Course code: MTH 250 (3 Credits)	Full marks: 100
Course title: Applied Mathematics (3-2-0)	Pass marks: 45
Nature of the course: Theory	Total lectures: 45 hrs.
Level: Bachelor	Program: BE

1. Course Description

This course is designed for developing competency of the students in the applications of various mathematical concepts they learned in courses in previous semesters. It is equipped with complex analysis, Z-transform, Partial differential Equations and Fourier Transform. The pre requisite for this course is Calculus I, II and Algebra and Geometry. The course will be delivered through lecture method, assignment on practically base engineering problems and class tests.

2. General Objectives

The course is designed with the general objective:

- To acquaint the students with applications of mathematical tools in engineering.

3. Methods of Instruction

Lecture, tutorials, discussions and assignments

4. Contents in Detail

Specific objectives	Contents
• Understand and apply function of complex variables, Calculus of functions of complex variables and their applications in Engineering problems.	**Unit I: Complex Analysis (17 hrs.)** **1.1 Complex numbers and functions (5 hrs.)** 1.1.1 Review on Complex number, their geometric representation, Polar form, power and roots**.** 1.1.2 Sets and functions in complex plane, Limits Continuity and derivatives of function of complex variables. (Definition and concepts only) 1.1.3 Analytic functions, Cauchy-Riemann(C-R) equations as necessary conditions for functions to be analytic, C-R equations as sufficient condition for analyticity (without proof), Polar form of C-R equations (No derivation). 1.1.4 Laplace equation, harmonic functions and harmonic conjugate 1.1.5 Related problems
	1.2 Integrals in complex plane (4 hrs.) 1.2.1 Line integrals in the complex plane, Evaluation of basic line integrals in complex plane 1.2.2 Cauchy's Integral theorem, Cauchy's integral formula

	and Cauchy integral formula of higher order (for analytic functions) without proof. 1.2.3 Related problems.
	1.3 Taylor and Laurent series for functions of complex variables. (6 hrs.) 1.3.1 Taylor series and Laurent series (Without Proof) and Related Problems 1.3.2 Singularities and zeros, Residues and integration, Cauchy Residue theorem (Without proof) and related Problems.
	1.4 Conformal mapping (2 hrs.): Special Linear fractional transformation (Bilinear fractional transformation) only.
• Understand and apply discrete transforms and solve difference equations.	**Unit II: Z-Transform and its Applications (10 hrs.)** 2.1 Z-transform, Z-transform of elementary functions, Properties of Z-transforms, Shifting theorems, initial value theorem, final value theorem. 2.2 Inverse z-transforms using division method, expansion method, Partial fraction method and residue method. 2.3 Application: Difference equations and solution by using Z-transform.
• Understand and apply higher dimensional systems and describe them by partial differential equations with solution techniques and interpretation of solutions.	**Unit III: Partial Differential Equations (12 hrs.)** 3.1 Partial differential equations and solutions by variable separation method. 3.2 One dimensional wave equation and its solutions and related problems. 3.3 One dimensional heat equation and it's solutions and related problems. 3.4 Two dimensional heat equation, Laplace equation (steady state heat equation) and its solution for rectangular boundaries. Laplace equation in polar form and its solution for circular boundaries, related problems.
• Evaluate Fourier integrals and Transforms.	**Unit IV Fourier integral and Transform (6 hrs.)** 4.1 Fourier integral, Fourier sine and cosine integrals and related problems. 4.2 Fourier integral in complex form and Fourier transform and inverse transform, Fourier sine and cosine transforms and their inverse transforms, Convolution theorem, Parseval's identity and related problems.

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials

Tutorial work covers the work to be done in tutorial. This will enable the students to compute the mathematics problem under the supervision of the course leader. The major tutorial works are as follows:

Total : 30 Hours

Unit no.	Unit name	List of Tutorials	Tutorial hours
1	**Unit I: Complex Analysis (9 hrs.)**	1.1 Problems on differentiability 1.2 Problems on analyticity 1.3 Problems on Harmonic and conjugate harmonic functions. 1.4 Problems on Integrals using Cauchy integral theorem and formula. 1.5 Problems on Taylor's series and Laurent's series 1.6 Problems on singularities and residues.	1 hr. 1 hr. 1 hr. 2 hr. 2 hr. 2 hr.
2	**Unit II: Z-Transform and its Applications (7 hrs.)**	2.1 Problems on Z-transforms of elementary functions. 2.2 Problems on Z-transforms using different theorems. 2.3 Problems on inverse z-transforms. 2.4 Solution of difference equations.	1 hr. 2 hrs. 2 hrs. 2 hrs.
3	**Unit III: Partial Differential Equations (10 hrs.)**	3.1 Problems on separation of variables methods. 3.2 Problems related to one dimensional wave equation. 3.3 Problems on one dimensional heat equation. 3.4 Problems on two-dimensional heat equation rectangular boundaries 3.5 Problems on two-dimensional heat equation circular boundaries.	2 hrs. 2 hrs. 2 hrs. 2 hrs. 2 hrs.
4	**Unit IV Fourier integral and Transform (4 hrs.)**	4.1 Problems on Fourier integrals. 4.2 Problems on Fourier Transforms and its inverse.	2 hrs. 2 hrs.

6. Evaluation System and Students' Responsibilities

Evaluation System

Internal evaluation is done as follows:

Internal Evaluation	Marks	External Evaluation	Weight	Marks
Attendance & Class Participation	10%	**Semester End Board Examination**	**50%**	50
Assignments	20%			
Presentations/Quizzes	10%			
Term exam	60%			
Total Internal	50			
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Text Book

1. Advanced Engineering Mathematics, Erwin Kreszig
2. Text Book of Engineering Mathematics, Debashis Dutta , NEW AGE International Publisher

References

1. Advanced Engineering Mathematics, Alan Jeffrey
2. Engineering Mathematics, S.S sastry Vol.1 and Vol.2

Pokhara University
Faculty of Science and Technology

Course No.: CMP 262 | Full marks: 100

Course title: **Computer Architecture (3-1-1)** | Pass marks: 45

Nature of the course: Theory & Practical | Total Lectures: 45 hrs

Level: Bachelor | Program: BE (Computer)

1. Course Description

This course is designed to provide the knowledge of the evolution of computer architecture and the factors influencing the design of hardware and software elements of computer systems. It aims to provide an understanding of the design of processing unit and control unit architectures. This course introduces the concepts of instruction set design, processor processor organization, pipelining, cache and virtual memory organizations, I/O and interrupts, parallel processing and multicore computers.

2. General Objectives

- To acquaint the students with the knowledge of computer architecture and associated processing, control unit and ALU unit of very simple central processing unit.
- To provide the knowledge of the functions of each element of memory hierarchy.
- To develop the skills in students to choose the appropriate Memory and Input Output organization used in real world computing systems.
- To acquaint the students with the knowledge of technology behind modern advanced computer architectures for parallel processing and multicore architecture.

3. Methods of instructions

Lectures, Tutorials, Case Studies, Discussion, Readings and Practical Works.

4. Content in details

Specific objectives	Contents
• Understand the concepts of computer architectures, functional units and components of computer systems and various addressing modes.	**Unit 1 Introduction to Architecture [4 Hrs]** 1.1. Brief overview of Computer organization and Architecture 1.2. Hierarchy structure of computer system 1.3. Computer evolution and generations 1.4. Computer Components and Functions 1.5. Future Trends in Computer 1.6. Review of Instruction sets, Addressing Modes and Instruction format

• Understand the VHDL Programming for simple operations.	**Unit -2: Register Transfer Language and Micro operations [4Hrs]** 2.1 Register Transfer and RTL 2.2.Micro Operation 2.3 Data Transfer Micro Operations 2.4 Arithmetic and Logical Operations 2.5 Shift Micro operations 2.6 Introduction to HDL and VHDL 2.7 VHDL programming for Adder, Mux, ALU
• Understand the functional units of CPU and their organization.	**Unit -3: Processor Organization [5 Hrs]** 3.1 CPU Organization/Structure 3.2 Register Organization and Data paths 3.3 Instruction Cycle(T states) 3.4 Arithmetic and Logical Unit 3.5 Design Principles for Modern Systems
• Understand the design of Hardwired and microprogrammed control units.	**UNIT 4 Control Unit [5 Hrs]** 4.1 Control of the processor 4.2 Hardwired Control Unit(Control unit inputs/logic) 4.3 Microinstruction Format 4.4 Micro Programmed Control Unit 4.5 Architecture of Microprogrammed Control Unit 4.6 Microinstruction Sequencing and Execution 4.7 Application of Hardwired and Micro programmed Control Units 4.8 RISC and CISC Architecture
• Understand the representation of binary numbers in signed and unsigned notation along with the algorithms used for the basic arithmetic operations.	**UNIT 5 Computer Arithmetic [7 Hrs.]** 5.1 Integer Representation 5.2 Integer Arithmetic 5.3 Unsigned Binary Addition and Subtraction 5.4 Unsigned Binary Multiplication Algorithm 5.5 Booth Multiplication Algorithm 5.6 Unsigned Binary Division Algorithm 5.7 Floating Point Representation
• Understand the concepts of pipelining for better performance.	**Unit 6: Pipelining [4 hrs]** 6.1 Pipelining 6.2 Arithmetic Pipeline 6.3 Instruction Pipeline 6.4 Conflicts in Instruction Pipelining and their solutions 6.5 RISC pipeline 6.6 Register Windowing and Register Renaming
• Review memory Hierarchy of computer systems and understand the principles of cache memory to increase the performance of CPU	**UNIT 7 Memory Organization [4 Hrs.]** 7.1 Memory Hierarchy 7.2 Main Memory and Auxiliary Memory 7.3 Associative Memory and Cache Memory 7.4 Cache mapping techniques- Direct,Associative

	and Set Associative Mapping 7.5 Cache Write Policy. 7.6 Cache Replacement algorithm (FIFO, LRU, LFU)
● Familiarize with IO interfaces and introduce various methods for improving I/O performances.	**Unit 8: Input-Output Processing [4 Hrs**] 8.1 Peripheral Devices 8.2 I/O Modules 8.3 I/O Interface and Techniques 8.4 Modes of Transfer: Programmed,Interrupt-Driven and DMA 8.5 I/O Processor and IO channel 8.6 GPU and TPU 8.7 External Interfaces: FireWire and Infiniband 244
● Understand the concept of parallel processing and multi thread architecture in modern processors.	**Unit 9: Parallel \Processing [4 Hrs]** 9.1 Parallel Processing 9.2 Parallelism In Uniprocessor system 9.3 Multiprocessor System and their characteristics 9.4 Flynn Classification 9.5 Interconnection structures in Multiprocessors 9.6 Vector processing and Array processing 9.7 Introduction to Multithreaded Architecture
● Prevalent new development in computer architecture: the use of multiple processors on a single chip	**Unit 10:Multi-core computer (4Hrs)** **10.1** Hardware performance issues 10.2 Software Performance Issues 10.3 Multicore Organization 10.4 Dual Core, Quad Core and Octa Core 10.5 Power Efficient Processor

1. Laboratory Works

Laboratory works of 15 hours per group of maximum 24 students should cover the following lab works:.

1. Write a program to implement the Booth Algorithm (2hr)
2. Write a program to implement the Non Restoring Division Algorithm (2 hr)
3. Write a VHDL Code for Realizing Logic Gates (1hr)
4. Write a VHDL code for Combination circuits (Decoder, Encoder, MUX, Demux ,Comparerator, Code converter) (6 Hrs)
5. Write a VHDL Program for Realizing Sequential Circuits Like Fliflop and counters (4 Hrs)

2. List of Tutorials:

The various tutorial activities that outfit this course should cover all the content of this course to give students a space to engage more actively with the course content in the presence of the instructor. Students should submit tutorials as assignments or class works to the instructor for evaluation. The following tutorial activities of 15 hrs should be conducted to cover all the content of this course:

A. Discussion based Tutorials (3 hrs)

1. Overview of Computer Organization and Architecture.
2. Memory hierarchy for modern processors.
3. Comparative analysis of different aspects of computing systems as defined in Flynn's Classification.

B. Problem Solving based Tutorials (6 hrs)

1. Design a CPU for any given registers set, instruction set and state diagram.
2. Develop a control unit for any given state diagram.
3. Design a microsequencer control unit for any given specifications following design procedure.
4. Perform arithmetic addition and subtraction in signed and unsigned notation for any given numbers.
5. Perform Multiplication operation for any given numbers using shift-add multiplication algorithm and Booth's algorithm.
6. Perform Division operation for any given numbers using restoring and Non restoring Division algorithm.

C. **Review and Question/Answer-based Tutorials:** (6 hrs)

1. Case study on any of multi threaded and Multi core processors. It should include the architecture of processor, control unit, memory as well as input output organization in detail. An oral presentation with the submission of a report should be a part of work and must be included as a component for evaluation.
2. Students ask questions within the course content and assignments and review key course content in preparation for tests or exams.

3. Evaluation system and Students' Responsibilities

Evaluation:

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		30		
Attendance and class Participation	10%			
Assignments	20%			
Project work/Presentations	20%			
Term Exam	50%			
Practical		20		

Attendance and Lab Participation	20%		Semester End examination	50
Lab report	30%			
Practical Exam	30%			
Viva	20%			
Total Internal Marks		50		
Full marks=50+50				

Students Responsibility:

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the semester End Examination. Failing to get such a score will be given NOT QUALIFIED(NQ) to appear for the Semester End Examination. Students are advised to attend all the classes, formal exam, test and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

4. Prescribed Text Books and References

Text Books:

1. Stalling W. (2011). *Computer Organization and Architecture,* Pearson Education.

References:

2. Carpinelli, John D. (2001). *Computer System Organization and Architecture*. Pearson Education Asia.
3. Hall, Douglas V. (2005). *Microprocessor and Interfacing programming and Hardware*. McGraw Hill, New Delhi.
4. Tanenbaum, A.S. (2003). *Structured Computer Organization*. Pearson Education.
5. Uffenbeck, J. (1991). *Microcomputers and microprocessors: the 8080, 8085, and Z-80 programming, interfacing, and troubleshooting*. Prentice-Hall, Inc..
6. Moris M. M. (1992). *Computer System Architecture*. Pearson

Pokhara University

Pokhara University
Faculty of Science and Technology

Course No.: CMP 270	Full marks: 100
Course title: **Research Fundamentals (2-0-2)**	Pass marks: 45
Nature of the course: Theory & Practical	Total Lectures: 45 hrs
Level: Bachelor	Program: BE (Computer, IT and Software)

1. Course Description

This course is designed to develop the skills of students to do a project/research work using the fundamental concepts of research. This course introduces what the research or project work is, explores in brief how it is done, explains what research ethics must be followed during the research/project work and finally guides the students how the research/project documentation is done in the form of the proposals report and final research/project report.

2. General Objectives

- To acquaint the students with basic knowledge of research/project work.
- To develop the skills in students to conduct research/project work.
- To develop the skills in students to work in a team.
- To develop the skills in students to write an impressive proposal report and final research/project report and present their work orally.
- To acquaint the students with the knowledge of research ethics.

3. Methods of Instruction

Lecture, Discussion and Project work.

4. Contents in Detail.

Specific Objectives	**Contents**

• Understand the basic concepts of research, purpose and outcomes of a research/project work.	**Unit 1: Introduction (4 hrs)** 1.1 What is research? 1.2 Research Aim and Objectives 1.3 Features of Research 1.4 Types of Research 1.5 The 6Ps of Research 1.6 Purpose of Research- reasons for doing research 1.7 Product of Research- outcomes of research 1.8 Research and Project
• Understand and implement the research process model to conduct a research/project work.	**Unit 2: Research Process Model (10hrs)** 2.1 Personal Experiences and Motivation 2.2 Literature Review 1. Purpose and objectives of a literature review 2. Literature resources 3. Conducting a literature review 4. Citation and its types 5. Bibliographic Detail and Referencing Systems 6. Plagiarism 2.3 Research Question 2.5 Conceptual framework 2.5 Strategies 1. Survey 2. Design and Creation 3. Experiment 4. Case Study 5. Action Research and 6. Ethnography 2.6 Data Generation Methods 1. Interview 2. Observations 3. Questionnaire 4. Documents 5. Types of triangulation in a research project 2.7 Data Analysis 1. Quantitative and 2. Qualitative data analysis
• Familiarize with the laws and ethics in research conduction.	**Unit 3: Participants and Research Ethics (4hrs)** 3.1 Participants 3.2 The law and Research 3.3 Rights of People Directly Involved 3.4 Responsibilities of an Ethical Researcher

• Familiarize with the research proposal and its components. • Develop a research/project proposal.	**Unit 4: Proposal Writing (4hrs)** 4.1 What is a research proposal? 4.2 Need of a Research Proposal 4.3 Components of a Research Proposal 4.4 A case study on any research paper/project
• Familiarize with the research/project report and its components. • Develop a research/project report.	**Unit 5: Report Writing (4hr)** 5.1 What is a research report? 5.2 Need of a Research Report 4.3 Components of a Research Report 4.4 A case study on any research paper/report

5. Practical Work

Laboratory works of 30 hours per group of maximum 24 students should cover all the concepts of research fundamentals studied in the lectures. Students must find a new problem, write a proposal, solve the problem as their project/research work and submit a final project/research report and present their work orally. The marks for the practical work will be based entirely on their project/research work. The entire project/research work shall be divided into two phases and evaluation shall be done accordingly:

Phase I:

- The students are grouped in teams each containing at most 4 students.
- Each team chooses a problem to solve as their project/research work and they work in a team.
- They must define clearly what the problem is, justify why they choose the problem and how they will solve it and submit this as a proposal report (based on Unit 2 and 4).
- Each team presents their proposal orally.

Phase II:

- After the approval of their proposal, they start working on the project.
- Each team follows the research process studied in Unit 2 to do their project/research work.
- Students keep reporting their progress about the project/research work to their instructor.
- Students complete the project/research work, develop the final project/research report (based on Unit 2 and 5) and again present it orally.

6. **Evaluation system**

Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
Theory		30		
Attendance & Class Participation	10%			
Assignments	20%			

Presentations/Quizzes	10%		Semester-End examination	50
Internal Assessment	60%			
Practical (Project/research Work)		20		
Proposal Report	30%			
Project Presentation	10%			
Final Project Report	40%			
Completeness of Project	20%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

7. Student Responsibilities:

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such a score will be given NOT QUALIFIED (NQ) to appear for the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

1. Oates, B. J., Griffiths, M., & McLean, R. (2022). *Researching information systems and computing*. Sage.
2. Walia, A. M., & Uppal, M. (2020). *Fundamentals of Research.* Notion Press.

8. Annex

A. **Components of Research Proposal**

1. Title Page
2. Abstract
3. Table of Contents, List Figures, List of Tables and Abbreviations
4. Introduction
   a. Rationale/background
   b. Problem and motivation
   c. Aim and objectives of research
   d. Significance of research

e. Scope of research
f. Limitation

5. Literature review
6. Research problem and Solution
7. Methodology
    a. Research design
    b. Participants
    c. Data collection methods
    d. Data analysis techniques
    e. Ethical considerations
    f. Validation Techniques
8. Data Analysis and Findings
9. Discussions and Conclusion
10. Contributions and Future Works
11. Reference list/bibliography
12. Annexes

B. Components of Research Report:

1. Title
2. Abstract
3. Keywords
4. Rationale/background and motivation
5. Aim and objectives of research
6. Literature review
7. Research problem
8. Methodology
9. Research plan and budget
10. Contributions- impact and significance
11. Reference list/bibliography
12. Annexes

Other Parts of Research Report:

1. Funding and Acknowledgement
2. Table of Contents, List Figures, List of Tables and Abbreviations
3. Title Page and Copyright Page
4. Declaration and Recommendation
5. Certification Page

Note*: The components of research proposal and research report may vary based on the research strategy and nature of the research problem.*

Pokhara University

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Faculty of Science and Technology

Course No.: CMP264	Full marks: 100
Course title: **Theory of Computation (3-1-0)**	Pass marks: 45
Nature of the course: Theory	Total Lectures: 45 hrs
Level: Bachelor	Program: BE (Computer)

1. Course Description

This course is designed to provide basic knowledge of the theory of automata, formal languages and computational complexity.

2. General Objectives

- To acquaint the students with the basic knowledge of automata and formal languages.
- To develop the skills in students to design various types of automata and analyze them.
- To acquaint the students with the concepts of computability, computational bounds and computational complexity.

3. Methods of Instruction

Lecture, Discussion, Readings, Tutorials.

4. Contents in Detail.

Specific Objectives	**Contents**
- Understand the concept of alphabet and language	**Unit 1: Introduction (4 hrs.)** 1.1 Review of set, relation and function 1.2 Proof techniques– proof by contradiction, pigeon hole principle, induction and diagonalization. 1.3 Alphabets and language 1.4 Chomsky's hierarchy?

- Design and implement the deterministic and non-deterministic finite automata. - Develop the equivalence of regular languages and finite automata	**Unit 2: Finite Automata and Regular Language (10 hrs)** 2.1 Deterministic Finite Automata, Non-Deterministic Finite Automata 2.2 Regular expressions and regular language, equivalence of regular language and finite automata 2.3 Properties of regular language 2.4 Pumping lemma for regular sets 2.5 Closure properties of regular sets 2.6 Decision algorithms for regular sets
- Explain the theory and design of context-free grammar and pushdown automata and their equivalence. - Explore the derivation trees, simplification and formal forms of context-free grammar.	**Unit 3: Context-Free Language and Pushdown Automata (13 hrs)** 3.1 Context-free grammar 3.2 Derivative trees and simplification of context-free grammar 3.3 Normal forms (CNF, GNF) 3.4 Pushdown automata (formal description and final state PDA design) 3.5 Equivalence of pushdown automata and context-free grammar 3.6 Properties of context-free languages (CFL) 3.7 Pumping lemma for CFL’s 3.8 Closure properties of CFL’s 3.9 Decision algorithms for CFL’s
- Explain the theory and significance of Turing machines - Explain computing mechanism and extensions of Turing machines - Understand the computable languages, functions and unrestricted grammar	**Unit 4: Turing Machines (10 hrs)** 4.1 Introduction to Turing machine 4.2 Computing with Turing machine 4.3 Extensions of Turing machine 4.4 Unrestricted grammar 4.6 Recursively enumerable languages
- Use the idea of undecidability introducing Church-Turing thesis and the halting problem - Understand the universal Turing machines and undecidable problems of Turing machines	**Unit 5: Undecidability (4 hrs)** 5.1 The Church-Turing thesis 5.2 Halting Problem 5.3 Universal Turing machines 5.4 Undecidable problems about Turing machines 5.5 Properties of Recursive and Recursively enumerable languages.

- Understand the concept of computational complexity and different classes of problems	**Unit 6: Computational Complexity (4 hrs)** 6.1 Introduction to Complexity theory, tractable and intractable problems. 6.3 Class P and Class NP problems 6.4 NP-complete problems.

5. List of Tutorials:

The various tutorial activities that suit this course should cover all the content of this course to give students a space to engage more actively with the course content in the presence of the instructor. Students should submit tutorials as assignments or class-works to the instructor for evaluation. The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover the content of this course:

A. Discussion-based Tutorials: (2 hrs)

1. Review discussion on set theory concepts like functions, relations, etc.
2. Discussion on the theoretical meaning and significance of computation and computers
3. A study and presentation can be done on the history of computation and Alan Turing as the father of computation (Oral Presentation).

B. Problem solving-based Tutorials: (8 hrs)

1. Solve problems to design deterministic and non-deterministic finite automata (DFA and NDFA) to recognize/generate given regular languages.
2. To develop regular expressions to recognize/generate given regular languages.
3. To convert a given NDFA to DFA.
4. To design Context-Free Grammar (CFG) to recognize/generate given Context-Free Language (CFL)
5. To simply a given CFG and convert it into CNF and GNF
6. To design Pushdown Automata (PDA) to recognize/generate given Context-Free Language (CFL)
7. To design Turing machines to recognize/generate given languages

C. Review and Question/Answer-based Tutorials: (5 hrs)

1. Case study of examples of DFA, PDA and Turing Machines for some practical tasks followed by Oral Presentation/demonstration in class.
2. Case study of Unsolvable problems such as the Tiling problem followed by Oral Presentation in class.
3. Case study of Class NP and NP-complete problems (eg, Travelling Salesman Problem) followed by Oral Presentation in class.

7. **Evaluation system and Students' Responsibilities**

Internal Evaluation

The internal evaluation of a student may consist of assignments, attendance, internal assessment, etc. The internal evaluation scheme for this course is as follows:

<table>
<tr><th>Internal Evaluation</th><th>Weight</th><th>Marks</th><th>External Evaluation</th><th>Marks</th></tr>
<tr><td>Theory</td><td></td><td>50</td><td rowspan="6">Semester-End examination</td><td rowspan="6">50</td></tr>
<tr><td>Attendance & Class Participation</td><td>10%</td><td></td></tr>
<tr><td>Assignments</td><td>20%</td><td></td></tr>
<tr><td>Presentations/Quizzes</td><td>10%</td><td></td></tr>
<tr><td>Internal Assessment</td><td>60%</td><td></td></tr>
<tr><td>Total Internal</td><td></td><td>50</td></tr>
<tr><td colspan="5">Full Marks: 50 + 50 = 100</td></tr>
</table>

Student Responsibilities:

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such a score will be given NOT QUALIFIED (NQ) to appear for the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books:

1. Lewis, H. R., & Papadimitriou, C. H., *Elements of theory of computation*, Pearson Education.
2. R. McNaughton, *Elementary Computability, Formal Languages, and Automata*, Prentice Hall of India.
3. Hopcroft, J. E., Motwani, R., & Ullman, J. D. (2008). *Introduction to automata theory, languages, and computation*. Pearson.

References:

1. M. Sipser, *Introduction to the Theory of Computation*, Thomson Course Technology
2. E. Engeler, *Introduction to the Theory of Computation*, Academic Press.