# SENG305 – Formal Languages and Automata

| Course Code | Course Name | | Semester | |
|---|---|---|---|---|
| SENG305 | Formal Languages and Automata | | Fall ☒ Spring ☐ Summer ☐ | |
| Hours | | | Credit | ECTS |
| Theory | Practice | Lab | 3 | 5 |
| 3 | 0 | 0 | | |

| Course Details | |
|---|---|
| **Department** | Software Engineering |
| **Course Language** | English |
| **Course Level** | Undergraduate ☒ Graduate ☐ |
| **Mode of Delivery** | Face to Face ☐ Online ☒ Hybrid ☐ |
| **Course Type** | Compulsory ☒ Elective ☐ |
| **Course Objectives** | The objective of this course is to provide an understanding of the theory of automata, computability of problems and complexity of computations. Different models of computation will be introduced and their comparisons will be done. |
| **Course Content** | Deterministic finite automata. Non-deterministic finite automata. Regular expressions. Context free grammars. Push down automata. Turing machine. Decidability and undecidability. P and NP classes. |
| **Course Method/ Techniques** | Lecture ☒ Question & Answer ☒ Presentation ☐ Discussion ☐ |
| **Prerequisites/ Corequisites** | |

| **Work Placement(s)** | |
|---|---|

**Textbook/References/Materials**

- John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition
- Michael Sipser, Introduction to the theory of computation.
- Peter Linz, An Introduction to Formal Languages and Automata.

| **Course Category** | | | | |
|---|---|---|---|---|
| Mathematics and Basic Sciences | ☒ | | Education | ☐ |
| Engineering | ☒ | | Science | ☐ |
| Engineering Design | ☒ | | Health | ☐ |
| Social Sciences | ☐ | | Profession | ☐ |

**Weekly Schedule**

| No | Topics | Materials/Notes |
|---|---|---|
| 1 | Introduction<br>Mathematical Preliminaries | Chapter 1 |
| 2 | Finite Automata (FA) | Chapter 2 |
| 3 | Finite Automata (FA):<br>Deterministic FA, Nondeterministic FA | Chapter 2 |
| 4 | Regular Expressions, Regular Grammars | Chapter 3 |
| 5 | Properties of Regular Languages<br>The pumping lemma | Chapter 4 |
| 6 | Context Free Grammars (CFGs) | Chapter 5 |
| 7 | Properties of CFGs<br>Normal Forms for CFGs | Chapter 7 |
| 8 | Midterm Exam | |
| 9 | Pushdown Automata (PDA) | Chapter 6 |
| 10 | Equivalence of PDA and CFG | Chapter 6 |
| 11 | Properties of Context Free Languages<br>The pumping lemma for Context Free Languages | Chapter 7 |
| 12 | Turing Machines | Chapter 8 |
| 13 | Decidability | Chapter 9 |
| 14 | P & NP, NP-completeness | Chapter 10 |
| 15 | P & NP, NP-completeness | Chapter 10 |
| 16 | Final Exam | |

| **Assessment Methods and Criteria** | | |
|---|---|---|
| **In-term studies** | **Quantity** | **Percentage** |
| Attendance | 1 | 5 |
| Lab | | |
| Practice | | |
| Fieldwork | | |
| Course-specific internship | | |
| Quiz/Studio/Criticize | | |
| Homework | 1 | 20 |
| Presentation / Seminar | | |
| Project | | |
| Report | | |
| Seminar | | |
| Midterm Exam | 1 | 30 |
| Final Exam | 1 | 45 |
| | **Total** | **100%** |
| **Contribution of Midterm Studies to Success Grade** | | 40 |
| **Contribution of End of Semester Studies to Success Grade** | | 60 |
| | **Total** | **100%** |

| **ECTS Allocated Based on Student Workload** | | | |
|---|---|---|---|
| **Activities** | **Quantity** | **Duration (Hrs)** | **Total Workload** |
| Course Hours | 14 | 3 | 42 |
| Lab | | | |
| Practice | | | |
| Fieldwork | | | |
| Course-specific Work Placement | | | |
| Out-of-class study time | 14 | 3 | 42 |
| Quiz/Studio/Criticize | | | |
| Homework | 1 | 10 | 10 |
| Presentation / Seminar | | | |
| Project | | | |
| Report | | | |
| Midterm Exam and Preparation for Midterm | 1 | 20 | 20 |
| Final Exam and Preparation for Final Exam | 1 | 25 | 25 |
| **Total Workload** | | | **139** |
| **Total Workload / 25** | | | **5.56** |
| **ECTS Credit** | | | **5** |

| **Course Learning Outcomes** | |
|---|---|
| **No** | **Outcome** |
| **L1** | Understand and construct Deterministic Finite-State Automata (DFA), Nondeterministic Finite-State Automata (NFA) |
| **L2** | Recognize the equivalence between NFA and DFA |
| **L3** | Understand and construct Context-Free Grammars (CFG) with simple examples |
| **L4** | Construct push down automata accepting a given context free language |
| **L5** | Recognize the equivalence between CFG and pushdown automata |
| **L6** | Apply the pumping lemma to demonstrate whether or not the language is regular or context free |
| **L7** | Understand computation through Turing Machines performing simple tasks |
| **L8** | Solve problems using formal languages |
| **L9** | Develop a fundamental understanding of computational theory and models including decidability and intractability |
| **L10** | Develop fundamental understanding of complexity theory |

| **Contribution of Course Learning Outcomes to Program Competencies/Outcomes** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant* | | | | | | | | | | | | |
| | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **P8** | **P9** | **P10** | **P11** | **Total** |
| **L1** | 5 | 4 | | 3 | | 2 | | | | | | 14 |
| **L2** | 5 | 4 | | 3 | | 2 | | | | | | 14 |
| **L3** | 4 | 5 | | 3 | | 2 | | | | | | 14 |
| **L4** | 5 | 4 | | 3 | | 2 | | | | | | 14 |
| **L5** | 5 | 4 | | 3 | | 2 | | | | | | 14 |
| **L6** | 5 | 4 | | 3 | | 2 | | | | | | 14 |
| **L7** | 4 | 5 | | 3 | | 2 | | | | | | 14 |
| **L8** | 4 | 5 | | 3 | | 2 | | | | | | 14 |
| **L9** | 4 | 4 | | 3 | | 2 | | | | | | 13 |
| **L10** | 4 | 4 | | 3 | | 2 | | | | | | 13 |
| | | | | | | | | | | | **Total** | 138 |