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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**College of Engineering Studies**

**Dehradun**

**COURSE PLAN**

Programme : B. Tech (CSE) ,B.Tech(CSE+SCF)

Course : **FORMAL LANGUAGES AND AUTOMATA THEORY**

Subject Code : CSEG3004

No. of credits : 3

Semester : III

Session : 2019 (July-Dec’19)

Batch : 2018-22

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**Approved By**

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**COURSE PLAN**

1. **PREREQUISITE:**
   1. Basic Knowledge Mathematics.

1. **PROGRAM OUTCOMES (POs) for SCF:**

After completion of the program the students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** 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.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** 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.

**PROGRAM SPECIFIC OUTCOMES**

PSO 1. Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques,

PSO 2. Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.

PSO 3. Apply computing knowledge to assess, design and propose cyber security solutions and perform forensic procedures on digital systems and cyber world using tools and technologies in the area of cyber security and cyber forensics.

1. **OBJECTIVES OF COURSE:-**

The objectives of this course are to:

1. Students should be able to design the finite Automata and pushdown automata.
2. Student should be able design the grammar for context free grammar
3. Student should be able to construct Turing Machine
4. Student should be able to Identify different formal language classes and their relationships

1. **COURSE OUTCOMES FOR FORMAL LANGUAGES AND AUTOMATA THEORY: At the end of this course student should be able to**
2. Construct finite- state machine, Deterministic Finite-state Automata,

Non-deterministic finite state Automata for various simple languages.

1. Construct regular expression for various set and discover the relationship between automata and regular set.
2. Construct PDA to accept CFG.

CO4. Construct Turing machine for various functions.

**Relationship between the Course Outcomes (COs) and Program Outcomes (POs)**

|  |  |  |
| --- | --- | --- |
| **Mapping between COs and POs** | | |
|  | **Course Outcomes (COs)** | **Mapped Programme Outcomes** |
| **CO1** | Construct finite- state machine, Deterministic Finite-state Automata, Non-deterministic finite state Automata for various simple languages. | **PO2 PO3 PO4 PSO1 ,PSO2,pso3** |
| **CO2** | Construct regular expression for various set and discover the relationship between automata and regular set. | **PO2 PO3 PO4 PSO1 ,PSO2,pso3** |
| **CO3** | Construct PDA to accept CFG | **PO2 PO3 PO4 PSO1 ,PSO2,pso3** |
| **CO4** | Construct Turing machine for various functions. | **PO2 PO3 PO4 PSO1 ,PSO2,pso3** |
|  |  |  |

**Table: Correlation of POs and PSOs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO6 | PO 7 | PO8 | PO9 | PO 10 | PO 11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 |  | 3 | 2 | 2 |  |  |  |  |  |  |  |  | 1 | 2 | 3 |
| CO2 |  | 3 | 2 | 2 |  |  |  |  |  |  |  |  | 1 | 2 | 3 |
| CO3 |  | 3 | 2 | 3 |  |  |  |  |  |  |  |  | 1 | 2 | 3 |
| CO4 |  | 3 | 2 | 3 |  |  |  |  |  |  |  |  | 1 | 2 | 3 |

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Engineering knowledge | Problem analysis | Design \ Development Solution | Conduct investigations of complex problems | Modern tool usage: | The engineer and society | Environment and sustainability | Ethics. | Individual and team work | Communication | Project management and finance | Life-long learning | system and application programming | software development and project management methodologies | Apply computing knowledge to assess, design and propose cyber security solutions and perform forensic procedures on digital systems and cyber world using tools and technologies in the area of cyber security and cyber forensics.  architectures and data analytics. |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO6 | PO 7 | PO8 | PO9 | PO 10 | PO 11 | PO12 | PSO1 | PSO2 | PSO3 |
| CSEG345 | FORMAL LANGUAGES AND AUTOMATA THEORY |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. **COURSE OUTLINE**
2. **PEDAGOGY**
3. **Class Test**
4. **Assignments/ Tutorials**
5. **Digital and analog Presentations**
6. **COURSE COMPLETION PLAN**

|  |  |
| --- | --- |
| **Total Class room sessions** | 34 |
| **Total Test** | 02 |
| **Total Assignment** | 02 |

One Session =60 minutes

1. **EVALUATION & GRADING**

Students will be evaluated based on the following 3 stages.

* 1. Internal Assessment - 30%

5.2 Mid-term Examination - 20%

* 1. End term Examination - 50%

**H1. INTERNAL ASSESSMENT: WEIGHTAGE – 30%**

Internal Assessment shall be done based on the following:

|  |  |  |
| --- | --- | --- |
| Sl. No. | Description | % of Weightage out of 30% |
| 1 | Class Tests | 50% |
| 2 | Assignments (Problems/Presentations) | 20% |
| 3 | Attendance and conduct in the class and concept diary | 30% |

**H2*. Internal Assessment Record Sheet (including Mid Term Examination marks)*** *will be displayed online at the end of semester i.e. last week of regular classroom teaching.*

**H3. CLASS TESTS:** Two Class Tests based on descriptive type theoretical & numerical questions will be held; one class test at least ten days before the Mid Term Examination and second class test at least ten days before the End Term Examination. Those who do not appear in Viva-Voce and quiz examinations shall lose their marks.

*The marks obtained by the students will be displayed on iCos a week before the start of Mid Term and End Term Examinations respectively.*

**H4. ASSIGNMENTS:** After completion of two units there will be home assignments based on theory and numerical problems. Those who fail to submit the assignments by the due date shall lose their marks.

**H5. GENERAL DISCIPLINE:** Based on student’s regularity, punctuality, sincerity and behavior in the class.

*The marks obtained by the students will be displayed on LMS at the end of semester.*

**H6. MID TERM EXAMINATION: WEIGHTAGE – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination ofShort and Long theory Questions.

***Date of showing Mid Term Examination Answer Sheets: Within a week after completion of mid Sem examination.***

**H7. END TERM EXAMINATION: WEIGHTAGE – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**H8. GRADING:**

The overall marks obtained at the end of the semester comprising all the above three mentioned shall be converted to a grade.

1. **DETAILED SESSION PLAN**

|  |  |  |  |
| --- | --- | --- | --- |
| **SESSION** | **TOPIC** | **Course Outcomes Addressed** | **Assignment(s)/Quizzes/ Tests** |
| **9** | **UNIT -1** |  |  |
| **L1** | Introduction to defining language, automata |  |
| **L2** | Kleene closures |  |
| **L3** | Finite Automata (FA) |  |
| **L4** | Construction of FA Machines |
| **L5** | Transition graph, generalized transition graph |  |
|  | **UNIT 2:** |
| **L6** | Construction of NFA |
| **L7** | Construction of NFA with E-moves |
| **L8** | NFA with E-moves to without E-moves |  |
| **L9** | NFA to DFA Conversion |
| **L10** |  |  | **TEST 1** |
| **L11** | Minimization of Automata |  |
| **L12** | Finite State Transducer: Moore machine, Mealy machine | Assignment – 1 |
| **L13** | Applications of Moore and Mealy Machines, Limitations of FA |
|  | **UNIT-3:** |
| **L14** | Introduction to Regular Expressions (RE) and Regular Languages. |
| **L15** | Equivalence of FA With RE |
| **L16** | Grammar Classification |  |  |
| **L17** | Arden Theorem |
| **L18** | Pumping Lemma for regular expressions, |  |
| **L19** | Myhill-Nerode theorem |
|  | **MID SEM** |
| **L20** | Context free grammar : Ambiguity, Simplification of CFGs |  |
| **L21** | Normal forms for CFGs, Pumping Lemma for CFLs, Decidability of CFGs, Ambiguous to Unambiguous CFG |  |
|  | **UNIT-4: PUSHDOWN AUTOMATA (PDA)** |  |
| **L22** | Description and definition |  |
| **L23** | Working of PDA, Acceptance of a string by PDA,PDA and CFG |
| **L24** | Introduction to auxiliary PDA |  |
| **L25** | Two stack PDA |  |
|  | **UNIT-5: Turing Machine TM** |  |
| **L26** | Basic model, definition |  |
| **L27** | Representation, Language acceptance by TM | Assignment – 2 |
| **L28** | TM and type 0 grammar |
| **L29** | Halting problem of TM, Modifications in TM |
| **L30** | Universal TM |  |
| **L31** |  | Test 2 |
|  | **UNIT-6: UNDECIDABILITY & RECURSIVELY ENUMERABLE LANGUAGE** |  |
| **L32** | Properties of recursive and recursively enumerable languages, |  |
| **L33** | unsolvable decision problem, |  |
| **L34** | un decidability of Post correspondence problem |  |
| **L35** | Church’s Thesis, Recursive function theory, |
| **L36** | Gödel Numbering. |

**GUIDELINES**

***Cell Phones and other Electronic Communication Devices*:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.

***E-Mail and online learning tool:*** Each student in the class should have an e-mail id and a pass word to access the LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.

***Attendance:*** Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

***Passing criterion:*** Student has to secure minimum 30%/40% marks of the “highest marks in the class scored by a student in that subject (in that class/group class)” individually in both the ‘End-Semester examination’ and ‘Total Marks’ in order to pass in that paper.

* Passing Criterion for B. Tech: minimum 30% of the highest marks in the class
* Passing Criterion for M. Tech: minimum 40% of the highest marks in the class

**Course outcome assessment:** To assess the fulfilment of course outcomes two different approaches have been decided. Degree of fulfillment of course outcomes will be assessed in different ways through direct assessment and indirect assessment. In Direct Assessment, it is measured through quizzes, tests, assignment, Mid-term and/or End-term examinations. It is suggested that each examination is designed in such a way that it can address one or two outcomes (depending upon the course completion). Indirect assessment is done through the student survey which needs to be designed by the faculty (sample format is given below) and it shall be conducted towards the end of course completion. The evaluation of the achievement of the Course Outcomes shall be done by analyzing the inputs received through Direct and Indirect Assessments and then corrective actions suggested for further improvement.

**Sample format for Indirect Assessment of Course outcomes**

|  |
| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes of formal language and Automata Theory.

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl. No. |  | 1 | 2 | 3 | 4 |
| 1 | Construct finite- state machine, Deterministic Finite-state Automata, Non-deterministic finite state Automata for various simple languages. |  |  |  |  |
| 2 | Construct regular expression for various set and discover the relationship between automata and regular set. |  |  |  |  |
| 3 | Construct PDA to accept CFG |  |  |  |  |
| 4 | Construct Turing machine for various functions. |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2