Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Course Structure and Syllabus

of

Second Year Engineering

in

Computer Engineering

Prepared by:- Board of Studies in Computer Engineering

Recommended by:- Academic Council of D. J. Sanghvi College of Engineering

Approved by:- Governing Body of D. J. Sanghvi College of Engineering

Revision: 1 (2020)

With effect from the Academic Year: 2020-2021

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme for Second Year B.Tech. Program in Computer Engineering : Semester IV (Autonomous)
(Academic Year 2020-2021)

Semester IV

Sr	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)					Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration	Theory	Oral	Pract	Oral & Pract	End Sem Exam Total	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork / Term Work Total	CA Total			
1	DJ19CEC401	Engineering Mathematics-IV	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19CET401	Engineering Mathematics-IV Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
2	DJ19CEC402	Formal Language & Automata Theory	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19CET402	Formal Language & Automata Theory Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
3	DJ19CEC403	Operating System	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19CEL403	Operating System Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	25	25	50	1	
4	DJ19CEC404	Analysis of Algorithms	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19CEL404	Analysis of Algorithms Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	25	25	50	1	
5	DJ19CEC405	Computer Networks	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19CEL405	Computer Networks Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	25	25	50	1	
6	DJ19IHC1	Universal Human Values	2	--	--	2	3	75	--	--	--	75	25	25	25	--	25	100	2	3
	DJ19IHT1	Universal Human Values Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
7	DJ19A4	Innovative Product Development-II	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			17	**8**	**3**	**23**	**24**	**450**	**0**	**0**	**75**	**525**	**150**	**150**	**150**	**150**	**300**	**825**	**23**	**23**

Prepared by: **HoD**

Name and Signatures (with date) **Department of Computer Engineering** **Vice-Principal** **Principal**

Checked By

Name and Signatures (with date)

<table>
<tr><td colspan="8">Program: Second Year B.Tech. in Computer Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Engineering Mathematics-IV</td><td colspan="3">Course Code:DJ19CEC401</td></tr>
<tr><td colspan="8">Course : Engineering Mathematics-IV Tutorial</td><td colspan="3">Course Code:DJ19CET401</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">-</td><td rowspan="2">1</td><td rowspan="2">4</td><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">25</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td><td>25</td></tr>
<tr><td>-</td><td>--</td><td>--</td><td>-</td><td>25</td><td>25</td><td></td></tr>
</table>

Pre-requisite: Engineering Mathematics – I &Engineering Mathematics – II

Course Objectives:

The objective of this course is to introduce students to the concepts of Eigen values and Eigenvectors of Matrices, probability, test of hypothesis and correlation between data.

Outcomes: On completion of the course, learner will be able to:

1. Demonstrate ability to manipulate matrices and compute Eigen values and Eigen vectors. Use matrix algebra with its specific rules to solve the system of linear equation, using concept of Eigen value and Eigen vector to the engineering problems.
2. Apply the concept of probability distribution to the engineering problems
3. Draw conclusions on population based on large and small samples taken and hence use it to understand data science
4. Apply the concept of Optimization, Correlation and Regression to the engineering problems.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Matrices:** Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof), Similar matrices, diagonalizable of matrix. Functions of square matrix	8
2	**Probability:** Baye's Theorem, Random Variables:- discrete & continuous random variables, expectation, Variance, Probability Density Function & Cumulative Density Function. Moments, Moment Generating Function. Probability distribution: binomial distribution, Poisson & normal distribution. (For detail study)	9
3	**Sampling Theory and ANOVA** Sampling Distribution, Test of Hypothesis, Level of significance, Critical region, One Tailed and Two Tailed test, Interval Estimation of population parameters. Large and small sample Test of significant for Large Samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples Test of significant for small samples: Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test Chi square test:- Test of goodness of fit and independence of attributes, Contingency table. Association of attributes and Yate's correction Analysis of Variance(F-Test): One way classification, Two-way classification(short-cut method)	13
4	**Mathematical Programming** Types of solution, Standard and Canonical form of LPP, Basic and feasible solutions, simplex method. Artificial variables, Big –M method (method of penalty). Duality, Dual simplex method. Non Linear Programming:-Problems with equality constrains and inequality constrains (No formulation, No Graphical method)	12
5	**Correlation & regression, Curve Fitting (Flipped Classroom)** Scattered diagrams, Karl Pearson's coefficient of correlation, covariance, Spearman's Rank correlation(non-repeated and repeated ranks) Regression coefficient & Lines of Regression. Fitting of curves: Least square method. Fitting of the straight line $y=a+bx$,parabolic curve $y=a+bx+cx^2$,& exponential curve $y=ab^x$	--

Books Recommended:

Text books:

1. Higher Engineering Mathematics by Dr. B. S. Grewal 42th edition, Khanna Publication 2.
Advanced Engineering Mathematics –Fourth Edition , Dennis G Zill& Warren S Wright
3. Operation Research by Hira &Gupta, S Chand.
4. Probability and Statistics for Engineering, Dr. J Ravichandran, Wiley-India.

Reference Books:

1. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
2. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett. TMH International Edition.
3. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
4. Fundamentals Of Mathematical Statistics by S. C. Gupta, V. K. Kapoor, Sultan Chand & Sons -2003

5. Probability & Statistics with reliability by Kishor s. Trivedi, Wiley India
6. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett.TMH International Edition
7. Operations Research by S.D. Sharma KedarNath, Ram Nath& Co. Meerat.
8. Engineering optimization (Theory and Practice) by SingiresuS.Rao, New Age International publication

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus, summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Tutorial: (Term work)

Term work shall consist of minimum 8 Tutorials covering the entire modules.

The distribution of marks for term work shall be as follows:
Tutorial– 25 marks

The final certification and acceptance of term work will be subject to satisfactory performance of tutorial work and upon fulfilling minimum passing criteria in the term work.

List of Tutorials:

1. Matrices
2. Probability and Random variable
3. Probability Distribution
4. Sampling: Large Sample Test
5. Sampling: Small Sample Test
6. Sampling: Chi Square Test, ANOVA
7. LPP: Simplex Method, Big M Method
8. LPP: Duality and Dual Simplex Method
9. NLPP
10. Correlation
11. Regression and Curve Fitting

<table>
<tr><td colspan="8">Program: Second Year B.Tech. in Computer Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Formal language and Automata Theory</td><td colspan="3">Course Code: DJ19CEC402</td></tr>
<tr><td colspan="8">Course : Formal language and Automata Theory Tutorial</td><td colspan="3">Course Code: DJ19CET402</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">25</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">1</td><td rowspan="2">4</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>25</td><td>25</td></tr>
</table>

Objectives:

To provide a theoretical foundation for the process of computation and to impart an understanding of the notions of automata, formal languages and computability.

Outcomes: On completion of the course, learner will be able to:

- Understand basic concepts in automata theory and theory of computation.
- Identify different formal language classes and their relationships.
- Design grammars and recognizers for different formal languages.
- Prove or disprove theorems in automata theory using its properties.
- Determine the decidability and intractability of computational problems.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Fundamentals:** Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non deterministic finite automaton, transition diagrams and Language recognizers.	**05**
2	**Finite Automata:** NFA with ε transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without ε transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Mealy machines. **Applications: –** • For the designing of lexical analysis phase of a compiler.	**06**
3	**Regular Languages:** Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).	**03**
4	**Grammars:** Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, and sentential forms. Right most and leftmost derivation of strings. **Context Free Grammars:** Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted), Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar.	**12**
5	**Push Down Automata:** Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA. **Applications:** • For designing the parsing phase of a compiler (Syntax Analysis). • For evaluating the arithmetic expressions	**08**
6	**Turing Machine:** Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines, Universal Turing Machine, Halting Problem.	**08**

List of Tutorials/Experiments:

1. Finite state machine and NFA with and without epsilon.

2. NFA to DFA, DFA minimization (Myhill-Nerode theorem), Moore and Mealy machines
3. Regular expressions, Arden's theorem
4. Derivation, Parse tree, ambiguity, Right and left linear grammar
5. CNF and GNF
6. Push down automata
7. Pumping lemma: RL and CFL,CFG to PDA
8. Turing Machine
9. Implement any 1 application of finite automata
10. Implement any 1 application of push down automata

Books Recommended: *Text books:*

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, " Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. J.C.Martin, "Introduction to languages and the Theory of Computation", TMH. 3. Michael Sipser, "Theory of Computation",Cengage Learning.

Reference Books: 1. O.G.Kakde, "Theory of Computation", LP.
2. Krishnamurthy E.V., "Introductory Theory of Computer Science", East-West press.

Evaluation Scheme:

Semester End Examination (A):

Theory:

3. *Question paper based on the entire syllabus, summing up to 75 marks.*
4. *Total duration allotted for writing the paper is 3 hrs.*

Continuous Assessment (B):

Theory:

4. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
5. Total duration allotted for writing each of the paper is 1 hr.
6. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: Second Year B.Tech. in Computer Engineering</td><td colspan="4">Semester : IV</td></tr>
<tr><td colspan="8">Course : Operating System</td><td colspan="4">Course Code: DJ19CEC403</td></tr>
<tr><td colspan="8">Course : Operating System Laboratory</td><td colspan="4">Course Code: DJ19CEL403</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">50</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">4</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Assignment/ Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Course objectives:

1. To introduce basic concepts and functions of different operating systems.
2. To understand the concept of process, thread and resource management.
3. To understand the concepts of process synchronization and deadlock.
4. To understand various Memory, I/O and File management techniques.

Course outcomes: On successful completion of course learner will be able to:

1. Understand basic functions of Operating System
2. Apply and evaluate process scheduling algorithms and IPC
3. Analyze various memory management techniques
4. Understand and interpret File and I/O management techniques
5. Discover functionalities of different operating systems

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Operating System** Operating System Objectives and Functions, Evolution of operating system, OS Design Considerations for Multiprocessor architectures, Operating System structures, System Calls	04
2	**Process Management** **Process:** Concept of a Process, Process States, Process Description, Process Control Block, Operations on Processes. **Threads**: Definition and Types, Concept of Multithreading, Multi core processors and threads. **Scheduling:** Types of Scheduling: Preemptive and, Non-preemptive, Scheduling Algorithms and their performance evaluation: FCFS, SJF, SRTN, Priority based, Round Robin, Introduction to Thread Scheduling	07
3	**Process Synchronization and Deadlocks** **Concurrency**: Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization. **Mutual Exclusion**: Requirements, Hardware and Software Support, Semaphores and Mutex, Monitors, Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem. **Principles of Deadlock**: Conditions and Resource Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm for Single & Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem.	10
4	**Memory Management** Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Next Fit, Relocation, Paging, Segmentation. **Virtual Memory**: Demand Paging, Structure of Page Tables, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Thrashing.	08
5	**File System and I/O Management** **File Management**: Overview, File Organization and Access, Secondary Storage Management: File Allocation Methods **Input /Output Management** **I/O Management and Disk Scheduling**: I/O Devices, I/O Buffering, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK. RAID	08
6	**Case Studies** XV6 OS, Distributed OS, Real Time OS, Mobile OS	05

Books Recommended:

Text books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.

Reference Books: 1. Maurice J. Bach, "Design of UNIX Operating System", PHI
2. Achyut Godbole and Atul Kahate, Operating Systems, Mc Graw Hill Education, 3rd Edition
3. The Linux Kernel Book, Remy Card, Eric Dumas, Frank Mevel, Wiley Publications.

Suggested List of Experiments:

List of Operating System Laboratory Experiments (DJ19CEL403): (At Least Ten)

1. Explore the internal commands of linux and Write shell scripts to do the following: Display top 10 processes in descending order
   Display processes with highest memory usage.
   Display current logged in user and logname.
   Display current shell, home directory, operating system type, current path setting, current working directory.
   Display OS version, release number, kernel version. Illustrate
   the use of sort, grep, awk, etc.
2. System calls for file manipulation
3. Building multi-threaded and multi-process applications
4. CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
5. Process and Thread Synchronisation using client server mechanism
6. There is a service counter which has a limited waiting queue outside it. It works as follows:
   - The counter remains open till the waiting queue is not empty
   - If the queue is already full, the new customer simply leaves
   - If the queue becomes empty, the outlet doors will be closed (service personnel sleep)
   - Whenever a customer arrives at the closed outlet, he/she needs to wake the person at the counter with a wake-up call

   Implement the above-described problem using semaphores or mutuexes along with threads.
   Also show how it works, if there are 2 service personnel, and a single queue. Try to
   simulate all possible events that can take place, in the above scenario.
7. Implement order scheduling in supply chain using Banker's Algorithm 8. Using the CPU-OS simulator analyze and synthesize the following:
   a. Process Scheduling algorithms.
   b. Thread creation and synchronization.
   c. Deadlock prevention and avoidance.
9. Implement various page replacement policies
10. Implement disk scheduling algorithm FCFS, SSTF, SCAN, CSCAN etc.
11. Building a scheduler in XV6
12. Building own file system

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus, summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral & Practical examination will be based on the entire syllabus including, the practical's performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19CEL403** with minimum 10 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

<table>
<tr><td colspan="5">Program: Second Year B.Tech. in Computer Engineering</td><td colspan="6">Semester : IV</td></tr>
<tr><td colspan="5">Course : Analysis of Algorithms</td><td colspan="6">Course Code:DJ19CEC404</td></tr>
<tr><td colspan="5">Course : Analysis of Algorithms Laboratory</td><td colspan="6">Course Code:DJ19CEL404</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">2</td><td rowspan="3">--</td><td rowspan="3">4</td><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td colspan="2">10</td><td>25</td></tr>
</table>

Prerequisite: Computer Programming **(**C Programming)

Objectives:

1. To provide mathematical approach for Analysis of Algorithms
2. To solve problems using various strategies
3. To analyze strategies for solving problems

Outcomes: On completion of the course, learner will be able to:

1. Analyze time and space complexity of an algorithm.
2. Apply divide and conquer strategy to solve problems
3. Apply the concept of dynamic programming and Greedy method to solve problems
4. Understand the concepts of backtracking, and string-matching algorithms.
5. Apply the concept of linear programming to optimize the solution

Detailed Syllabus: (Unit wise)

Unit	Description	Duration
1	**Introduction to analysis of algorithms:** Introduction, Asymptotic notations (Big-Oh, small-oh, Big Omega, Theta notations). Analysis of Selection Sort, Insertion Sort, Recurrences: Recursion Tree Method, Substitution method, Master's theorem.	**08**
2	**Divide and Conquer :** Analysis of Quick sort, Merge sort, Min-Max algorithm, Finding Median, Efficient algorithms for Integer arithmetic (Euclid's algorithm, Karatsuba's algorithm for integer multiplication, fast exponentiation).	**08**
3	**Dynamic Programming:** General strategy, 0/1 knapsack, Multistage graph, Single Source Shortest Path, All Pair Shortest Path, Travelling salesman problem, Longest common subsequence problem.	**08**
4	**Greedy Approach** General strategy, Knapsack problem, Single Source shortest path, Minimum Spanning Tree (Prims and Kruskal Algorithm), Job Sequencing with deadline.	**05**
5	**Backtracking Strategy and Linear Programming:** **Backtracking Strategy: General** strategy, nqueen problem, graph coloring, sum of subset problem. **Linear Programming:** Introduction to linear programming, geometric interpretation, LP duality, Simplex algorithm, Linear optimization problems and their LP formulation.	**09**
6	**String Matching Algorithms:** The naïve string matching Algorithms ,The Rabin Karp algorithm, String matching with finite automata, The Knuth Morris Pratt algorithm.	**04**

List of Laboratory Experiments: (At Least 08)

Minimum 2 experiments should be implemented using any language on each algorithm design strategy (Divide and conquer, dynamic programming, Greedy method, backtracking and string matching).

Suggested Laboratory Experiments:

Sr. No.	Module Name	Suggested Experiment List
1	Introduction to analysis of algorithm Divide and Conquer Approach	Selection sort, insertion sort. Merge sort, Quick sort, and Binary search.
2	Dynamic Programming Approach	Multistage graphs, single source shortest path, all pair shortest path, 0/1 knapsack, Travelling salesman problem, Longest common subsequence.
3	Greedy Approach	Single source shortest path, Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees-Kruskal and prim's algorithm, Optimal storage on tapes.
4	Backtracking and String Matching Algorithms	8 queen problem (N-queen problem), Sum of subsets, Graph coloring, Any String matching algorithm

Books Recommended:

Text Books:

1. T.H.Coreman , C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd edition , PHI publication 2005.
2. Ellis horowitz , Sartaj Sahni , S. Rajsekaran. "Fundamentals of computer algorithms" University Press

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.
3. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson.
4. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral& Practical examination will be based on the entire syllabus including, the practical's performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19CEL404** with minimum 08 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

<table>
<tr><td colspan="8">Program: Second Year B.Tech. in Computer Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Computer Networks</td><td colspan="3">Course Code: DJ19CEC405</td></tr>
<tr><td colspan="8">Course : Computer Networks Laboratory</td><td colspan="3">Course Code: DJ19CEL405</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="11">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="5">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="3">Theory</td><td colspan="2">Term Test 1</td><td colspan="2">Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">4</td><td colspan="3">Laboratory Examination</td><td colspan="4">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">50</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td colspan="2">Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>-</td><td>25</td><td colspan="2">15</td><td colspan="2">10</td><td>25</td></tr>
</table>

Objectives:

To get familiar with contemporary issues and challenges of various protocol designing in layered architecture and performance analysis of routing and transport layer protocols for various applications.

Outcomes: On completion of the course, learner will be able to:

1. Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model & TCP/IP model.
2. Demonstrate the working of networking protocols at data link layer.
3. Design of network using given IP addressing and subnetting / supernetting schemes.
4. Compare and analyze the performance of various routing protocols.
5. Compare and analyze the transport layer protocols and various congestion control algorithms.
6. Explore various protocols at application layer.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Networking:** Introduction to computer network, network application, network software and hardware components, Network topology, design issues for the layers. **Reference models:** Layer details of OSI, TCP/IP models.	**04**
2	**Physical Layer:** Introduction to Digital Communication System: Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth.	**06**
3	**Data Link Layer:** Design Issues: Framing, Error Control: Error Detection and Correction (Hamming Code, CRC, Checksum), Flow Control: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), Elementary Data Link protocols, HDLC,PPP. **Medium Access Control Sublayer:** Channel Allocation problem, Multiple Access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CA, CSMA/CD), Wired LANS: Ethernet, Ethernet Standards, Virtual LANs.	**10**
4	**Network Layer:** Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (Classfull and Classless), Subnetting, Supernetting design problems ,IPv4 Protocol, Network Address Translation (NAT) Routing algorithms : Shortest Path (Dijkastra's), Link state routing, Distance Vector Routing Protocols - ARP,RARP, ICMP, IGMP Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms.	**10**
5	**Transport Layer** The Transport Service: Port Addressing, Transport service primitives, Berkeley Sockets, Connection management (Handshake, Teardown), UDP, TCP, TCP state transition, TCP timers TCP Flow control (sliding Window), TCP Congestion Control: Slow Start .	**06**
6	**Application Layer** DNS: Name Space, Resource Record and Types of Name Server. HTTP, HTTPS, SMTP, Telnet, FTP, DHCP.	**06**

List of Laboratory Experiments: (At Least Ten)

1. A Study of LAN topology.
   B. Study of various Network devices.
2. Installation & Configuration of Network Simulator (NS2) in Linux environment. -Study of different topologies and create duplex link in NS2.
3. Building of wired & wireless topology using NS2.
4. Write a program to implement A) Error Detection and Correction
   B. Framing
5. Implement Stop and Wait protocol in NS2.
6. Write a program to implement Sliding Window Protocols- Selective Repeat, Go Back N.
7. Build Class A & Class B Network using router and Implement subnetting concept.
8. Write a program to implement any one Routing Protocol.
9. Write a program to find out class of a given IP address, subnet mask & first & last IP address of that block.
10. Write a program to implement Congestion Control algorithms.

11. Write a program to build client-server model on different computers. Implement TCP-UDP scenario in NS2/NS3.
12. Install and configure Network Management/ Monitoring Tools.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Andrew S. Tanenbaum, David J. Wetherall, - Computer Networks, Pearson Education, (5e)
2. Behrouz A. Forouzan, -Data Communications and Networking‖, TMH (5e)
3. Oliver C Ibe - Fundamentals of Data Communication Networks, Wiley Publications (1e).
4. James F. Kurose, Keith W. Ross, -Computer Networking, A Top-Down Approach Featuring the Internet‖, Pearson Education, (6e). *Reference Books:*

1. S.Keshav,- An Engineering Approach To Computer Networking, Pearson Education, (3e)
2. Natalia Olifer& Victor Olifer,- Computer Networks: Principles, Technologies & Protocols for Network Design, Wiley India, 2011.
3. Larry L.Peterson, Bruce S. Davie,- Computer Networks: A Systems Approach, Second Edition (The Morgan Kaufmann Series in Networking).

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

2. Oral& Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19CEL405** with minimum 10 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

iii. Laboratory work (Performance of Experiments): 15 Marks

iv. Journal documentation (Write-up and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

<table>
<tr><td colspan="6">Program: Common for all programs</td><td colspan="6">Semester: IV</td></tr>
<tr><td colspan="6">Course: Universal Human Values</td><td colspan="6">Course Code: DJ19IHC1</td></tr>
<tr><td colspan="6">Course: Universal Human Values Tutorial</td><td colspan="6">Course Code: DJ19IHT1</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3"></td><td rowspan="3">125</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">1</td><td rowspan="2">3</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td colspan="3">Total Term work (C)</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td colspan="3">25</td></tr>
</table>

Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Outcomes: On completion of the course, learner will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.
2. Become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).
3. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Unit	Description	Duration in Hrs
1	**Introduction**: **Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	**05**
2	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I am being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.	**06**
3	**Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship**. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**06**
4	**Understanding Harmony in the Nature and Existence: Whole existence as Coexistence** Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	**05**
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**: Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers, b. At the level of society: as mutually enriching institutions and organizations.	**06**

Books Recommended: ***Textbooks:***

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Evaluation:

Semester End Examination (A):

Theory:

1) Question paper will be based on the entire syllabus summing up to 75 marks.
2) Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1) Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2) Total duration allotted for writing each of the paper is 1 hr.
3) Average of the marks scored in both the two tests will be considered for final grading.

Continuous Assessment (C):

Tutorials: (Term work)

1. Term work shall consist of minimum 4activities based on activities suggested.
2. Term work shall carry total 25 marks based on the performance in the tutorials.

The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and coexistence) rather than as arbitrariness in choice based on liking-disliking.

Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.
Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

The final certification and acceptance of term work will be subject to satisfactory performance of activities and upon fulfilling minimum passing criteria in the term work.

<table>
<tr><td colspan="8">Program: Common For all Programs</td><td colspan="3">Semester : III & IV Combined</td></tr>
<tr><td colspan="8">Course : Innovative Product Development-II</td><td colspan="3">Course Code: DJ19A4</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours/week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Semester review</td><td rowspan="2">Total</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">--</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Review 1</td><td>Review 2</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>50</td><td>50</td><td>100</td></tr>
</table>

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualise and create a successful product. **Outcome:**

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of theteam or as theleader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).

- Students should carry out a survey and identify the need, which shall be converted into conceptualisation of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution tothe team activity, their understanding and involvement as well as responses to the questionsbeing raised at all points in time.
- Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
    - Marks awarded by the supervisor based on log-book : 20
    - Marks awarded by review committee : 20
    - Quality of the write-up : 10

In the last review of the semester IV, the marks will be awarded as follows.

- Marks awarded by the supervisor (Considering technical paper writing) : 30
- Marks awarded by the review committee : 20

Note- A Candidate needs to secure a minimum of 50% marks to be declared to have completed the audit course.

Review/progress monitoring committee may consider the following points during the assessment.

- In the semester III, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.
    - ✦ First shall be for finalisation of the product selected.
    - ✦ Second shall be on finalisation of the proposed design of the product.

- In the semester IV, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.
    - ✦ First review is based on readiness of building the working prototype.
    - ✦ Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

- The semester reviews (III and IV) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester IV.