<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="4">Semester : V</td></tr>
<tr><td colspan="8">Course : Data Mining and Warehouse</td><td colspan="4">Course Code:DJ19CEC501</td></tr>
<tr><td colspan="8">Course : Data Mining and Warehouse Laboratory</td><td colspan="4">Course Code: DJ19CEL501</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
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Pre-requisite: Basic database concepts, Concepts of algorithm design and analysis

Course Objectives:

1. To identify the scope and essentiality of Data Mining and Warehouse.
2. To analyze data, choose relevant models and algorithms for respective applications.
3. To develop research interest towards advances in data mining.

Outcomes: On successful completion of course learner will be able to:

1. Understand Data Warehouse fundamentals and data mining principles.
2. Design data warehouse with dimensional modelling
3. Understand ETL process and apply OLAP operations.
4. Apply appropriate pre-processing techniques.
5. Identify appropriate data mining algorithms to solve real world problems.
6. Compare and evaluate different data mining techniques like classification, clustering and association rule mining

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Data Warehouse and Dimensional modelling:** Introduction to Strategic Information, Need for Strategic Information, Features of Data Warehouse, Data warehouse versus Data Marts, Data warehouse versus Data Lake, Top-down versus Bottom-up approach. Data warehouse architecture, metadata, E-R modelling versus Dimensional Modelling, Information Package Diagram, STAR schema, STAR schema keys, Snowflake Schema, Fact Constellation Schema, Factless Fact tables, Update to the dimension tables, Aggregate fact tables.	8
2	**ETL Process and OLAP:** Major steps in ETL process, Data extraction: Techniques, Data transformation: Basic tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Analysis, Hypercubes, OLAP operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models: MOLAP, ROLAP.	6
3	**Introduction to Data Mining, Data Exploration and Preprocessing:** Data Mining Task and Techniques, KDD process, Issues in Data Mining, Applications of Data Mining Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization, Measuring data similarity and dissimilarity. Data Preprocessing: Major tasks in preprocessing, Data Cleaning: Missing values, Noisy data; Data Integration: Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Data Transformation by Normalization, Discretization by Binning, Discretization by Histogram Analysis, Concept hierarchy generation for Nominal data	6
4	**Classification and Prediction:** Basic Concepts of classification, Decision Tree Induction, Attribute Selection Measures using Information Gain, Tree pruning Bayes Classification Methods: Bayes' Theorem, Naïve Bayesian Classification Rule - Based Classification: Using IFTHEN Rules for classification, Rule Extraction from a Decision Tree, Rule Quality Measures, Rule Pruning Model Evaluation & Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves Improving Classification Accuracy: Ensemble classification, Bagging, Boosting and AdaBoost, Random Forests, Improving Classification Accuracy in Class Imbalance Data Prediction: Simple Linear regression	6
5	**Clustering:** Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive Density Based Methods: DBScan Evaluation of Clustering: Assessing Clustering Tendency, Determining Number of Clusters and Measuring cluster quality: Intrinsic and Extrinsic methods	5
6	**Mining Frequent Patterns and Association Rules:**	6

	Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule Frequent Item set Mining Methods: Apriori Algorithm, Association Rule Generation, Improving the Efficiency of Apriori. FP growth, Mining frequent Itemsets using Vertical Data Format Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules	
7	**Spatial and Web Mining:** Spatial Data, Spatial Vs. Classical Data Mining, Spatial Data Structures, Mining Spatial Association and Co-location Patterns, Spatial Clustering Techniques: CLARANS Extension, Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining, Applications of Web Mining	5

Books Recommended:

1. ***Paulraj Ponniah, —Data Warehousing: Fundamentals for IT Professionals‖, Wiley India.***
2. ***Reema Theraja —Data warehousing‖, Oxford University Press.***
3. ***Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd edition.***
4. ***M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.***

Suggested List of Experiments:

Sr. No.	Title of Experiments
1.	Build Data Warehouse/Data Mart for a given problem statement i. Identifying the source tables and populating sample data ii. Making information package diagram iii. Design dimensional data model i.e. Star schema, Snowflake schema and Fact Constellation schema (if applicable)
2.	Perform data Pre-processing task on your dataset
3.	To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot
4.	Implementation of Classification algorithm i. Using Decision Tree ID3 ii. Naïve Bayes algorithm
5.	Implementation of Clustering algorithm i. K-means ii. Hierarchical clustering (single/complete/average) iii. DBScan
6.	Implementation of Association Rule Mining algorithm 1. Apriori algorithm

	2. FP Tree algorithm
7.	Demonstrate performing Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA, R tool, XL Miner, etc.)
8.	Case study on recent data mining applications

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 **DJ19CEL501** with experiments to be performed in Python / R programming languages.

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.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="5">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="5">Semester : V</td></tr>
<tr><td colspan="5">Course : Processor Architecture</td><td colspan="5">Course Code: DJ19CEC502</td></tr>
<tr><td colspan="5">Course : Processor Architecture Laboratory</td><td colspan="5">Course Code: DJ19CEL502</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: Digital Electronics, Operating systems

Course Objectives:

1. To have a thorough understanding of the basic structure and operations of a computer system.
2. To study the hierarchical memory system including cache memories and virtual memory.
3. To prepare students for higher processor architectures and embedded systems.
4. To apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

Outcomes: On successful completion of course learner will be able to:

1. Understand the arithmetic and logic algorithms for processors.
2. Understand the concepts of memory organization and mapping techniques.
3. Explain, Interpret and implement the instructions and addressing modes of 8086 microprocessor and write assembly and mixed language programs.
4. Understand the architecture and concepts of an 8051 microcontroller.
5. Understand advanced trends and technologies in processor architectures.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Computer Architecture & Organization:** Introduction, Basic organization of computer architecture; Von Neumann model and Harvard architecture; Data Representation and Arithmetic Algorithms- Addition, Subtraction, Multiplication - unsigned multiplication, Booth's algorithm (Signed multiplication), Division of integers - restoring division, non-restoring division.	**6**
2	**Memory organization:** Types of RAM (SRAM, DRAM, SDRAM, DDR, SSD) and ROM; Characteristics of memory; Memory hierarchy- cost and performance measurement; Virtual Memory: Concept, Segmentation and Paging; Address translation mechanism; Interleaved and Associative memory; Cache memory Concepts, Cache Coherency	**8**
3	**Intel 8086 architecture and addressing modes:** Major features of 8086 processor; 8086 CPU architecture and pipelined operations; programmer's model and 8086 pin description; 8086 addressing modes.	**6**
4	**8086 Instruction set, Interrupts and Programming:** Instruction set of 8086 microprocessor; assembler directives; procedure and macros; Interrupts in 8086 microprocessor: Dedicated interrupts, Software interrupts, DOS interrupts (Programming examples); Assembly language programming for 8086 microprocessor; mixed mode programming for 8086.	**10**
5	**8051 microcontroller:** Architecture of 8051 microcontroller; Addressing modes for 8051; Instruction set for 8051 microcontroller: Data transfer, Arithmetic and logical; Interrupts in 8051 microcontroller.	**6**
6	**Intel Pentium Processor:** Features of Intel Pentium processor, Pentium Superscalar architecture, Pipelining, Branch prediction, Instruction and data cache concept.	**6**

Books Recommended:

1. *William Stallings- "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10th Edition, 2013.*
2. *John P. Hayes- "Computer Architecture and Organization", McGraw-Hill, 1988.*
3. *John Uffenbeck – "8086/8088 family: Design Programming and Interfacing", PHI.*
4. *Douglas Hall- "Microprocessor and Interfacing", Tata McGraw Hill.*
5. *M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay- "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Pearson Education, 2ndEdition.*
6. *Kenneth J. Ayala- "The 8051 Microcontroller", Cengage Learning India Pvt. Ltd, 3rdEdition*
7. *James L. Antonakos- "The Intel Microprocessor family: Hardware and Software principles and Applications", Cengage Learning.*

Suggested List of Experiments:

Sr. No.	Title of Experiments
1.	To implement shift and add method of multiplication algorithm.
2.	To implement Booth's multiplication algorithm.
3.	To study and implement Restoring division algorithm.
4.	To study and implement Non- Restoring Division algorithm.
5.	To implement First Fit Memory allocation policy.
6.	To implement Best Fit Memory allocation policy.
7.	To study and implement FIFO page replacement policy
8.	To study and implement LRU page replacement policy
9.	Assembly program for 16-bit addition
10.	Assembly Program to transfer n block of data from one segment to another segment.
11.	Assembly program to sort numbers in ascending/ descending order
12.	Assembly program to find minimum/ maximum no. from a given array.
13.	Assembly language program using Macros.
14.	To implement mixed language programming using Assembly Language and C.

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 **DJ19CEL502** 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.

Prepared by Checked by Head of the Department Principal

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<tr><td colspan="8">Course : Artificial Intelligence</td><td colspan="3">Course Code: DJ19CEC503</td></tr>
<tr><td colspan="8">Course : Artificial Intelligence Laboratory</td><td colspan="3">Course Code: DJ19CEL503</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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Pre-requisite: Knowledge of

1. Basic Mathematics

2. Algorithms

Objectives:

1. Provide the basic ideas and techniques underlying the design of intelligent systems.
2. Impart the knowledge of various search techniques for problem solving.
3. Learn knowledge representation and provide the knowledge to deal with uncertain and incomplete information.
4. Impart the knowledge of planning and forms of learning.
5. Learn to apply techniques of Artificial Intelligence to different applications

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

1. Develop a basic understanding of AI building blocks presented in intelligent agents.
2. Design appropriate problem solving method for an agent to find a sequence of actions to reach goal state.
3. Analyse various AI approaches to knowledge– intensive problem solving, reasoning and planning.
4. Design models for reasoning with uncertainty as well as different types of learning.
5. Design and develop the AI applications in real world scenario.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Artificial Intelligence :** Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Current trends in AI **Intelligent Agents :** Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent.	05
2	**Problem solving :** Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems. **Search Methods:** Uninformed search, Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. **Local Search Algorithms and Optimization Problems:** Hill climbing search, Simulated annealing, Local beam search, Genetic algorithms, Ant Colony Optimization **Adversarial Search:** Games, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning.	12

3	**Knowledge and Reasoning :** Knowledge based Agents, The Wumpus World, Propositional Logic, First Order Logic, Inference in FOL, Forward chaining, Backward chaining,Knowledge Engineering in First-Order Logic, Unification, Resolution,logic programming (PROLOG), Knowledge Representation: Ontological Engineering, Semantic networks, Description logics, RDF, OWL, Semantic Web. **Uncertain Knowledge and Reasoning:** Uncertainty, Representing knowledge in an uncertain domain, The semantics of Bayesian belief network, Inference in belief network. Rule-based methods for uncertain reasoning, Dempster-Shafer theory, Fuzzy sets and fuzzy logic.	10
4	**Planning** : The planning problem, Planning with state space search, Planning graphs, Partial order planning, Hierarchical planning, Planning and Acting in Nondeterministic Domain : Sensorless planning, Contingent planning, Online replanning, Multiagent planning.	05
5	**Learning**: Types of Learning, Inductive Learning **Artificial Neural Networks:** McCulloh Pitts Model, Perceptron, Feed Forward Network, Backpropagation Algorithm, Self Organizing Map.	06
6	**Expert System:** Introduction, Phases in building Expert Systems, ES Architecture **Applications :** Natural Language Processing, Robotics, Character Recognition, Genetic Algorithm in game playing, Travelling Salesman Problem, Best path finding, Recommender Systems, Prediction Systems, Atari Games, Face Recognition	04

List of Laboratory Experiments:

1. Select a problem statement relevant to AI .
   i)Identify the problem
   ii)PEAS Description
   iii)Problem formulation
2. Program to implement Family Tree in Prolog
3. Identify and analyze uninformed search Algorithm to solve the problem.
   Implement BFS/DFS/DFID search algorithms to reach goal state.
4. Identify and analyze informed search Algorithm to solve the problem.
   Implement A* search algorithm to reach goal state.
5. Program to implement Local Search algorithm : Hill climbing search
6. Program on Genetic Algorithm to solve a optimization problem in AI.
7. Identify,analyze, implement a planning problem/Rule based Expert System in a real world scenario.
8. Implementation on any AI Problem : Wumpus world, Tic-tac-toe, 8-Queens Problem
9. Program to implement learning : Perceptron Learning/Backpropagation Algorithm.
10. Case study of an AI Application.

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

Books Recommended:

Text Books

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach “Second Edition" Pearson Education.
2. Saroj Kaushik “Artificial Intelligence”, Cengage Learning.
3. George F Luger “Artificial Intelligence” Low Price Edition, Pearson Education., Fourth edition.
4. Deepak Khemani.” A First Course in Artificial Intelligence”, McGraw Hill Education (India), 2013.

Reference Books

1. Ivan Bratko “PROLOG Programming for Artificial Intelligence”, Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight “Artificial Intelligence” Third Edition
3. Davis E.Goldberg , “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. Hagan, Demuth, Beale, “Neural Network Design” CENGAGE Learning, India Edition.
5. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley, Third Edition.
6. Han Kamber, “Data Mining Concepts and Techniques”, Morgann Kaufmann Publishers.
7. N.P.Padhy , “Artificial Intelligence and Intelligent Systems”, Oxford University Press.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral 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 **DJ19CEL503** with minimum 10 experiments.

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

1. Laboratory work (Performance of Experiments): 15 Marks
2. 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.

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<tr><td colspan="8">Course : Professional and Business Communication Laboratory</td><td colspan="2">Course Code: DJ19CEL504</td></tr>
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*2 hrs. Theory (Class wise) and 2 hrs. Tutorial (Batch wise)

Pre-requisite:

Basic course in Effective Communication Skills

Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance communication and interpersonal skills
3. To develop effective presentation skills
4. To hone written skills for technical documentation

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

1. Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication
2. Apply techniques of writing resume, participating in a group discussion and facing interviews
3. Develop interpersonal skills in professional and personal situations
4. Understand the documentation process of meetings and conduct meetings in a professional manner
5. Understand communication across cultures and work ethics
6. Design and deliver effective presentations using Power Point

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
	Unit 1:Technical Writing	
	Report Writing : Types of report, parts of formal report, collection of data and survey analysis, pre-writing of report, language and style in reports, formatting of reports, referencing in report **Proposal Writing :**Types of technical proposals, format of proposal, language and style, presentation of proposal **Technical Paper Writing:** parts of a technical paper, language and formatting, referencing in IEEE format **Plagiarism :** Types of plagiarism, consequences of plagiarism	**08**
	Unit 2: Employment Skills	
	Group Discussion: Purpose of a GD, types of GD, criteria for evaluating a GD, Dos and Don'ts of a GD, Tips to be successful in GD **Cover Letter & Resume Writing:** Format and content of cover letter, types of resume, structure, content and formatting of resume **Interview Skills:** Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview	**06**
	Unit 3 : Introduction to Interpersonal Skills	
	Emotional Intelligence: Definition, difference between IQ and EQ, how to develop EQ **Leadership:** Types of leadership, leadership styles, case studies **Team Building:** Difference between group and team, importance of team work, strategies to be a good team player **Time Management:** Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals, **Conflict Management:** Types of conflicts, strategies to manage conflict, case studies	**05**
	Unit 4: Meetings and Documentation	
	Planning and preparation for meetings, strategies for conducting effective meetings, notice, agenda and minutes of a meeting, business meeting etiquettes	**02**
	Unit 5: Cross-cultural communication and Ethics	
	Communication across cultures, professional and work ethics, responsible use of social media, introduction to Intellectual Property Rights	**03**
	Unit 6 :Presentation Skills	
	Presentation strategies, overcoming stage fear, techniques to prepare effective PowerPoint presentation	**02**

List of Assignments

3. Business Proposal (PowerPoint presentation)
4. Resume writing
5. Interpersonal Skills (documentation of activity)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)

7. Business ethics
8. Presentation Skills

Books Recommended:

Reference Books

1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, *"Personal Development for Life and Work",* Thomson Learning, 12th edition
5. Heta Murphy, *"Effective Business Communication",* Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing",* Tata McGraw-Hill Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development",* Tata McGraw Hill. Lehman,
8. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
9. Dr. Alex, K., "Soft Skills", S Chand and Company
10. Subramaniam, R., "Professional Ethics" Oxford University Press.

Evaluation Scheme:

Laboratory: (Term work)

Term work shall consist of 6 assignments, Group Discussion and Power Point Presentation based on the written report

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

Assignments …… (25) Marks

Project Report and Presentation…… (15) Marks

Group Discussion…….. (10) Marks

TOTAL: …….. (50) 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.

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<tr><td colspan="8">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="3">Semester : V</td></tr>
<tr><td colspan="8">Course : Advanced Operating System</td><td colspan="3">Course Code: DJ19CEEC5011</td></tr>
<tr><td colspan="8">Course : Advanced Operating System Laboratory</td><td colspan="3">Course Code: DJ19CEEL5011</td></tr>
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<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>
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<tr><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>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Operating System and Computer Organization.

Course Objectives:

1. To understand the difference between distributed, multiprocessor and virtualization concepts.
2. To explore Real time operating system concepts.
3. To explore mobile operating system.

Outcomes: On successful completion of course learner will be able to:

1. Analyze the difference between different types of operating systems.
2. Describe real time operating systems.
3. Apply correct distributed and multiprocessor operating system concepts to solve real life problems.
4. Improve system performance by applying virtualization concepts.
5. Understand mobile operating system.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction** Functions of operating systems, design approaches: layered, kernel based and virtual machine approach, need for advanced operating systems, types of advanced operating systems (NOS, DOS, Multiprocessor OS, Mobile OS, RTOS, Cloud OS)	4
2	**Distributed operating Systems:** Architecture of distributed operating systems, system architecture types, issues in distributed operating systems, inherent limitation of distribute systems. Distributed mutual exclusion: classification of mutual exclusion algorithms, Lamport's, token-based algorithm, Suzuki-Kasami's Broadcast algorithm, Raymond's Tree based algorithm Distributed deadlock detection, Distributed file systems, Distributed shared memory, Distributed scheduling	10
3	**Real Time Operating Systems:** Basic Model of Real time systems, Characteristics, Applications of Real time systems, Real time task scheduling, Types of tasks and their characteristics. Task Scheduling, Clock driven Scheduling, Hybrid Schedulers, Event driven Scheduling, EDF Scheduling, Rate Monotonic Algorithm, handling resource sharing Resource Handling: Resource Sharing, Priority Inversion, PIP, PCP, HLP, Scheduling real time tasks in distributed systems	10
4	**Multiprocessor Operating Systems:** Introduction, Basic multiprocessor system architectures, design issues, Threads Process synchronization: the test and set instruction, the swap instruction, implementation of the process wait. Processor scheduling: Issues, Co-scheduling, Smart scheduling, Affinity Based scheduling	6
5	**Virtualisation:** Introduction to Virtualisation, Types of Virtualisation, Bare Metal (XEN), Hosted (KVM) Virtualisation, Para virtualisation, Full virtualisation, Emulation, Server Virtualisation, Network Virtualisation and Storage Virtualisation.	6
6	**Mobile Operating System:** Symbian O.S: introduction, kernel design in Symbian OS, scheduling in Symbian OS, File systems on mobile phones, I/O in Symbian OS, Application development using Android.	6

Books Recommended:

1. Mukesh Singhal, Niranjan Shivaratri―Advance Concepts in Operating System, Mc Graw Hill.
2. K. C. Wang – embedded and Real Time Operating System, Springer.
3. Cris Wolf and Eric M Halter – Virtualization from Desktop to Enterprise, Apress.
4. Ben Morris – The Symbian OS Architecture Source Book, Willey India.
5. Sunita Mahajan and Seema Shah, Distributed System, Oxford.

Suggested List of Experiments:

LAB	Topic / Activity	Explanation of Activity
Lab1	Distributed Programming	Implement concurrent client-server application.
Lab2	Logical Clock	Simulate Lamport's logical clock
Lab3	Distributed Mutual Exclusion	Implement Ricart-Aggarwala Algorithm.
Lab4	Distributed Deadlock	Demonstrate deadlock detection using Edge Chasing algorithm.
Lab5	Hosted Virtualization	Demonstrate hosted virtualization using KVM.
Lab6	Bare Metal Virtualization	Load a new operating system virtually on the client machine using the concept of bare metal virtualization by XEN.
Lab7	Android Programming Basics	Hello world, linking activities, passing data.
Lab8	Handing image and text using Android Programming	ICreate a simple list view with image and text.
Lab9	Building an Application using Android	Integrate a website inside an application, use of SQLite.
Lab10	Case study	Symbian OS

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 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 **DJ19CEEL5011** 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.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="4">Semester : V</td></tr>
<tr><td colspan="8">Course : Advanced Database Management System</td><td colspan="4">Course Code: DJ19CEEC5012</td></tr>
<tr><td colspan="8">Course : Advanced Database Management System Laboratory</td><td colspan="4">Course Code: DJ19CEEL5012</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
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</table>

Prerequisite: Basic knowledge of Database management System.

Objectives:

1. To provide overview of advancement in SQL and Database technology.
2. To impart knowledge of query processing and optimization.
3. To provide an overview of distributed database systems.
4. To introduce the concept of document-oriented database.
5. To create awareness about potential security threats to a database and mechanisms to handle it.
6. Understand the usage of advanced data models for real life application.

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

1. Discuss new developments in database technology.
2. Measure query cost and optimize query execution.
3. Design distributed database for better resource management.
4. Demonstrate the understanding of the concepts of document-oriented databases.
5. Apply appropriate security techniques database systems.
6. Implement advanced data models for real life applications.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Advance Databases** Indexing and Hashing:Types of Single-Level Ordered Indexes; Multilevel Indexes; Dynamic Multilevel Indexes Using B-Trees and B+-Trees; New database applications and architectures: e.g., Data Warehousing; Multimedia database; Mobility database; NoSQL, Native XML databases (NXD), Document orientated databases, Graph database, Federated Databases	**06**
2	**Query processing and Optimization** Query Processing: Overview, Measures of Query cost, Selection operation, Sorting, Join Operations, and other Operations, Evaluation of Expression Query Optimization: Translations of SQL Queries into relational algebra, Heuristic approach and cost-based optimization	**08**
3	**Distributed Databases** Introduction: Types of Distributed Database Systems, Distributed Database Architectures Distributed Database Design: Data Fragmentation, Replication and Allocation Techniques Distributed Query Processing (Semi join) Transaction Management, Concurrency Control (locking) and Recovery in Distributed Databases	**08**
4	**Document oriented database** Object Oriented Database: Need of object-oriented database, Impedance matching problem between OO languages and Relational database, Case study db4O Document Oriented Database: Need of Document Oriented database, difference between Document Oriented Database and Traditional database, Types of encoding XML, JSON, BSON, Representation XML, Json Objects. Case study on doc oriented based such a Mariadb	**08**
5	**Advanced data models** Temporal data models: Aspects of valid time, Bitemporal time and bi-temporal time with examples of each. Spatial model: Types of spatial data models - Raster, Vector and Image MYSQL Postgres, Mobile databases	**06**
6	**Data Security** Introduction to Database Security Issues; Authentication and authorization, Database auditing, Discretionary Access Control Based on Granting and Revoking Privileges, Mandatory Access Control and Role-Based Access Control for Multilevel Security Introduction to Statistical Database Security	**06**

Books Recommended:

Text books:

1. Elmasri&Navathe, "Fundamentals of Database Systems" IV edition. PEARSON Education.
2. Korth, Silberschatzsudarshan, "Database systems, concepts" 5th edition McGraw Hill
3. Raghu Ramkrishnan& Johannes Gehrke, "Database Management System" Tata McGraw Hill. III edition.
4. Ruosell J.T. Dyer, Learning MySQL and Mariadb.

Reference Books:

1. Chhanda Ray, "Distributed Database System", Pearson Education India.
2. Hector Garcia-Molina, Jeffery D. Ullman, Jennifer Widom, "Database system Implementation"
3. Thomas M.Connolly Carolyn Begg, Database Systems: A practical Approach to Design, Implementation and Management, 4/e.

Suggested List of Experiments:

LAB	Topic / Activity	Explanation of Activity
Lab1	SQL Programming	Case study on Professional and Commercial Databases: Summary and Comparison
Lab2	Query Optimization	Simulate Query optimization by applying an SQL Query on any database.
Lab3	Query Monitoring	Implementation of Query monitor (QEP- Query Execution Plan, Query Statistics)
Lab4	Distributed Database Design	Perform Fragmentation (Range, List, Hash and Key) in DDBS design.
Lab5	Distributed Database Design	Implementation of Replication transparency in DDB
Lab6	Distributed Database Design	Implementations of two phase / three phases commit protocol.
Lab7	XML Programming	Query execution on XML database.
Lab8	Document Database	Data handing using JSON. (eg. Display user information from JSON file downloaded from Mobile)
Lab9	Spatial and Temporal Data Handling	Processing of Spatial and temporal data
Lab10	Case study	Case study on Database security issues and measures taken to handle those issues.

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 the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19CEEL5012** 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.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="5">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="5">Semester : V</td></tr>
<tr><td colspan="5">Course : Network Engineering</td><td colspan="5">Course Code: DJ19CEEC5013</td></tr>
<tr><td colspan="5">Course : Network Engineering Laboratory</td><td colspan="5">Course Code: DJ19CEEL5013</td></tr>
<tr><td colspan="4" rowspan="2">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="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>
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</table>

Pre-requisite: Computer Networking.

Objectives: Students will try to:

1. Study the Design and Analysis of Advance Computer network.
2. Acquire knowledge of design and analysis of networking paradigms and protocols.
3. Gain advance knowledge of Network layer routing protocols and IP addressing.
4. Study complex network concepts and design issues.
5. Study advance networking architectures vise Software defined network (SDN).
6. Understand the high-performance networking and apply them in real time applications.

Outcomes: Students will be able to

1. Analyze the existing network architecture.
2. Understand the routing design principles.
3. Describe different protocol specifications and their components.
4. Design the complex network by converging different technologies.
5. Understand and explain advance network architectures and its components.
6. Understanding and developing high performance networks.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Design and Analysis of networks** Address Masks, Prefixes, and Sub networks, Network Address Translation (NAT) IP Switching and Routing - Local Delivery and Loopbacks - Address Resolution Protocol Route Control and Recording Fast Retransmit and Fast Recovery - Congestion-Avoidance Mechanisms – DECbit - Random Early Detection - Source-Based Congestion Avoidance – Tahoe, Reno, and Vegas QoS Application Requirements - Real-Time Audio - Taxonomy of Real-Time Applications - Approaches to QoS Support	06
2	**Internet Routing Design** Router Architectures: Functions, Types, Elements of a Router, Packet Flow Packet Processing: Fast Path versus Slow Path Router Architectures QoS Attributes Adapting Routing: A Basic Framework. Update Frequency, Information Inaccuracy, and Impact on Routing Dynamic Call Routing in the PSTN Heterogeneous Service, Single-Link Case A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing	08
3	**Protocol Engineering** Protocol Specification: Components of specification, Service specification. Communication Service Specification Protocol entity specification: Sender, Receiver and Channel specification Interface specifications Interactions, Multimedia specifications, Alternating Bit Protocol Specification, RSVP specification Protocol Specification Language (SDL): Salient Features. Communication System Description using SDL Structure of SDL. Data types and communication paths Examples of SDL based Protocol Specifications: Question and answer protocol, X-on-X-off protocol, Alternating bit protocol, Sliding window protocol specification	08
4	**Complex Networks** Types of network: Social networks, Information networks, Technological networks, Biological networks Properties of network: Small world effect, transitivity and clustering, degree distribution, scale free networks, maximum degree,network resilience Applications: Search on networks, exhaustive network search guided network search, network navigation; network visualization 5G Mobile network: Requirement, Designing and deployment of 5G networks	08
5	**Software Defined Networking** SDN vs. P2P/Overlay Networks Players in the SDN Eco-system SDN Applications, SDN Open source, SDN Future	04
6	**High Performance Networks** Network Performance analysis: Objectives and requirements for Quality of Service (QoS) in high performance networks Architecture of high performance networks (HPN) Design issues, protocols for HPN, VHF backbone networks Virtual interface architectures, virtual interface for networking	08

Books Recommended:

1. Design and Analysis of Communication Networks By V Ahuja , McGraw Hill

2. Storage Networks Explained – UifTroppens, R Erkens and W Muller, John Wiley & Sons, 2003.
3. Alex Goldman, "Storage Area Networks Fundamentals", Cisco Press 2002
4. Storage Area Network Essentials: a Complete Guide to understanding andimplementing SANs- Richard Barker and Paul Massiglia, John Wiley India
5. Paul Goransson, Chuck Black, " Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, Elsevier, USA, 2014
6. PallapaVenkataram and Sunilkumar S. Manvi: Communication Protocol Engineering, PHI, 2004.
7. S. N. Dorogovtsev and J. F. F. Mendes, Evolution of Networks, Oxford University press
8. James D.McCabe, Network analysis, Architecture and Design, 2nd Edition, Elsevier,2003.
9. Bertsekas&Gallager, Data Networks, second edition, Pearson Education, 2003.
10. 5G Mobile core Network: Design, Deployment, Automation and Testing strategies, by R. Shetty, Apress publication.

Suggested List of Experiments:

Sr. No.	Title of the Experiment
1.	Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default
2.	Configure, implement and debug the following: Use open-source tools for debugging and diagnostics.
3.	Demonstrate any one of the protocol – a) ARP/RARP protocols b) RIP routing protocols c) BGP routing d) OSPF routing protocols
4.	Evaluate Network Performance Evaluation using NS-2
5.	Comparative analysis of routing protocols with respect to QOS parameters using Xgraph /gnuplot for different load conditions.
6.	Analyze HTTP Traffic using Wireshark.
7.	Configure and use iptables
8.	Simulate simple SDN network
9.	Evaluate different QoS parameters through ns2
10.	Creating and set up a virtual LAN.

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. Practical and oral 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 the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19CEEC5013** with minimum 06 experiments along with a mini project to be incorporated.

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

1. Laboratory work (Performance of Experiments): 15 Marks
2. 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.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="6">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="6">Semester: V</td></tr>
<tr><td colspan="6">Course: Programming Laboratory –II (Python)</td><td colspan="6">Course Code: DJ19CEL505</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td>-</td><td>-</td><td>25</td><td>25</td><td colspan="2">25</td><td>50</td></tr>
</table>

Course Objectives:

1. To learn the basic and OOP concepts of Python.
2. To study various advance python concept like inheritance, exception handling, modules etc.
3. Learn to develop GUI based standalone and web application.

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

1. Understand basic and object-oriented concepts, data structure implementation in python.
2. Apply file, directory handling and text processing concepts in python.
3. Apply database connectivity, client-server communication using python.
4. Apply various advance modules of Python for data analysis.
5. Develop python-based application (web/Desktop) using django web framework/Tkinter.

Unit	Description	Hours
1	**Python basics** Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries Exception, Introduction to OOP, Classes, Objects, Linked List, Stack, Queues, Inheritance	12
2	**Advanced Python** Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders (Python OS Module, Python Datetime Module, Python Math and Random Modules Text Processing Regular expression in python	10
3	**Python Integration Primer** Graphical User interface using Tkinter : Form designing Networking in Python: Client Server socket programming Python database connectivity: Data Definition Language (DDL), and Data Manipulation Language (DML) Emails with Python: Introduction to Emails with Python, Sending Emails with Python, Receiving Emails with Python	10
4	**Python advance Modules** Numpy: Working with Numpy, Constructing Numpy arrays, Printing arrays, Arithmetic Operations on matrix OpenCV: Open CV - Installation, Sample code – Open CV Matplotlib: Matplotlib-Installation & Sample code, Bar Chart Pandas: Data Processing, Pandas-Data structure, Pandas-Series data, Data Frames	12
5	**Django Framework** Introduction to Django: Django's take on MVC: Model, View and Template, Installation and set up models.py, urls.py, views.py, Setting up database connections Managing Users & the Django admin tool Designing a good URL scheme, Generic Views, Form classes, Validation, Authentication, Advanced Forms processing techniques Django REST framework	12

Books Recommended:

Text books:

1. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
3. Introduction to computing and problem-solving using python, E Balagurusamy, McGraw Hill Education.

Reference Books:

1. Learn Python the Hard Way: (3rd Edition) (Zed Shaw's Hard Way Series)
2. Python Projects, Laura Cassell, Alan Gauld, Wrox publication

Digital Material:

1. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
2. http://spoken-tutorial.org
3. www.staredusolutions.org
4. https://www.tutorialspoint.com/python/index.htm

Suggested experiments using Python:

Expt No	Experiment Title
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python.
3	Menu driven program for data structure using built in function for link list, stack and queues.
4	Demonstrate exception handling.
5	Python program to explore different types of Modules
6	Demonstrate File handling and Directories a. Python program to append data to existing file and then display the entire file. b. Python program to count number of lines, words and characters in a file. c. Python program to display file available in current directory
7	Make use of RE module to perform text processing.
8	Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
9	Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/ MySQL) using python.
10	Implementation of simple socket programming for message exchange between server and client.
11	Make use of advance modules of Python like OpenCV, Matplotlib, NumPy
12	Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).

Evaluation Scheme:

Practical and Oral(A):

Oral & Practical examination will be based on the practical's performed during laboratory sessions.

1. Implementation:15 Marks
2. Oral:10 Marks

Total :25 Marks

Continuous Assessment (B):

Term Work:

Laboratory work will be based on syllabus with minimum 10 experiments to be incorporated. Experiments should be completed by students in the given time duration.

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.

1. Laboratory work (Performance of Experiments): 10 Marks
2. MCQ Quiz:15 Marks
3. Mini Project:20 Marks
4. Attendance (Practical): 05 Marks

Total: 50 Marks

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Computer Engineering</td><td colspan="4">Semester : V</td></tr>
<tr><td colspan="8">Course : Innovative Product Development-III</td><td colspan="4">Course Code: DJ19CEL506</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours/week)</td><td colspan="8">Evaluation Scheme</td></tr>
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</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 the team or as the leader.
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 convert the solution designed in semester 3 and 4 into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- The working model 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 the extended 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.
- 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 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 V and VI.

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 to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration on their working model
- The distribution of marks for term work shall be as follows:
    1. Marks awarded by the supervisor based on log-book : 10
    2. Marks awarded by review committee : 10
    3. Quality of the write-up : 05

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 (V and VI) 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 VI. Students are compulsorily required to present the outline of the extended technical paper prepared by them during the final review in semester VI.

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