|  |  |  |  |
| --- | --- | --- | --- |
| **Institute / College Name :** | **DARBHANGA COLLEGE OF ENGINEERING, DARBHANGA** | | |
| **Program Name** | B. Tech, COMPUTER SCIENCE AND ENGINEERING | | |
| **Course Code** | 051611 | | |
| **Course Name** | FORMAL LANGUAGE AND AUTOMATA THEORY | | |
| **Lecture / Tutorial (per week):** | 3 | **Course Credits** | 3 |
| **Course Coordinator Name** | PUNAM PRABHA | | |

1. **Scope and Objectives of the Course**

After completion of this course, the student should be able to:

* Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, (non-) deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, Turing machines;
* Explain the power and the limitations of regular languages and context-free languages.
* Prove properties of languages, grammars and automata with rigorously formal mathematical methods.
* Transform between equivalent deterministic and non-deterministic finite automata, and regular expressions.
* Differentiate and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions.

1. **Textbooks**

**TB1**: ‘Theory of Computer Science: Automata, Languages and Computation, by K.L.P. Mishra, N. Chandrasekaran, PHI Learning Private Limited’

**TB2**: ‘Introduction to Automata Theory, Languages, and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.’

1. **Reference Books**

**RB1:** ‘Formal Languages and Automata Theory, by Basavaraj S. Anami, Karibasappa K.G., WILEY.’

**Other readings and relevant websites**

|  |  |
| --- | --- |
| S.No. | **Link of Journals, Magazines, websites and Research Papers** |
|  | https://www.youtube.com/watch?v=eqCkkC9A0Q4&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |
|  | https://www.youtube.com/watch?v=2cyryXRmN5Q |

1. **Course Plan**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Lecture Number** | Date of Lecture | Topics | **Web Links for video lectures** | **Text Book / Reference Book / Other reading material** | **Page numbers of Text Book(s)** |
| 1-10 |  | Introduction to Automata |  | TB1, RB1 | 71-135,1-23 |
|  |  | Study and central concepts of automata theory, An informal picture of Finite Automata, Deterministic & Non-deterministic finite automata, Application of finite automata, Finite automata with epsilon transition | https://www.youtube.com/watch?v=eqCkkC9A0Q4&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK&index=1 |  |  |
| 11-16 |  | **Regular Expression and Languages** |  | TB1, RB1 | 136-179 ,25-37 |
|  |  | Regular Expressions, Finite Automata and regular expressions, Applications of regular expressions, Algebraic law of regular expressions | https://www.youtube.com/watch?v=P-18JzOC7rk&index=61&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |  |  |
| 17-21 |  | **Properties of Regular Language** |  | TB2, RB1 | 117-154 ,39-99 |
|  |  | Proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of automata | https://www.youtube.com/watch?v=WzmrmitqbPc&index=57&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |  |  |
| 22-27 |  | **Context-free Grammars and Languages** |  | TB2,RB1 | 157-203, 101-138 |
|  |  | Parse trees, Application of context free grammar, Ambiguity in grammars & languages. | https://www.youtube.com/watch?v=8a2jBm5Syjs&index=66&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |  |  |
| 28-33 |  | **Pushdown Automata** |  | TB2, RB1 | 205-238, 141-161 |
|  |  | Pushdown Automata(PDA), The language of PDA, Equivalence of PDA’s and CFG’s, Deterministic Pushdown Automata | https://www.youtube.com/watch?v=-2E2QPeJvN4&index=69&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |  |  |
| 34-39 |  | **Properties of Context-Free Languages** |  | TB2, RB1 | 239-285, 163-177 |
|  |  | Normal forms of context-free grammars, Pumping lemma for context free languages, Closure properties of context free languages | https://www.youtube.com/watch?v=F7x-uSuYgC4&index=68&list=PLEbnTDJUr\_IdM\_\_\_FmDFBJBz0zCsOFxfK |  |  |
| 40-43 |  | **Introduction to Turing machine** |  | TB2, RB1 | 287-342, 179-203 |
|  |  | Te Turing Machine, Programming techniques for Turing Machine, Extensions to the basic Turing Machine, Restricted Turing Machine, Turing Machine and Computers, Undecidable problem about Turing machine, Post’s correspondence problems | https://www.youtube.com/watch?v=sX5\_9xjr-9Q |  |  |
| 44-45 |  | **Intractable Problem** |  | TB2, RB1 | 387-437, 215-227 |
|  |  | The classes P & NP, NP-complete problem, Example of P & NP problem | https://www.youtube.com/watch?v=2cyryXRmN5Q |  |  |
| **Assignment I** | | | | | |
| Introduction to Automata  Regular Expression and Language  Properties of Regular Language | | | | | |
| **Assignment II** | | | | | |
| Context-free Grammars and Languages  Pushdown Automata  Properties of Context-free Languages | | | | | |
| **Assignment III** | | | | | |
| Introduction to Turing Machine  Intractable Problem | | | | | |
|  | | | | | |

1. **Evaluation Scheme:**

|  |  |  |
| --- | --- | --- |
| Component 1 | Mid Semester Exam | 20 |
| Component 2 | Assignment Evaluation /Attendance/ Class Test | 10 |
| Component 3\*\* | End Term Examination\*\* | 70 |
|  | **Total** | **100** |

**\*\*** The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

**SYLLABUS**

|  |  |
| --- | --- |
| Topics | **No of lectures** |
| **Regular Expression and Languages:** Study and central concepts of automata theory, An informal picture of Finite Automata, Deterministic & Non-deterministic finite automata, Application of finite automata, Finite automata with epsilon transition | 3 |
| **Regular Expression and Languages:** Regular Expressions, Finite Automata and regular expressions, Applications of regular expressions, Algebraic law of regular expressions | 6 |
| **Properties of Regular Language:** Proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of automata | 4 |
| **Context-free Grammars and Languages:** Parse trees, Application of context free grammar, Ambiguity in grammars & languages. | 6 |
| **Pushdown Automata:** Pushdown Automata(PDA), The language of PDA, Equivalence of PDA’s and CFG’s, Deterministic Pushdown Automata | 6 |
| **Properties of Context-Free Languages:** Normal forms of context-free grammars, Pumping lemma for context free languages, Closure properties of context free languages | 5 |
| **Introduction to Turing machine:** Te Turing Machine, Programming techniques for Turing Machine, Extensions to the basic Turing Machine, Restricted Turing Machine, Turing Machine and Computers, Undecidable problem about Turing machine, Post’s correspondence problems | 7 |
| **Intractable Problem:** The classes P & NP, NP-complete problem, Example of P & NP problem | 5 |

**Evaluation and Examination Blue Print:**

Internal assessment is done through quiz tests, presentations, assignments and project work. Evaluation is a very transparent process and the answer sheets of sessional tests, internal assessment assignments are returned back to the students.

The components of evaluations along with their weightage followed by the University is given below

Mid sem 20%

Assignments/Quiz Tests/Seminars 10%

End term examination 70%

**This Document is approved by:**

|  |  |  |
| --- | --- | --- |
| **Designation** | **Name** | **Signature** |
| Course Coordinator | Punam Prabha |  |
| H.O.D | Dr. RAMAN KUMAR JHA |  |
| Principal | Dr. ASEEM THAKUR |  |
| Date |  |  |