**University of Asia Pacific (UAP)**

**Department of Computer Science and Engineering (CSE)**

**Course Outline**

**Program:** Computer Science and Engineering (CSE)

**Course Title:** Mathematics for Computer Science

**Course Code:** CSE 401

**Semester:** Fall 2019

**Level:** 4th year 1st Semester

**Credit Hour:** 3.00

**Name & Designation of Teacher:**  Mahathir Monjur, Lecturer

**Office/Room:** 7th floor, UAP

**Class Hours: Sunday**: 8:00-9:20 am (A), **Sunday**: 9:30 -10:50 am (B)  
 **Monday**: 12:30 -1:50 pm (A), **Tuesday:** 11:00 -12:20 pm (B)

**Consultation Hours: Tuesday**: 8:00-10:50 am (Section A, B)

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**Mobile:** 01781461842

**Rationale:** An essential course to provide the students mathematical knowledge and analytical skills required in computer science, especially for the analysis of algorithms. This course is also cardinal as it introduces the basic ideas of probabilistic models which is of paramount importance in the field of artificial intelligence.

**Pre-requisite** (if any)**: MTH 203, CSE 207**

**Course Synopsis:**

**Recurrent Problems:** Tower of Hanoi, Lines in a plane, Josephus Problem

**Manipulation of Sums:** Summand, Reduction of recurrence into sums, Perturbation method, Iversion’s Convention

**Integer Functions:** Floor and Ceiling

**Number Theory:** Prime numbers, Divisibility

**Special Numbers:** Stirling number, Fibonacci number, Harmonic numbers

**Random Variables:** Discrete, Bernoulli, Binomial, Geometric, Poisson, Continuous, Exponential, Gamma, Normal Random Variable

**Conditional Probability**: The ballot problem

**Markov Chain**: Chapman–Kolmogorov equations, Limiting Probability, Gambler’s Ruin Problem

**Queuing Theory:** Single Server Exponential Queuing System (M/M/1), Queuing Systems with Bulk Service

**Course Objectives (CO):** The objectives of this course are:

1. To **introduce** the concepts of recursion, sums, number theory, special numbers and integer functions.
2. To **enable** the students to use mathematical formulas in algorithm design.
3. To **explain** the process of analyzing an algorithm using mathematical techniques.
4. To **emphasize** the usage of probabilistic formulas to model and solve real world problems.

**Learning Outcomes (LO):** Upon completion of the course, the students will be able to:

LO 1: **Explain** mathematical equations and formulas that are used in computer science.

LO 2: **Apply** mathematical equations to **solve** problems and implement algorithms.

LO 3: **Analyze** an algorithm using recurrence formulas and manipulation of sums.

LO 4: **Use** probabilistic formulas to solve real world complex scenarios.

**Teaching-learning and Assessment Strategy:** Lectures, assignments, quizzes, exams.

**Linkage of LO with Assessment Methods & their Weights:**

|  |  |  |
| --- | --- | --- |
| **LO** | **Assessment Method** | **(%)** |
|  |  |  |
| 1 – 3 | Quiz | 10 |
| 1 – 5 | Class attendance | 10 |
| 4,5 | Assignment | 10 |
| 1– 4 | Midterm Exam | 20 |
| 1 – 5 | Final Exam | 50 |

**Minimum attendance:** 70% class attendance is mandatory for a student in order to appear at the final examination.

**Mapping of Course LO and Generic Skills:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Learning Outcome (LO) of the Course** | **Generic Skills\* (Appendix-1)** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| LO 1: **Explain** mathematical equations and formulas that are used in computer science. | ✓ |  |  |  |  |  |  |  |  |  |  |  |
| LO 2: **Apply** mathematical equations to **solve** problems and implement algorithms. | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |
| LO 3: **Analyze** an algorithm using recurrence formulas and manipulation of sums. |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| LO 4: **Use** probabilistic formulas to solve real world complex scenarios. | ✓ | ✓ | ✓ |  |  |  |  |  |  | ✓ |  |  |

**Lecture Schedule**

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| --- | --- | --- | --- |
| **Lecture** | **Topic** | **Reading assignment** | **Work assignment** |
| Lecture 1 | Introduction to CSE 401 | * Slides provided in the class | To be assigned during lecture. |
| Lecture 2-4 | Recurrent Problems: Tower of Hanoi, Lines in a plane, Josephus Problem | * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 1 * Slides provided in the class | To be assigned during lecture. |
| Lecture 5-7 | Manipulation of Sums: Sums and recurrences, General Methods | * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 2 * Slides provided in the class | Class Test 01 |
| Lecture 8-10 | Integer Functions: Floor/ Ceiling Recurrences, Application, Sums | * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 3 * Slides provided in the class | To be assigned during lecture. |
| Lecture 11-13 | Number Theory: Prime numbers  Special numbers: Stirling number, Harmonic numbers | * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 4, 6 * Slides provided in the class | Class Test 02 |
| Lecture 14 | Overview of Concrete Mathematics | * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 1-6 * Slides provided in the class | To be assigned during lecture. |
| Mid Term Exam | Mid Term Exam | Mid Term Exam | Mid Term Exam |
| Lecture 15 | Introduction to Probability | * ***Introduction to Probability Models,*** Chapter: 1 * Slides provided in the class | To be assigned during lecture. |
| Lecture 16-17 | Random Variables (RV): Discrete, Bernoulli, Binomial, Geometric, Poisson, Continuous, Exponential, Gamma, Normal RV and their expectation, variance | * ***Introduction to Probability Models,*** Chapter: 2 * Slides provided in the class | To be assigned during lecture. |
| Lecture 18-19 | Conditional Probability and their expectations | * ***Introduction to Probability Models,*** Chapter: 3 * Slides provided in the class | Class Test 03 |
| Lecture 20-22 | Markov Chain: Chapman–Kolmogorov equations, Limiting Probability, Gambler’s Ruin Problem | * ***Introduction to Probability Models,*** Chapter: 4 * Slides provided in the class | To be assigned during lecture. |
| Lecture 23-24 | Exponential Distribution and their Properties | * ***Introduction to Probability Models,*** Chapter: 5 * Slides provided in the class | To be assigned during lecture. |
| Lecture 25-27 | Queuing Theory: Single Server Exponential Queuing System (M/M/1), Queuing Systems with Bulk Service | * ***Introduction to Probability Models,*** Chapter: 8 * Slides provided in the class | Class Test 04 |
| Lecture 28 | Overview | * ***Introduction to Probability Models,*** Chapter: 1-5, 8 * ***Concrete Mathematics****: A Foundation for Computer Science*, Chapter: 1-6 | To be assigned during lecture. |

**Required References: 1. Concrete Mathematics:** **A Foundation for Computer Science**  
by Ronald Graham, **Donald Knuth**, and Oren Patashnik. **2nd Edition**, Addison-Wesley Professional

**2. Introduction to Probability Models** by **Seldon M. Ross, 11th Edition**, Academic Press

**Recommended References:** The Art of Computer Programming, Volume 1 and 2  
by **Donald E. Knuth**, Third Edition, Addison-Wesley.

**Grading System:** As per the approved grading scale of University of Asia Pacific (Appendix-2).

**Student’s responsibilities:** Students must come to the class prepared for the course material covered in the previous class (es).

They must submit their assignments on time.

No late or partial assignments will be acceptable. There will be no make-up quizzes.

**Appendix-1: Generic Skills**

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| --- | --- |
| **No.** | **Generic Skills** |
|  |  |
| 1. | **Engineering Knowledge** |
| 2. | **Problem Analysis** |
| 3. | **Design/Development of Solutions** |
| 4. | **Investigation** |
| 5. | **Modern Tool Usage** |
| 6. | **The Engineer and Society** |
| 7. | **Environment and Sustainability** |
| 8. | **Ethics** |
| 9. | **Communication** |
| 10. | **Individual and Team Work** |
| 11. | **Life Long Learning** |
| 12. | **Project Management and Finance** |

**Generic Skills (Detailed):**

1. **Engineering Knowledge (T)** -Apply knowledge of mathematics, sciences, engineering fundamentals and manufacturing engineering to the solution of complex engineering problems;
2. **Problem Analysis (T)** – Identify, formulate, research relevant literature and analyze complex engineering problems, and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. **Design/Development of Solutions (A)** –Design solutions, exhibiting innovativeness, for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, economical, ethical, environmental and sustainability issues.
4. **Investigation (D)** Conduct investigation into complex problems, displaying creativeness, using research-based knowledge, and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. **Modern Tool Usage (A & D)** -Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations;
6. **The Engineer and Society (ESSE)** -Apply reasoning based on contextual knowledge to assess societal, health, safety, legal, cultural, contemporary issues, and the consequent responsibilities relevant to professional engineering practices.
7. **Environment and Sustainability (ESSE)** -Understand the impact of professional engineering solutions in societal, global, and environmental contexts and demonstrate knowledge of and need for sustainable development;
8. **Ethics (ESSE)** –Apply professional ethics with Islamic values and commit to responsibilities and norms of professional engineering code of practices.
9. **Communication (S)** -Communicate effectively 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;
10. **Individual and Team Work (S)** -Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
11. **Life Long Learning (S)** -Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
12. **Project Management and Finance (S)** -Demonstrate knowledge and understanding of engineering management and financial principles and apply these to one’s own work, as a member and/or leader in a team, to manage projects in multidisciplinary settings, and identify opportunities of entrepreneurship.

**Appendix-2: Grading Policy**

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| **Numeric Grade** | **Letter Grade** | **Grade Point** |
|  |  |  |
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | D | 2.00 |
| Less than 40% | F | 0.00 |

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| **Prepared by:**  **----------------------------------** | **Checked by:**  **-----------------------------** | **Approved by: (Head of the Dept.)**  **-----------------------------** |