, line sweep, map overlay, polyhedral intersection and geometric searching.

**Course Outcomes:** At the end of the course the students will be able to

- Construct algorithms for simple geometrical problems
- Implement computational geometry algorithms in various disciplines
- Learn application of computational geometry in robotics, computer graphics, GIS, spatial databases and machine learning

| **Grading (%)** | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☒ **Review Paper** | **15** |

**Text Book**:

- Computational Geometry: Algorithms and Applications by Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, 3rd Edition, Springer-Verlag, 2008. ISBN: 3540779736.

**Reference Book:**

- Handbook of Discrete and Computational Geometry by J. E. Goodman and J. O'Rourke, 2nd Edition, CRC Press LLC, 2004. ISBN: 1584883014.

| Course Name | Advanced Modeling and Simulation | | النمذجة والمحاكاة المتقدمة | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CS727** | **0911727** | **3** | | **3** | **0** | **3** |
| Department | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| Track | ☐ Core ☒ Elective | | | | | | |
| Level | | Prerequisite | | | | | |

**Course Description:**

As simulation is increasingly applied to more complex applications, exploiting efficiencies in model design and hence model execution has becomes a challenging task. The aim of this course is to provide students with the ability to model simulate and analyze complex systems in a reasonable time. This course is divided into three parts and covers advanced techniques in simulation model design, model execution and model analysis. A selection of model design techniques such as conceptual models, declarative models, functional models, constraint models, and multi-models will be discussed. Model execution techniques include discussion of serial and parallel discrete-event simulation algorithms. For model analysis, topics include input-output analysis, variance reduction techniques and experimental design.

**Course Outcomes:** At the end of the course the students will be able to

- Understand concepts in discrete-event simulation, serial algorithms and model design techniques
- Practice parallel and distributed simulation, input and output data modeling and analysis
- Know components and organization of discrete-event simulation

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☒ **Project** | **20** | ☒ **Quizzes** | **15** |
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book:**

- A First Course in Mathematical Modeling by Frank R. Giordano, William P. Fox, Maurice D. Weir, Cengage Learning, 2009. ISBN: 0495011592.

**Reference Book:**

- Mathematical Modeling by Mark M. Meerschaert, Elsevier, 2007. ISBN: 0123708575.

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|---|---|---|---|---|---|---|---|
| **Course Name** | **Advanced Database Management Systems** | | نظم إدارة قواعد البيانات المتقدمة | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **IS611** | **0912611** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☒ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | 1st Semester | **Prerequisite** | | | | | |

**Course Description:**

This course covers advanced topics in the design and management of database systems including record storage and primary file organizations, index structures and access methods for files, directory management, query processing, query optimization, transaction processing, nested transactions, concurrency control techniques, deadlock management, fragmentation and its control, integrity constraints, database recovery, distributed databases, object and object-relational databases, deductive databases and data integration in multi-databases.

**Course Outcomes:** At the end of the course students will be able to

- Learn advanced concepts involved in performance tuning of databases
- Learn efficient retrieval of information especially when massive data storage is involved
- Get an insight to the internal working of DBMSs
- Have an insight to the issues and challenges involved in database design and management
- Learn alternate solutions to these issues and challenges

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book:**

- Database System Concepts by Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw-Hill, 2010. ISBN: 0072958863.

**Reference Books:**

- Database Systems: Design, Implementation, and Management by Carlos Coronel, Steven Morris and Peter Rob, 9th Edition, Course Technology, 2009. ISBN: 0538469684.
- Database Processing by David M. Kroenke and David Auer, 11th Edition, Prentice Hall, 2009. ISBN: 0132302675.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Name** | **Information Retrieval and Extraction** | | استرجاع واستخلاص المعلومات | | | | |
| **Course Information** | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **IS627** | **0912627** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☒ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

This course will cover traditional material, as well as recent advances in Information Retrieval (IR), the study of indexing, processing, and querying textual data. Basic retrieval models, algorithms, and IR system implementations will be covered. The course will also address more advanced topics in "intelligent" IR, including Natural Language Processing techniques, and "smart" Web agents. Topics: Introduction to IR models and methods, Perl tutorial, Text analysis / Web spidering, Text properties, Vector-based model, Boolean model, Probabilistic model; other IR models, IR evaluation and IR test collections, Relevance feedback, query expansion, Web search: link based and content based, Query-based and content sensitive link analysis, Search engine technologies, Search engine user interfaces, Text classification and clustering.

**Course Outcomes:** After completing this course students can

- Get familiar with indexing, processing, and querying textual data
- Use basic retrieval models, algorithms, and IR system implementation
- Understand advanced topics in intelligent IR, including natural language processing techniques, and smart web agents

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grading (%)** | ☒ **Mid-term** | **25** | ☒ **Project** | **15** | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☐ **Review Paper** | |

**Text Book:**

- Modern Information Retrieval: The Concepts and Technology Behind Search by Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley, 2nd Edition, 2011. ISBN: 0321416910.

**Reference Book:**

- Information Retrieval: Algorithms and Heuristics by D. A. Grossman and O. Frieder, 2nd Edition, Springer, 2004. ISBN: 1402030045.

| Course Name | Multimedia Systems Design | | تصميم نظم الوسائط المتعددة | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **IS628** | **0912628** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☒ Information System ☐ Comp Engineering ☐ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Interactive multimedia systems are becoming increasingly widespread in many domains including games, arts and business. This subject introduces fundamental principles of interactive multimedia and associated tools. Topics include digital multimedia applications, social and ethical considerations. Enabling technologies such as digital representations, hardware and software requirements, Introduction to computer graphics: vector graphics and bitmapped images, image manipulation and compression, Digitized video standards, video compression, streamed video, video editing and post-production, Captured animation and image sequences, key frame and 3-D animation, Digitized sound, sound compression, sound format, combining sound and picture, hypermedia, synchronization-based presentation, Multimedia and Networks: computer network and transport protocols, multicasting, quality of service, server-side computation, protocols applications.

**Course Outcomes:** At the end of the course students will be able to

- Get background knowledge of the different components of digital media, text, images, sound & video, their representations and media carriers
- Get practical knowledge in processing digital media and integration of its components
- Design and program digital media applications
- Acquire necessary knowledge to work in a team of digital media designers and developers

| Grading (%) | ☒ **Mid-term** | **25** | ☒ **Project** | **25** | ☒ **Quizzes** | **10** |
|---|---|---|---|---|---|---|
| | ☒ **Final** | **40** | ☐ **Assignments** | | ☐ **Review Paper** | |

**Text Book:**

- Digital Media Primer by Wong Y-L, International Edition, Pearson/Prentice Hall, 2009. ISBN: 0132239442

**Reference Books:**

- The Science of Digital Media by Burg J., Prentice Hall, 2008. ISBN: 0132435802
- Digital Art: Its Art and Science, Wong Y-L, Prentice Hall, 2009. ISBN: 0131757032.
- Digital Multimedia by Nigel Chapman and Jenny Chapman, 3rd Edition, Wiley, 2009. ISBN: 0470512164.

| Course Name | New Trends in Computer Networks | | اتجاهات حديثة في شبكات الحاسب | | | | |
|---|---|---|---|---|---|---|---|
| Course Information | Course Code | Course No | Credit Units | Contact Hours | Lec. | Lab. | Total |
| | **CN621** | **0914621** | **3** | | **3** | **0** | **3** |
| **Department** | ☐ Comp Science ☐ Information System ☐ Comp Engineering ☒ Comp Network | | | | | | |
| **Track** | ☐ Core ☒ Elective | | | | | | |
| **Level** | | **Prerequisite** | | | | | |

**Course Description:**

Review of LANs, internet and TCP/IP protocol, Resource sharing through multiplexing, Circuit and packet switching technologies, Design issues, Traffic and service classes, Broadband access networks, Internet service provider, T-1 Lease Lines, DSL, Cable access networks, High speed WANs, Frame relay, Asynchronous transfer mode, High speed switched LAN, Traffic modeling, IP multicasting, Optical networks and architectures, Synchronous optical networking, Overview of wireless networks, Mobile IP, Mobile ad-hoc networks, The OSI model, packet and circuit switching, Integrated services digital networks, The TCP/IP protocol stack, Internet control message protocol, Routing, RSVP, Next generation IP, Wireless communication systems, Voice over IP, VPNs, Network security, Quality of service, Distributed systems, Management Protocols.

**Course Outcomes:** At the end of the course the students will be able to

- Have advanced network services and emerging ultra-fast network technologies
- Practice broadband multimedia applications including IP multicasting and present a host of multicast routing procedures, ultra-broadband and optical networking technologies
- Use current trends and leading research in the computer networking area
- Perform evaluation and analysis of computer and communications networks

| Grading (%) | | | | | | |
|---|---|---|---|---|---|---|
| | ☒ **Mid-term** | **25** | ☐ **Project** | | ☒ **Quizzes** | **10** |
| | ☒ **Final** | **40** | ☒ **Assignments** | **10** | ☒ **Review Paper** | **15** |

**Text Book:**

- Computer Networks-A Systems Approach by Larry L. Peterson and Bruce S. Davie, 5th Edition, Morgan-Kaufmann, 2011. ISBN: 0123850592.

**Reference Book:**

- UNIX Network Programming, The Sockets Networking API by W. Richard Stevens, 3rd Edition, Prentice Hall, 2003. ISBN: 013490012X.

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|---|---|---|---|
| **Course Name** | **Project Proposal** | مقترح المشروع | |
| **Course Information** | Course Code | Course No | Credit Units |
| | **CS690** | **0911690** | **3** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | |
| **Track** | ☒ Core ☐ Elective | | |
| **Level** | | **Prerequisite** | Department Approval |

**Course Description:**

The Project Proposal emphasizes on application of the theoretical concepts of software analysis and design learned during the course work. The analysis component comprises of preparing formal Software Requirements Specifications (SRS) document including problem statement, scope, justification, requirements, cost estimation, assumptions, limitations, methodology and tools to be used in project development. The assumption should be taken in such a way that scope of the problem becomes clear and well defined in the problem statement. All the functional and non-functional requirements of the system must be identified and analyzed in the proposal. The students will be encouraged to develop/describe logical model of the proposed system based on the requirements. The design component of the course includes prototype including input and output of the proposed system.

**Course Outcomes:** At the end of the course, students will be able to

- Identify and define problem statement
- Define and justify scope of the problem
- Gather and analyze system requirements
- Propose an optimized solution among the existing solutions
- Practice software analysis and design techniques learned during the course work
- Develop technical report writing and oral presentation skills

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|---|---|---|---|---|
| **Grading (%)** | ☒ **Supervision & Progress Reports** | | | **30** |
| | ☒ **Project Report Evaluation** | **35** | ☒ **Project Oral Examination** | **35** |

**Textbook(s):**

- Lynn E. Miner & Jeremy T. Miner, "Proposal Planning and Writing", Third Edition, Greenwood Publishing Group, 2003, ISBN: 1573564982

**Reference Book(s):**

- Statistics for Engineers and Scientists by William Navidi, 2nd Edition, McGraw-Hill, 2007. ISBN: 0073309494.

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|---|---|---|---|
| **Course Name** | **Project Implementation** | تنفيذ المشروع | |
| **Course Information** | Course Code | Course No | Credit Units |
| | **CS695** | **0911695** | **6** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | |
| **Track** | ☒ Core ☐ Elective | | |
| **Level** | 4th Semester | **Prerequisite** | Project Proposal |

**Course Description:**

In this course the students will be required to implement proposed design of the project. The students will review the design specification and make any necessary enhancements to synchronize the implementation details. The students will identify and learn the use of tools required for the project implementation. The students will be expected to: prepare application architecture, code, debug, document, and test the application software within suggested timeframe. A key focus of the course is to emphasize the quality of software project through various evaluation aspects such as professional coding style, documentation of code, intuitive user interface design, input validation, verification and user guide. The students will be further required to evaluate the developed system by generating test cases of the critical components of the designed model.

**Course Outcomes:** At the end of the project, students will be able to

- Develop a functional application based on the software design
- Apply the coding, debugging and testing tools to enhance the quality of the software
- Construct new software systems based on the theory and practice gained through this exercise
- Prepare the proper documentation of software projects following the standard guidelines
- Learn technical report and oral presentation skills

| | | | | |
|---|---|---|---|---|
| **Grading (%)** | ☒ **Supervision & Progress Reports** | | | **30** |
| | ☒ **Project Report Evaluation** | **35** | ☒ **Project Oral Examination** | **35** |

**Textbook(s):**

- Lynn E. Miner & Jeremy T. Miner, "Proposal Planning and Writing", Third Edition, Greenwood Publishing Group, 2003, ISBN: 1573564982

**Reference Book(s):**

- Statistics for Engineers and Scientists by William Navidi, 2nd Edition, McGraw-Hill, 2007. ISBN: 0073309494.

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|---|---|---|---|
| **Course Name** | **Dissertation** | الأطروحة (الرسالة) | |
| **Course Information** | Course Code | Course No | Credit Units |
| | **CS700** | **0911700** | **9** |
| **Department** | ☒ Comp Science ☐ Information System ☐ Comp Engineering ☐ Comp Network | | |
| **Track** | ☒ Core ☐ Elective | | |
| **Level** | 4th Semester | **Prerequisite** | Department Approval |

**Course Description:**

Student will choose a research topic under supervision of a faculty member. After approval of the dissertation subject, the student needs to define objectives of the research and prepare the research proposal. In the proposal, he/she will be required to (i) conduct an exhaustive survey (ii) identify and define the problem clearly (iii) decide scope of the problem and provide its assumptions and limitations (iv) ensure the originality of the research proposal (v) suggest the approach and methodology used in the research and (vi) present the expected results. At the successful presentation of the proposal, student will be asked to submit the proposal. The student will apply the proposed methodology to solve the problem. After completion, student will submit the dissertation. Then student will defend the dissertation.

**Course Outcomes:** At the end of the thesis students will be able to

- Conduct survey of research issues
- Practice research techniques, tools and methodologies
- Work independently and take initiatives in academic or professional environment
- Develop writing and oral presentation skills

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|---|---|---|
| **Grading (%)** | ☒ **Dissertation Evaluation** | **40** |
| | ☒ **Dissertation Oral Examination** | **60** |

**Text Book(s):**

- The Craft of Research: Chicago Guides to Writing, Editing and Publishing by Booth, Colomb & Williams, 3rd Edition, University of Chicago Press, 2008. ISBN: 0226065669.

**Reference Book(s):**

- Statistics for Engineers and Scientists by William Navidi, 2nd Edition, McGraw-Hill, 2007. ISBN: 0073309494.