UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2018 SCHEME)

SYLLABUS FOR

IV SEMESTER

COMPUTER SCIENCE & ENGINEERING

SCHEME -2018

IV SEMESTER
COMPUTER SCIENCE & ENGINEERING (R)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
18.401	Probability, Random Processes and Numerical Techniques (FR)	4	3	1	-	50	3	100	150
18.402	Computer Organization and Design (FR)	3	2	1	-	50	3	100	150
18.403	Object Oriented Techniques (FR)	3	2	1	-	50	3	100	150
18.404	Data Communication (FR)	3	2	1	-	50	3	100	150
18.405	Data Base Design (FR)	3	2	1	-	50	3	100	150
18.406	Formal Languages and Automata Theory(R)	4	3	1	-	50	3	100	150
18.407	Data Structures Lab(FR)	2	-	-	2	50	3	100	150
18.408	Digital System Lab(R)	2	-	-	2	50	3	100	150
	Total	**24**	**14**	**6**	**4**	**400**		**800**	**1200**

18.401 PROBABILITY, RANDOM PROCESSES AND NUMERICAL TECHNIQUES (FR)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To provide a basic understanding of random variables and probability distributions.*
- *To have a basic idea about Random process- its classification, types and properties and their applications in engineering fields.*
- *Numerical techniques for solving differential equations are also introduced as a part of this course.*

Module – I

Random Variables -Discrete and continuous random variables -Probability distributions.-Mathematical Expectation and properties.

Special probability distributions-Binomial distribution, Poisson distribution, Poisson approximation to Binomial, Uniform distribution, Exponential Distribution, Normal distribution- mean and variance of the above distributions (derivations except for normal distribution).

Module – II

Two dimensional random variables-Joint and marginal distributions-Expectations-Conditional probability distributions –independence.

Curve fitting- Principle of least squares – Fitting a straight line – Fitting a parabola $y= a+bx+x^2$ **correlation and Regression** – Scatter diagram – Coefficient of correlation – Regression – Rank correlation.

Module – III

Random processes-Types of random processes-Ensemble mean- Stationarity -Strict sense stationary process (SSS) and Wide sense stationary (WSS) process.-Autocorrelation, autocovariance and their properties(without proof).
Special types of processes-Poisson process-mean and variance-simple problems

Module – IV

Numerical techniques-Solutions of algebraic and transcendental equations-Bisection method-Regula falsi method- Newton- Raphson method. Solution of system of equations-Gauss elimination, Gauss- Siedel iteration. Interpolation – Newton's Forward and backward formulae - Lagrange's interpolation formula .Numerical integration-Trapezoidal rule and Simpson's one third rule.

References:

1. Veerarajan T., *Probability, Statistics and Random Processes*, 3/e, Tata McGraw Hill, 2002.
2. Papoulis A. and S.U. Pillai, *Probability, Random Variables and Stochastic Processes*, 3/e, Tata McGraw Hill, 2002.
3. Koneru S. R., *Engineering Mathematics*, 2/e, Universities Press (India) Pvt. Ltd., 2012.
4. Sastry S. S., *Introductory Methods of Numerical Analysis*, 5/e, PHI Learning, 2012.
5. Babu Ram, *Numerical Methods*, 1/e, Pearson Education, 2010.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be familiar with the various concepts of Random process which are essential in the communication field and they will be able to use the numerical methods to solve problems related to engineering fields.

18.402 COMPUTER ORGANIZATION AND DESIGN (FR)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

- *To impart an understanding of the internal organisation and operations of a computer.*
- *To introduce the concepts of processor logic design and control logic design.*

Module – I

Basic Structure of computers – functional units – basic operational concepts – bus structures – software. Memory locations and addresses – memory operations – instructions and instruction sequencing –addressing modes –ARM Example (*programs not required*). Basic I/O operations – stacks subroutine calls.

Module – II

Basic processing unit – fundamental concepts – instruction cycle - execution of a complete instruction – multiple-bus organization – sequencing of control signals**.**

Processor Logic Design: Register transfer logic – inter register transfer – arithmetic, logic and shift micro operations – conditional control statements.

Processor organization:– design of arithmetic unit, logic unit, arithmetic logic unit and shifter – status register – processor unit – design of accumulator.

Module – III

Control Logic Design: Control organization – design of hardwired control – control of processor unit – PLA control

Micro programmed control – microinstructions – horizontal and vertical micro instructions – micro program sequencer – micro programmed CPU organization.

Module – IV

I/O organization: – accessing of I/O devices – interrupts – direct memory access – buses – interface circuits – standard I/O interfaces (PCI, SCSI, USB).

Memory system: – basic concepts – semiconductor RAMs – memory system considerations – semiconductor ROMs – flash memory – cache memory and mapping functions.

References

1. Hamacher C., Z. Vranesic and S. Zaky, *Computer Organization*, 6/e, McGraw Hill, 2011. [Chapters: 2, 3, 4 (4.1 , 4.2, 4.4 – 4.7), 5 (5.2, 5.3, 5.5, 5.6)]

2. Mano M. M., *Digital Logic & Computer Design*, 4/e, Pearson Education, 2013. [Chapters: 8 - 10]

3. Patterson D.A. and J. L. Hennessey, *Computer Organization and Design*, 5/e, Morgan Kauffmann Publishers, 2013.

4. Chaudhuri P., *Computer Organization and Design*, 2/e, Prentice Hall, 2008.

5. Rajaraman V. and T. Radhakrishnan, *Computer Organization and Architecture*, Prentice Hall, 2011.

6. Messmer H. P., *The Indispensable PC Hardware Book*, 4/e, Addison-Wesley, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question (question may contain sub-divisions), out of the two from each module. Each question carries 20 marks.

Course outcome:

- *Students would understand the basic structure and functioning of a digital computer.*
- *The concepts of addressing and instruction execution cycle would enable the students to develop efficient programs.*
- *Ability to design a basic processing unit using the concepts of ALU and control logic design.*

18.403 OBJECT ORIENTED TECHNIQUES (FR)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

- *To impart the basic concepts of object oriented techniques.*
- *To develop programming skills in C++ programming language.*
- *To implement object oriented techniques using C++ language features.*

Module – I

Fundamentals of object oriented programming paradigm- Data Abstraction, Encapsulation, classes, objects, inheritance and class hierarchies, polymorphism, Dynamic binding, Applications of object oriented programming, object oriented languages.

Basics of C++- C++ enhancements to C, "const" qualifier, reference variables, reference as function parameters, references as return values, inline functions, default arguments, function overloading, scope resolution operator, new and delete operators.

Module – II

Introduction to classes and objects: specifying a class, creating objects, defining member functions, memory allocation for objects, static members, array of objects, objects as function argument, returning objects from functions, friendly functions and friend classes, passing references to objects and returning references.

Constructors and Destructors: Default and parameterised constructor, Constructor overloading, default argument constructor, copy constructors, dynamic constructors, destructors.

Module – III

Inheritance and access control- derived class and base class, base class access control, classification of inheritance, virtual base class, constructors in base and derived classes, pointers to objects, this pointer, pointers to derived classes, virtual functions, abstract classes, dynamic binding.

Polymorphism- Member function overloading, Operator overloading- overloading unary & binary operators – overloading of increment, decrement, comma, subscript, assignment, arithmetic, relational and logical operators, friend operator function, type conversions, overloading versus overriding.

Module – IV

Using stream for input and output, manipulators, File processing- formatted, unformatted and random files.

Generic programming- class template, function template. Exception handling- errors and exception, exception handling mechanisms, throwing and exception, specifying exception.

References:

1. Schildt H., *Teach Yourself C++*, Tata McGraw Hill, 2000.
2. Hubbard J.R., *Schaum's Outline of Programming with C++*, McGraw Hill, 2000.
3. Balagurusamy, *Object Oriented Programming with C++*, Tata McGraw Hill, 2008.
4. Lafore R., *Object Oriented Programming in C++*, Galgotia Publications, 2001.
5. Stephen D. R., C. Diggins, J. Turkanis and J. Cogswell, *C ++ Cook book,* O'Reilly Media, 2013.
6. Oualline S., *Practical C++ Programming*, 2/e, O'Reilly Media, 2002.
7. Meyers S., *Effective C++*, Addison Wesley, 2011.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question (question may contain sub-divisions), out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Attain conceptual understanding of object oriented techniques.*
- *Gain strong foundations in C++ language programming.*
- *Apply object oriented techniques using C++ language constructs in application program*

18.404 DATA COMMUNICATION (FR)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *Build an understanding of the fundamental concepts of data transmission.*
- *Familiarize the student with the basic taxonomy and terminology of the computer networking area.*
- *Preparing the student for understanding advanced courses in computer networking*

Module – I

Communication model Simplex, half duplex and full duplex transmission. Time Domain and Frequency Domain concepts - Analog & Digital data and signals - Transmission Impairments - Attenuation, Delay distortion, Noise - Different types of noise - Channel capacity - Shannon's Theorem - Transmission media- twisted pair, Coaxial cable, optical fiber, terrestrial microwave, satellite microwave.

Module – II

Synchronous and Asynchronous transmission. Sampling theorem - Encoding digital data into digital signal - NRZ, Biphase, Multilevel binary - Encoding digital data into analog signals - ASK, FSK, PSK - Encoding analog data into digital signals - PCM, PM, DM - Encoding analog data into analog signals - AM, FM, PM.

Module – III

Multiplexing - TDM, FDM, WDM & DWDM. Error Detecting and correcting codes. Error detection - parity check,CRC. Forward Error Correction -Hamming codes,Convolution codes.

Module – IV

Basic principles of switching - circuit switching, packet switching, message switching. Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access. Basics of wireless communication, Introduction to WiFi, WiMax, GSM, GPRS.

References:

1. Stallings W., *Data and Computer Communications*, 8/e, Prentice Hall, 2007.
2. Forouzan B. A., *Data Communications and Networking*, 4/e, Tata McGraw Hill, 2007.

3. Tanenbaum A. S and D. Wetherall, *Computer Networks*, Pearson Education, 2013.
4. Schiller J., *Mobile Communications,* 2/e, Pearson Education, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question (question may contain sub-divisions), out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the successful completion of the course students will be able to

- *Explain Data Communications concepts and its components.*
- *Identify the different types of Transmission media and their functions within a network.*
- *Independently understand basic computer network technology.*

18.405 DATABASE DESIGN (FR)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To impart the basic understanding of the theory and applications of database management systems.*
- *To give basic level understanding of internals of database systems.*

Module – I

Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Entity-Relationship Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Module – II

Relational Model: Structure of relational Databases, Integrity Constraints, relational algebra, tuple relational calculus, Extended Relational Algebra Operations.

Database Languages: Concept of DDL and DML, Basic SQL Structure, examples, Set operations, Aggregate Functions, nested sub-queries, assertions, triggers, views.

Module – III

Relational Database Design: Different anomalies in designing a database. Synthesizing ER diagram to relational schema, normalization, functional dependency, Armstrong's Axioms, closures, Equivalence of FDs, minimal Cover (proofs not required). Normalization using functional dependencies, INF, 2NF, 3NF and BCNF, lossless and dependency preserving decompositions.

Module – IV

Physical Data Organization: Secondary storage, buffering, file operations, unordered and ordered-files, hashing, index structures, primary, secondary and clustering indices, multi-level indexing and B-Trees (algorithms not needed).

Query Optimization: algorithms for relational algebra operations, heuristics-based query optimization.

Transaction Processing Concepts: over view of concurrency control and recovery acid properties, serial and concurrent schedules, conflict serializability. Two-phase locking, failure classification, storage structure, stable storage, log based recovery, immediate and deferred database modification, check-pointing, database security.

Recent topics (preliminary ideas only): RDF and Big Data.

References:

1. Elmasri R. and S. Navathe*, Database Systems: Models, Languages, Design and Application Programming*, Pearson Education, 2013. [Chapters 1, 2, 3, 4, 5.1-5.3, 6.1-6.6, 7.1-7.13, 8.1-8.2, 14.1-14.5, 15.1-15.2, 16.1-16.8, 17.1-17.3, 18.1-18.4, 18.6, 18.7, 20, 21.1, 22.1-22.3, 25.1, 25.2].

2. Sliberschatz A., H. F. Korth and S. Sudarshan, *Database System Concepts*, 5/e, McGraw Hill, 2006. [Chapters 16.1 (except 16.1.4-16.1.5), 17.1 – 17.7].

3. Powers S., *Practical RDF*, O'Reilly Media, 2003. [Chapter 1].

4. Plunkett T., B. Macdonald, *et al.*, *Oracle Big Data Hand Book*, Oracle Press, 2013. [Chapters 1, 2]

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as class room/home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question (question may contain sub-divisions), out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course, the student is expected to:

- *have a thorough understanding of the concepts of databases.*
- *be able to do design a relational database following the design principles.*
- *be able to develop queries for relation database.*
- *have basic level understanding of the internal architecture and working of a database.*
- *have a basic awareness of emerging areas of database technology.*

18.406 FORMAL LANGUAGES AND AUTOMATA THEORY (R)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Presenting the theory of finite automata, as the first step towards learning advanced topics, such as compiler design.*
- *Applying the concepts learned in fundamental courses such as Discrete Mathematics, in a theoretical setting; in particular, the application of proof techniques.*
- *Discussing the applications of finite automata towards text processing.*
- *Developing an understanding of computation through Turing Machines.*

Module – I

Introduction to theory of computation, Finite state automata – description of finite automata, Properties of transition functions, Designing finite automata, NFA, , Equivalence of NFA and DFA, Conversion of NFA to DFA, Finite Automata with Epsilon Transitions, Equivalence and Conversion of NFA with and without Epsilon Transitions. Myhill-Nerode Theorem, Minimal State FA Computation. Finite State Machines with Output- designing Mealy and Moor machine, Two-Way Finite Automata.

Module – II

Regular grammars, Regular expressions- , converting DFA's to Regular Expressions, Converting Regular Expressions to DFA's, Converting Regular Expressions to Automata, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular sets and Regular grammars, Decision Algorithms for Regular Sets, Application of Finite Automata.

Module – III

Chomsky Classification of Languages, CFGs, Designing CFGs, Derivation trees, Ambiguity, Simplification of CFG, Normal forms of CFGs- Chomsky Normal Form, Greibach normal forms., Pumping Lemma for CFGs, Decision Algorithms for CFGs, Closure properties of CFLs (Proof not required),PDA – Formal definition, Examples of PDA, Non-Deterministic Pushdown Automata (NPDA), Equivalence with CFGs, PDA and CFG,Chomsky hierarchy.

Module – IV

Turing machines basics and formal definition, Language acceptability by TM, TMs as Transducers, examples of TM, variants of TMs – multitape TM, NDTM, Universal Turing Machine, offline TMs, Enumeration Machine (Equivalence not required), recursive and recursively enumerable languages, decidable and undecidable problems – examples, halting problem, reducibility.

References:-

1. Hopcroft J. E., R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages and Computation*, 2/e, Addison Wesley, 2001.
2. Krithivasan K. and R. Rama*, Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education, 2009.
3. Sipser M., *Introduction to the Theory of Computation*, 2/e, Cenagage Learning, 2005.
4. Manna Z., Mathematical Theory of Computation, McGraw Hill, 1974.
5. Linz P., *Introduction to Automata Theory and Formal Languages*, Narosa, 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as class room/home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question (question may contain sub-divisions), out of the two from each module. Each question carries 20 marks.

Note: *The question paper shall contain at least 50% analytical/problem solving questions.*

Course Outcome:

At the end of the course, Students will be able to:

- *Solve the problems using formal language and apply a number of proof techniques to theorems in language design.*
- *Develop a clear understanding of undecidability.*
- *Explain the basic concepts of deterministic and non-deterministic finite automata, regular language, context-free language, Turing machines, Church's thesis, halting problem, computability and complexity.*
- *Describe the formal relationships among machines, languages and grammars.*
- *Perceive the power and limitation of a computer, effectively and efficiently.*
- *Develop a view on the importance of computational theory.*

18.407 DATA STRUCTURES LAB (FR)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *Implementation of basic data structures Stack, Queue and DEQUEUE.*
- *To familiarize the use of basic data structures for solving real world problems.*
- *To implement algorithms for various sorting techniques.*
- *To familiarize operations and applications using linked list and binary trees.*

List of Exercises:

1. Implementation of Stack and Multiple stacks using one dimensional array.
2. Application problems using stacks: Infix to post fix conversion, String reversal.
3. Implementation of Queue, DEQUEUE and Circular queue using arrays.
4. Implementation of various linked list operations.
5. Implementation of stack, queue and their applications using linked list.
6. Representation of polynomials using linked list, addition of polynomials.
7. Implementation of binary tree operations- creations, insertion, deletion and traversal.
8. Implementation of sorting algorithms – bubble, insertion, selection, quick (recursive and non recursive), merge sort (recursive and non recursive), and heap sort.
9. Implementation of various string operations.
10. Sparse matrix representation transpose and addition.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record (Up-to-date lab work, problem solving capability, keeping track of rough record and fair record, term projects, assignment, software/hardware exercises, etc.)

20% - Regularity in the class.

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

Marks should be awarded as follows:

20% - Algorithm/Design

30% - Implementing / Conducting the work assigned

25% - Output/Results and inference

25% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

After successful completion of this course, students will be able to:

- *Choose appropriate data structure for a given problem*
- *Design algorithms to solve real world problems.*
- *Compare the performance of various searching and sorting algorithms.*

18.408 DIGITAL SYSTEM LAB (R)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To familiarize students with digital ICs, the building blocks of digital circuits*
- *To provide students the opportunity to set up different types of digital circuits and study their behaviour*

List of Exercises:

1. Familiarisation and verification of the truth tables of basic gates and universal gates.
2. Implementation of half adder and full adder circuits using logic gates.
3. Realization of 4 bit adder/subtractor and BCD adder circuits using IC 7483.
4. Implementation of a 2 bit magnitude comparator circuit using logic gates.
5. Design and implementation of code convertor circuits
   a) BCD to excess 3 code b) binary to gray code
6. Implementation of multiplexer and demultiplexer circuits using logic gates. Familiarization with various multiplexer and demultiplexer ICs.
7. Realization of combinational circuits using multiplexer/demultiplexer ICs.
8. Implementation of SR, D, JK, JK master slave and T flip flops using logic gates. Familiarization with IC 7474 and IC 7476.
9. Implementation of shift registers, ring counter and Johnson counter using flip flop Integrated Circuits.
10. Realization of synchronous and asynchronous counters using flip flop ICs. Familiarization with various counter Integrated Circuits.
11. Implementation of a BCD to 7 segment decoder and display.
12. Design and implementation of astable and monostable multivibrator circuits using IC 7400.
13. Simulation of Half adder, Full adder using VHDL.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record (Up-to-date lab work, problem solving capability, keeping track of rough record and fair record, term projects, assignment, software/hardware exercises, etc.)

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

Marks should be awarded as follows:

20% - Algorithm/Design

30% - Implementing / Conducting the work assigned

25% - Output/Results and inference

25% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

After successful completion of this course,

- *Students will be familiar with the digital ICs and their use in implementing digital circuits.*
- *Students will gain practical experience in the design and implementation of different kinds of digital circuits.*