SOMAIYA
VIDYAVIHAR
K J Somaiya Institute of Technology
An Autonomous Institute Permanently Affiliated to the University of Mumbai

# Autonomy Syllabus Scheme III (2023-24)

## (As per NEP 2020 Guidelines)

## for

## Four Year Multidisciplinary

## Bachelors of Technology (B.Tech.) Computer Engineering

## with

## Multiple Entry and Multiple Exit Options

## *Levels 4.5 - 6*

**(First Year Effective from A.Y. 2023-24,**
**Second Year Effective from A.Y. 2024-25,**
**Third Year Effective from A.Y. 2025-26,**
**Last Year Effective from A.Y. 2026-27)**

# Nomenclature and Alignment of Verticals and Components

| Verticals as per NEP 2020 Guidelines | Components Aligning with KJSIT Autonomy Syllabus Scheme I / II / II B | Nomenclature for KJSIT Autonomy Syllabus Scheme III Aligned with NEP 2020 Guidelines |
|---|---|---|
| Basic and Engineering Science Courses | Basic Science (BS) Course | Basic Science (BS) Courses |
| | Engineering Science (ES) Course | Engineering Science (ES) Courses |
| Major Courses | Professional Core (PC) Courses | Major / Professional Core (PC) Courses |
| | Professional Elective - Department-level (PE-DLC) Courses | Major / Professional Elective - Department-level (PE-DLC) Courses |
| Generic / Open Elective Courses | Open Elective - Institute-level (OE-ILC) Courses | Open Elective - Institute-level (OE-ILC) Courses |
| Multidisciplinary Minor Courses | - | Multidisciplinary Minor (MM) Courses |
| Vocational Skill Courses | Workshop I; Workshop II; SAT Courses – TBL | Vocational Skill - SAT (VS-SAT) Courses |
| Skill Enhancement Courses | SAT Courses – SBL (Program Specific) | Skill Enhancement - SAT (SE-SAT) Courses |
| Ability Enhancement Courses | Professional Communication Skills; SAT Course – SBL (Foreign and/or Indian Modern Languages) | Ability Enhancement - SAT (AE - SAT) Courses |
| Indian Knowledge System Courses | - | Indian Knowledge System - SAT (IKS - SAT) Courses |
| Value Education Courses | SAT Course – ABL (National, Global, Societal and Environmental Aspects); Business Communication & Ethics | Value Education - SAT (VE - SAT) Courses |
| Field Projects / Community Engagement Projects | PBL – Mini, Minor, Major | Community Engagement – Project-Based Learning (PBL) |
| Internship / Apprenticeship | Internship | Internship (INT) |
| Co-curricular Courses | Student Induction Program | Co-curricular - SAT (CC - SAT) Courses |

***Other Abbreviations:***

- SAT – Skill/Activity/Technology-Based Learning (Exposure Courses)
- TH – Theory
- P – Practical
- TUT – Tutorial
- T1 – Test 1
- T2 – Test 2
- CA – Continuous Assessment Test (T = T1 + T2)
- ESE – End Semester Exam
- TW – Term Work
- O – Oral Exam
- P – Practical Exam
- P&O – Practical & Oral Exam

## SEMESTER V: COMPUTER ENGINEERING

### TEACHING SCHEME

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | Credits Assigned | | Course Category |
|---|---|---|---|---|---|---|
| | | TH – P – TUT | Total | TH – P – TUT | Total | |
| CEC501 | Computer Network | 3 – 0 – 0 | 03 | 3 – 0 – 0 | 03 | PC |
| CEC502 | Machine Learning | 3 – 0 – 0 | 03 | 3 – 0 – 0 | 03 | PC |
| CEC503 | Software Engineering | 3 – 0 – 0 | 03 | 3 – 0 – 0 | 03 | PC |
| CEDLC504 | Major / Professional Elective - Department-level Course – I | 3 – 0 – 0 | 03 | 3 – 0 – 0 | 03 | PE-DLC |
| CEC505 | Multidisciplinary Minor Course | 3 – 0 – 0 | 03 | 3 – 0 – 0 | 03 | MM |
| CEL501 | Computer Network Lab | 0 – 2 – 0 | 02 | 0 – 1 – 0 | 01 | PC |
| CEL502 | Machine Learning Lab | 0 – 2 – 0 | 02 | 0 – 1 – 0 | 01 | PC |
| CEDLL504 | Major / Professional Elective - Department-level Lab – I | 0 – 2 – 0 | 02 | 0 – 1 – 0 | 01 | PE-DLC |
| CEPR54 | Community Engagement PBL – Minor Project | 0 – 2 – 0 | 02[$] | 0 – 1 – 0 | 01 | PBL |
| CEXS510 | Skill Enhancement – SAT X: Skill-Based Learning: Aptitude / Logic Building & Competitive Programming | 0 – 2[*] – 0 | 02 | 0 – 1 – 0 | 01 | SE-SAT |
| CEXA511 | Value Education – SAT XI: Activity-Based Learning: Business Communication and Ethics | 0 – 4[**] – 0 | 04 | 0 – 2 – 0 | 02 | VE-SAT |
| **Total** | | **15 – 14 – 0** | **29** | **15 – 7 – 0** | **22** | |

[*]SAT can be conducted as TH or P or both as required.

[$]Load of learner, not the faculty.

[**]02 Hours class-wise and 02 Hours batch-wise.

### Professional Electives - Department Level Elective Courses and Labs (PE-DLC – I)

| Group A: Databases/ Data Science | Group B: Network and Communications | Group C: Security/ IoT/ Blockchain | Group D: AI/ML/DL |
|---|---|---|---|
| CEDLC5041: ADBMS | CEDLC5042: Internet Programming | CEDLC5043: Web Security | CEDLC5044: Probabilistic Graphical Models |
| CEDLL5041: ADBMS Lab | CEDLL5042: Internet Programming Lab | CEDLL5043: Web Security Lab | CEDLL5044: Probabilistic Graphical Models Lab |

## EXAMINATION SCHEME

| Course Code | Course Name | CA Marks | | | ESE | | TW / O / P Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T1 | T2 | T = T1 + T2 | Marks | Duration (in Hrs) | TW | O | P | P&O | |
| CEC501 | Computer Network | 20 | 20 | 40 | 60 | 2.5 | - | - | - | - | 100 |
| CEC502 | Machine Learning | 20 | 20 | 40 | 60 | 2.5 | - | - | - | - | 100 |
| CEC503 | Software Engineering | 20 | 20 | 40 | 60 | 2.5 | - | - | - | - | 100 |
| CEDLC504 | Major / Professional Elective - Department-level Course – I | 20 | 20 | 40 | 60 | 2.5 | - | - | - | - | 100 |
| CEC505 | Multidisciplinary Minor Course | - | - | - | - | - | 50 | 50 | - | - | 100 |
| CEL501 | Computer Network Lab | - | - | - | - | - | 25 | - | 25 | - | 50 |
| CEL502 | Machine Learning Lab | - | - | - | - | - | 25 | - | - | - | 25 |
| CEDLL504 | Major / Professional Elective - Department-level Lab – I | - | - | - | - | - | 25 | - | - | - | 25 |
| CEPR53 | Community Engagement PBL – Minor Project | - | - | - | - | - | 25 | - | - | 25 | 50 |
| CEXS510 | Skill Enhancement – SAT X: Skill-Based Learning: Aptitude / Logic Building & Competitive Programming | - | - | - | - | - | 25 | - | - | - | 25 |
| CEXA511 | Value Education – SAT XI: Activity-Based Learning: Business Communication and Ethics | - | - | - | - | - | 25 | 25 | - | - | 50 |
| **Total** | | **80** | **80** | **160** | **240** | **-** | **200** | **75** | **25** | **25** | **725** |

### Professional Electives - Department Level Elective Courses and Labs (PE-DLC – I)

| Group A: Databases/ Data Science | Group B: Network and Communications | Group C: Security/ IoT/ Blockchain | Group D: AI/ML/DL |
|---|---|---|---|
| CEDLC5041: ADBMS | CEDLC5042: Internet Programming | CEDLC5043: Web Security | CEDLC5044: Probabilistic Graphical Models |
| CEDLL5041: ADBMS Lab | CEDLL5042: Internet Programming Lab | CEDLL5043: Web Security Lab | CEDLL5044: Probabilistic Graphical Models Lab |

## Major Discipline: Computer Engineering

| Major / Professional Core (PC) Courses Basket | |
|---|---|
| Discrete Structures and Graph Theory | Data Structures |
| Digital Logic & Computer Architecture | Computer Graphics |
| Analysis of Algorithm | Database Management System |
| Operating Systems | Microprocessor |
| Theory of Computer Science | Software Engineering |
| Computer Network | Machine Learning |
| System Programming & Compiler Construction | Cryptography & System Security |
| Mobile Computing | Artificial Intelligence |
| Machine Learning | Big Data Analytics |
| Distributed Computing | |

| Major / Professional Elective - Department-level Course (PE-DLC) Basket | |
|---|---|
| Advance Database Management System | Quantitative Analysis |
| Internet Programming | Multimedia System |
| Web Security | Infrastructure Security |
| Probabilistic Graphical Models | Digital Signal & Image Processing |
| Artificial Intelligence | Augmented and Virtual Reality |
| Ad Hoc Wireless Network | Internet Communication |
| Ethical Hacking and Security | Blockchain |
| Natural Language Processing | Information Retrieval |
| Applied Data Science | Social Media Analytics |
| Software Defined Network | High Performance Computing |
| Digital Forensic | Secure Application Development |
| Deep Learning | Optimization in Machine Learning |
| Quantum Computing | Computer Vision |

| Multiple Exit Courses* | |
|---|---|
| Object Oriented Programming JAVA | Web Development (HTML, PHP, CSS, etc.) |
| Flutter Application Development | Mobile Application Development |
| Python Programming | Machine Learning |
| Digital Marketing | Networking & Administration |
| Mini Project | 4 Weeks Internship |

| **OR**<br>**06-08 Week Internship** |
|---|

**To pursue 02 Courses of 04 Credits each OR 01 course of 04 Credits and 04 Week's Internship of 04 Credits OR 06-08 Week's Internship of 08 Credits.*

## ***Baskets for Honors Courses***

| **Honors Domain 1:<br>Artificial Intelligence and Machine Learning<br>Basket** |
|---|
| Mathematics for AI & ML |
| Game Theory using AI & ML |
| AI & ML in Healthcare |
| Text, Web and Social Media Analytics |

| **Honors Domain 2:<br>Blockchain<br>Basket** |
|---|
| Bit Coins and Crypto Currency |
| Blockchain Platform |
| Blockchain Development |
| Decentralized Finance (DeFi) |

| **Honors Domain 3:<br>Cyber Security<br>Basket** |
|---|
| Ethical Hacking |
| Digital Forensic |
| Security Information Management |
| Application Security |

| **Honors Domain 4:<br>Data Science<br>Basket** |
|---|
| Mathematics for Data Science |
| Statistical Learning for Data Science |
| Data Science for Health and Social Care |
| Text, Web and Social Media Analytics |

| **Honors Domain 5:<br>Augmented and Virtual Reality<br>Basket** |
|---|
| Virtual Reality |
| AR and Mix Reality |
| ARVR Application |
| Game Development with VR |

| **Honors Domain 6:<br>Internet of Things<br>Basket** |
|---|
| IoT Sensor Technologies |
| IoT System Design |
| Dynamic Paradigm in IoT |
| Industrial IoT |

**** Some Major / Minor / SAT / Honors Courses will be offered as learning from MOOCs.***

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| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| **CEC501** | **Computer Networks** | 3 - 0 - 0 |
| **Prerequisite:** | Digital Communication Fundamentals | |
| | | |
| **Course Objectives:** | 1. To introduce concepts and fundamentals of computer network and ISO-OSI & TCP/IP model.<br>2. To explore the inter-working of various layers of OSI.<br>3. To explore functionalities and various protocols of OSI layers.<br>4. To assess the strengths and weaknesses of various routing algorithms and congestion control algorithms. | |
| | | |
| **Course Outcomes:** | **After the successful completion of this course, learner will be able to:**<br>1. Demonstrate the fundamentals of computer network with the details of layers in OSI and TCP/IP models.<br>2. Explore different guided and unguided transmission media.<br>3. Explain framing, error detection, flow control techniques and protocols for data link layer<br>4. Design the network by applying subnetting, supernetting, and analyze routing algorithms & protocols of network layer.<br>5. Analyse transport layer protocols and congestion control algorithms.<br>6. Explore protocols at application layering. | |
| | | |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub Topics | Total Hrs/ Module |
|---|---|---|---|---|
| **1. Introduction to Networking** | Introduction to computer network, network application, network software and hardware components (Interconnection networking devices) | **CO1** | **02** | **06** |
| | Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services | | **02** | |
| | Reference models: Layer details of OSI, TCP/IP models. Communication between layer. | | **02** | |
| **2.Physical layer** | Introduction to Communication Electromagnetic Spectrum, Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. | **CO2** | **03** | **05** |
| | Unguided Media | | **02** | |
| **3.Data Link Layer** | DLL Design Issues (Services, Framing, Error Control, Flow Control) | **CO2** | **01** | **08** |
| | Error Detection and Correction (Hamming Code, CRC, Checksum) | | **03** | |

| | | | | |
|---|---|---|---|---|
| | Elementary Data Link protocols, Stop and Wait, Sliding Window (Go Back N, Selective Repeat), Multiple Access | | **04** | |
| **4.Network Layer** | Network Layer design issues, Communication Primitives: Unicast, Multicast,Broadcast. | **CO4** | **01** | **09** |
| | IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems IPv4 Protocol, Network Address Translation (NAT) | | **04** | |
| | Routing algorithms : Shortest Path (Dijkastra_s), Link state routing, Distance Vector Routing, Protocols - ARP,RARP, ICMP, IGMP | | **04** | |
| **5.Transport Layer** | The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake) | **CO5** | **01** | **08** |
| | UDP, TCP, TCP state transition, TCP timers,TCP Flow control (sliding Window) | | **03** | |
| | TCP Congestion Control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms | | **04** | |
| **6. Application Layer** | DNS: Name Space, Resource Record | **CO6** | **02** | **06** |
| | Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP | | **04** | |
| **Total Hours** | | | | **42** |

**Books:**

| | |
|---|---|
| **Text Books** | 1. A.S. Tanenbaum, ―Computer Networks‖, Pearson Education, (4e)<br>2. B.A. Forouzan, ―Data Communications and Networking‖, TMH (5e)<br>3. James F. Kurose, Keith W. Ross, ―Computer Networking, A Top-Down Approach Featuring the Internet‖, Addison Wesley, (6e) |
| **Reference Books** | 1. S.Keshav: An Engineering Approach To Computer Networking, Pearson<br>2. Natalia Olifer & Victor Olifer,― Computer Networks: Principles, Technologies & Protocols for Network Design‖, Wiley India, 2011.<br>3. Larry L.Peterson, Bruce S.Davie, Computer Networks: A Systems Approach, Second Edition (The Morgan Kaufmann Series in Networking). |

**Useful Links:**

1. https://www.netacad.com/courses/networking/networking-essentials
2. https://www.coursera.org/learn/computer-networking
3. https://nptel.ac.in/courses/106/105/106105081
4. https://www.edx.org/course/introduction-to-networking

**Assessment:**

Continuous Assessment for 40 marks:

1. Test 1 – 20 marks
2. Test 2 – 20 marks

**End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.**

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEC502 | Machine Learning | (3+0+0) |

| | |
|---|---|
| **Prerequisite:** | 1. Linear Algebra, Calculus<br>2. Basic Probability and Statistics<br>3. Data Structures<br>4. Algorithms |
| **Course Objectives:** | 1. To introduce students to the basic concepts and techniques of Machine Learning.<br>2. To have comprehensive knowledge with regression, classification & clustering methods<br>3. To understand dimensionality reduction techniques to optimize model performance. |
| **Course Outcomes:** | **After the successful completion of this course, learner will be able to:**<br>1. Describe the basics of machine learning, its applications.<br>2. Implement regression algorithms and evaluate their performance<br>3. Apply and compare various classification algorithms.<br>4. Analyze ensemble and support vector methods.<br>5. Design clustering algorithms and association rule mining techniques.<br>6. Apply dimensionality reduction techniques. |

| Module No & Name | Sub Topics | CO mapped | Hrs/ Sub topic | Total Hrs / Module |
|---|---|---|---|---|
| **1. Introduction to Machine Learning** | Introduction to Machine Learning, Types of Machine Learning, Steps in developing a Machine Learning Application, Issues, Applications of Machine Learning, | **CO1** | **03** | **07** |
| | Data Preprocessing : Feature Engineering, Data Cleaning Exploratory Data Analysis (EDA) | | **02** | |
| | Model Performance: Training Error, Generalization error, Overfitting, Underfitting, Bias-Variance trade-off | | **02** | |
| **2. Learning with Regression** | Linear Regression, Types of Linear Regression, Logistic regression, Types of. | **CO2** | **03** | **06** |
| | Logistic Regression, Applications, Performance Metrics for Linear Regression | | **03** | |
| **3. Basic classification** | Learning with Trees**:** Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART) | **CO3** | **04** | **07** |
| | Bayesian Classification: Naive Bayes, K-nearest neighbour method, Performance Metrics for Classification. | | **03** | |
| **4. Advanced Classification** | Introduction to Ensemble Learning, Boosting, Stumping, XGBoost, Bagging, Subagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers | **CO4** | **04** | **07** |
| | Support Vector Machine: Margins and support vectors, Quadratic Programming, SVM for linear | | **03** | |

| | | | | |
|---|---|---|---|---|
| | and nonlinear classification, Kernel trick . | | | |
| **5. Learning with Clustering and Association** | Introduction to clustering, Applications of clustering , Clustering: Distance Measures, Partitioning Methods (k-Means, k-Medoids), Hierarchical Methods(Agglomerative, Divisive) | **CO5** | **02** | **08** |
| | Graph Based Clustering: Clustering with minimal spanning tree. | | **02** | |
| | Density Based Clustering: Density-based spatial clustering of applications with noise (DBSCAN) | | **02** | |
| | Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Apriori Algorithm, Generating Association Rules from Frequent Itemsets using the Apriori Algorithm. | | **02** | |
| 6. **Dimensionali -ty Reduction** | Introduction, Dimensionality Reduction Techniques. | **CO6** | **02** | **06** |
| | Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition. | | **04** | |
| **Total Hours** | | | | **42** |

| **Books:** | |
|---|---|
| **Text Books** | 1. Peter Harrington, "Machine Learning in Action", DreamTech Press<br>2. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press<br>3. Tom M.Mitchell, "Machine Learning" McGraw Hill<br>4. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press |
| **Reference Books** | 1. Han Kamber, Data Mining Concepts and Techniques‖, Morgan Kaufmann Publishers<br>2. Margaret.H.Dunham, Data Mining Introductory and Advanced Topic, Pearson Education<br>3. Kevin P. Murphy , Machine Learning — A Probabilistic Perspective.<br>4. William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge<br>5. Richard Duda ,Peter E Hart,David G Stork " Pattern classification " A Wiley- Interscience Publication<br>6. Zhi-Hua Zhou Ensembles Methods :Foundations and Algorithms,CRC Press, Taylor and Francis Group.<br>7. Samir Roy and Chakraborty, —Introduction to soft computing‖, Pearson Edition. |

**Useful Links:**

1. Data sets for Machine Learning algorithms:- https://www.kaggle.com/datasets
2. http://deeplearning.net/datasets/
3. Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
4. https://www.visualdata.io/discovery
5. https://towardsdatascience.com/machine-learning/home
6. https://machinelearningmastery.com/
7. https://www.analyticsvidhya.com/

**Continuous Assessment for 40 marks:**

1. Test 1 – 20 marks
2. Test 2 – 20 marks

**End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.**

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEC503 | Software Engineering | 3 - 0 – 0 |

| | |
|---|---|
| **Prerequisite:** | 1. Object Oriented Programming with Java<br>2. Python Programming |
| **Course Objectives:** | 1. To provide the knowledge of software engineering discipline.<br>2. To apply analysis, design and testing principles to software project development.<br>3. To demonstrate and evaluate real world software projects. |
| **Course Outcomes:** | **After the successful completion of this course, learner will be able to:**<br>1. Identify requirements & assess the process models.<br>2. Identify requirements and provide plan, schedule, track the progress of the projects.<br>3. Estimate the cost of project using different techniques<br>4. Design the software projects.<br>5. Do testing of software project.<br>6. Identify risks, manage the change to assure quality, maintenance strategies, integrating DevOps principles for continuous delivery and operational excellence. |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub topics | Total Hrs/ Module |
|---|---|---|---|---|
| **1. Introduction To Software Engineering and Process Models** | Software Engineering-process framework, the Capability Maturity Model (CMM), Advanced Trends in Software Engineering. | **CO1** | **02** | **07** |
| | Prescriptive Process Models: The Waterfall, Incremental Process Models, Evolutionary Process Models: RAD & Spiral. | | **04** | |
| | Agile process model: Extreme Programming (XP), Scrum, Kanban | | **01** | |
| **2. Software Requirements Analysis and Modeling** | Requirement Engineering, Requirement Modeling, Data flow diagram. | **CO1** | **02** | **05** |
| | Scenario based model. | | **02** | |
| | Software Requirement Specification document format(IEEE) | | **01** | |
| **3. Software Estimation Metrics** | Software Metrics. | **CO3** | **01** | **07** |
| | Software Project Estimation (LOC, FP, COCOMO II ) | | **05** | |
| | Project Scheduling & Tracking | | **01** | |
| **4.Software Design** | Design Principles & Concepts, Effective Modular Design | **CO4** | **01** | **07** |
| | Cohesion and Coupling | | **01** | |
| | Architectural design | | **02** | |
| | UML Diagrams | | **03** | |

| | | | | |
|---|---|---|---|---|
| **5. Software Testing** | Unit testing, Integration testing, validation testing, System testing, Testing Techniques | **CO5** | **02** | **07** |
| | White-box testing: Basis path, Control structure testing | | **03** | |
| | Black-box testing: Graph based Static Testing, Equivalence, Boundary Value | | **02** | |
| **6.Software Configuration Management, Quality Assurance and Maintenance** | Risk Analysis & Management: Risk Mitigation, Monitoring and Management Plan (RMMM). | **CO6** | **02** | **09** |
| | Quality Concepts and Software Quality assurance Metrics, Formal Technical Reviews, Software Reliability,The Software Configuration Management (SCM) | | **02** | |
| | Version Control and Change Control | | **01** | |
| | Types of Software Maintenance, Re-Engineering, Reverse Engineering | | **02** | |
| | Introduction to Devops Concepts, Jira &Trello Tools | | **02** | |
| **Total Hours** | | | | **42** |

**Books:**

| | |
|---|---|
| **Text Books** | 1. Roger Pressman, ―Software Engineering: A Practitioner_s Approach‖, 9th edition ,McGraw-Hill Publications, 2019<br>2. Ian Sommerville, ―Software Engineering‖, 9th edition, Pearson Education, 201.<br>3. Ali Behfrooz and Fredeick J. Hudson, "Software Engineering Fundamentals", Oxford University Press, 1997<br>4. Grady Booch, James Rambaugh, Ivar Jacobson, ―The unified modeling language user guide‖, 2nd edition, Pearson Education, 2005 |
| **Reference Books** | 1. Pankaj Jalote, "An integrated approach to Software Engineering", 3rd edition, Springer,2005<br>2. Rajib Mall, "Fundamentals of Software Engineering", 5th edition, Prentice Hall India, 2014<br>4. Jibitesh Mishra and Ashok Mohanty, ―Software Engineering‖, Pearson , 2011<br>5. Ugrasen Suman, ―Software Engineering – Concepts and Practices‖, Cengage Learning,2013<br>6. Waman S Jawadekar, ―Software Engineering principles and practice‖, McGraw Hill Education, 2004 |

**Useful Links:**

1. https://nptel.ac.in/courses/106/105/106105182/
2. https://onlinecourses.nptel.ac.in/noc19_cs69/preview
3. https://www.mooc-list.com/course/software-engineering-introduction-edx

**Assessment:**

**Continuous Assessment for 40 marks:**

1. Test 1 for 40% of syllabus – 20 marks
2. Test 2 for 40% of syllabus – 20 marks

**End Semester Examination will be of 60 marks**

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| **CEDLC5041** | **Advance Database Management System** | **3 - 0 – 0** |

| | |
|---|---|
| **Prerequisite:** | Database Management System |
| **Course Objectives:** | 1. To provide insights into distributed database management system<br>2. To specify the various approaches used for interoperability using XML and JSON technologies<br>3. To apply the concepts behind the various types of NoSQL databases and utilize it for Mongodb<br>4. To learn about the trends in advance databases |
| **Course Outcomes:** | **After the successful completion of this course, learner will be able to:**<br>1. Design distributed database using the various techniques for query processing<br>2. Measure query cost and perform distributed transaction management<br>3. Organize the data using XML and JSON database for better interoperability<br>4. Compare different types of NoSQL databases<br>5. Formulate NoSQL queries using Mongodb<br>6. Describe various trends in advance databases through temporal, graph based and spatial based databases |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub Topics | Total Hrs/ Module |
|---|---|---|---|---|
| **1. Distributed Databases** | Introduction, Distributed DBMS Architecture, | **CO1** | **02** | **05** |
| | Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design. | | **03** | |
| **2. Distributed Database Handling** | Definition of Distributed Transaction Management, properties and types of Distributed Transaction Management, | **CO2** | **02** | **08** |
| | Characterization of distributed Query Processors, Layers/ phases of distributed query processing. | | **02** | |
| | Taxonomy of Distributed Concurrency Control, Locking based and Basic TO algorithm for Distributed Concurrency Control | | **02** | |
| | Failures in distributed database, 2PC and 3PC protocol for Recovery in Distributed Databases | | **02** | |

| | | | | |
|---|---|---|---|---|
| **3. Data interoperability:- XML and JSON** | XML Databases, Document Type Definition, XML Schema, Querying and Transformation using XPath and XQuery. | **CO3** | **02** | **06** |
| | Basic JSON syntax, (Java Script Object Notation),JSON data types, Stringifying and parsing the JSON for sending & receiving, | | **02** | |
| | JSON Object retrieval using key-value pair and JQuery, XML Vs JSON | | **02** | |
| **4. NoSQL Distribution Model** | NoSQL database concepts, NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system | **CO4** | **03** | **10** |
| | Replication and sharding, Distribution Models Consistency in distributed data, CAP theorem, Notion of ACID Vs BASE, handling Transactions, consistency and eventual consistency | | **04** | |
| | Types of NoSQL databases, Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties. | | **03** | |
| **5. NoSQL using MongoDB** | Introduction to MongoDB Shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDB shell, Basic Data Types, Arrays, Embedded Documents. | **CO5** | **03** | **06** |
| | Querying MongoDB using find () functions, advanced queries using logical operators and sorting, simple aggregate functions, saving and updating document, Concepts of replication and horizontal scaling through sharding in MongoDB | | **03** | |
| **6. Trends in advance databases** | Temporal database Concepts, time representation, time dimension, incorporating time in relational databases | **CO6** | **03** | **07** |
| | Graph Database Introduction, Features, Transactions, consistency, Availability, Querying, Case Study Neo4J | | **02** | |
| | Spatial database Introduction, data types, models, operators and queries | | **02** | |
| **Total Hours** | | | | **42** |

**Books:**

**Text Books**


1. Korth, Siberchatz,Sudarshan, ―Database System Concepts‖, 6th Edition, McGraw Hill
2. Elmasri and Navathe, ―Fundamentals of Database Systems‖, 7th Edition, Pearson Education
3. Ozsu, M. Tamer, Valduriez, Patrick, ―Principles of distributed database systems‖,3rd Edition, Pearson Education, Inc
4. Pramod Sadalge, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition Addison Wesley/ Pearson
5. Jeff Friesen , Java XML and JSON,2nd Edition, 2019, après Inc

| | |
|---|---|
| **Reference Books** | **1.** Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5th Edition**.**<br>2. Adam Fowler, NoSQL for dummies, February 2015 , John Wiley & Sons, Inc.<br>3. Shashank Tiwari, Professional NOSQL, 2011, John Willy & Sons. Inc<br>4. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition TMH<br>5. MongoDB Manual : https://docs.mongodb.com/manual |
| **Useful Links:** | |
| https://cassandra.apache.org | |
| https://www.mongodb.com | |
| https://riak.com | |
| https://neo4j.com | |
| https://martinfowler.com/articles/nosql-intro-original.pdf | |
| **Assessment:** | |
| **Continuous Assessment for 40 marks:**<br>1. Test 1 – 20 marks<br>2. Test 2 – 20 marks | |
| **End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.** | |

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEDLC5042 | Internet Programming | 3-0-0 |

| | |
|---|---|
| **Prerequisite:** | Basics of Programming Languages |
| **Course Objectives:** | 1. To provide a foundational understanding of Internet programming and HTML5.<br>2. To equip students with the knowledge and skills to design and develop web interfaces.<br>3. To introduce students to client-side scripting for building interactive web applications.<br>4. To familiarize students with Rich Internet Application (RIA) concepts and the use of AJAX and jQuery for dynamic web interfaces.<br>5. To develop an understanding of server-side programming and database integration for web application development.<br>6. To introduce students to full-stack development using React.js and the MERN stack. |
| **Course Outcomes:** | After the successful completion of this course, learner will be able to:<br>1. Explain the working of the web and internet protocols, and develop structured web pages using HTML5.<br>2. Create responsive web pages and apply UI/UX principles to enhance user experience.<br>3. Use client-side scripting to develop interactive and dynamic web applications.<br>4. Design and implement rich web interfaces using AJAX and jQuery.<br>5. Develop backend functionality using PHP and Node.js, and perform CRUD operations with databases.<br>6. Develop and deploy full-stack web applications using the MERN stack. |

| Module No & Name | Sub Topics | CO mapped | Hrs / Sub Topics | Total Hrs/ Module |
|---|---|---|---|---|
| **1. Web Foundations + HTML5 Basics** | **Web Essentials**: Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers<br>**HTML5:**fundamental syntax and semantics, Tables, Lists, Image, HTML5 control elements, Semantic elements, Drag and Drop, Audio,Video controls | **CO1** | **07** | **07** |
| **2.User Interface Design and Styling with CSS3 & Bootstrap** | **UI/UX Design Fundamentals**: Color theory, typography, spacing, User flow diagrams, wire framing (Figma), Accessibility and usability testing | **CO2** | **03** | **07** |
| | **CSS3**:Inline, embedded and external style sheets, Rule cascading, Inheritance, Backgrounds, BorderImages, Colors, Shadows,Text, Transformations, Transitions, Animation, Bootstrap, grid system, components, modals, navbars. | | **04** | |

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|---|---|---|---|---|
| **3.Client-Side Scripting with JavaScript and JSON** | **Java script**: An introduction to JavaScript, JavaScript DOM Model, Date and Objects, Regular Expressions, Exception Handling, Validation, Built-in objects, Event Handling, DHTML with JavaScript, JQuery Framework | **CO3** | **05** | **07** |
| | **JSON**: An introduction to JSON Syntax , Function Files, Http Request, Dynamic rendering of JSON data on the web page | | **02** | |
| **4.Rich Internet Applications and AJAX with jQuery** | Introduction to Rich Internet Applications, Characteristics of RIA, **Introduction to AJAX**: AJAX design basics, AJAX vs Traditional Approach, Rich User Interface using Ajax, jQuery framework with AJAX. | **CO4** | **07** | **07** |
| **5. Backend Development with PHP, Node.js, and Database Integration** | **Introduction to PHP**- Data types, control structures, built in functions, building web<br><br>applications using PHP- tracking users<br>Database interaction: PHP and MySQL database connectivity with example. | **CO5** | **04** | **07** |
| | **Node.js & Express:** setup, routing, middleware, error handling, RESTful API design and JSON response creation, Sessions, cookies, authentication basics.MongoDB (Node.js + Mongoose) NoSQL database, document structure, CRUD with Mongoose, validation | | **03** | |
| **6.Full stack development** | **React.js**:JSX, components, state, props, hooks,Event handling, conditional rendering. **MERN Stack**:InCombine React frontend with Express backend,Connect Express APIs to MongoDB,Full-stack app structure and deployment (Vercel, Render) | **CO6** | **07** | **07** |
| **Total Hours** | | | | **42** |

**Books:**

**Text Books**


1. Ralph Moseley, M.T. Savliya, "Developing Web Applications", Willy India, Second Edition, ISBN: 978-81-265-3867-6
2. "Web Technology Black Book", Dremtech Press, First Edition, 978-7722-997
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY, 2014. (http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascript_CSS_HTML5_Robin_Nixon_3e.pdf)
4. Dana Moore, Raymond Budd, Edward Benson, Professional Rich
5. Internet Applications: AJAX and Beyond Wiley publications. https://ebooks-it.org/0470082801-ebook.htm
6. Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux, OREILLY, First Edition

| | |
|---|---|
| **Reference Books** | 1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, Internet and World Wide Web - How To Program, Fifth Edition, Pearson Education, 2011.<br>2. Achyut S Godbole and Atul Kahate, Web Technologies, Second Edition, Tata McGraw Hill, 2012.<br>3. Thomas A Powell, Fritz Schneider, ―JavaScript: The Complete Reference, Third Edition, Tata McGraw Hill, 2013<br>4. David Flanagan, ―JavaScript: The Definitive Guide, Sixth Edition, O'Reilly Media, 2011<br>5. Steven Holzner ―The Complete Reference - PHP, Tata McGraw Hill,2008<br>6. Mike Mcgrath―PHP & MySQL in easy Steps, Tata McGraw Hill, 2012. |

**Useful Links:**

1. https://books.goalkicker.com/ReactJSBook/
2. https://www.guru99.com/reactjs-tutorial.html
3. www.nptelvideos.in
4. www.w3schools.com
5. https://spoken-tutorial.org/
6. www.coursera.org
7. https://www.mongodb.com/

**Assessment:**

**Continuous Assessment for 40 marks:**

1. Test 1 – 20 marks
2. Test 2 – 20 marks

**End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.**

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEDLC5043 | Web Security | 3-0-0 |
| Prerequisite: | Computer Networks, Knowledge on Web Application. | |
| Course Objectives: | 1. Understand the ethics of hacking and the importance of ethical hacking, as well as develop knowledge and skills in vulnerability assessment and penetration testing.<br>2. Comprehend and analyze various types of attacks in cyber security, Gain proficiency in using Metasploit for penetration testing.<br>3. Develop management and reporting skills for penetration test. Explore and exploit vulnerabilities in operating systems.<br>4. Gain knowledge of web application security vulnerabilities and acquire skills in vulnerability analysis.<br>5. Develop skills in malware analysis and client-side browser exploits | |
| Course Outcomes: | **After the successful completion of this course, learner will be able to:**<br>1. Explain ethical issues and legal effects of ethical hacking using proper tools.<br>2. Analyze and defend against social, physical, and insider attacks using automated testing.<br>3. Conduct penetration tests and report results.<br>4. Analyze and mitigate web security issues and conduct vulnerability checks.<br>5. Evaluate and protect against browser-based client-side attacks.<br>6. Provide an overview of mobile threats, risks, and best security practices for Android and iOS. | |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub Topics | Total Hrs/ Module |
|---|---|---|---|---|
| 1. Introduction Ethics of Ethical Hacking | Why you need to understand enemy's tactics ,Vulnerability Assessment and Penetration Testing. Penetration Testing and Tools: Social Engineering Attacks: How a social engineering attack works, conducting a social engineering attack. | CO1 | 03 | 06 |
| | Common attacks used in penetration testing preparing yourself for face-to-face attacks, defending against social engineering attacks. | | 03 | |
| 2.Physical Penetration Attacks | Why a physical penetration is important, conducting a physical penetration, common ways into a building, defending against physical penetrations. | CO2 | 02 | 08 |
| | Insider Attacks: Conducting an insider attack, defending against insider attacks. | | 02 | |
| | Metasploit: The big picture, getting Metasploit, using the Metasploit console to launch exploits, exploiting client-side vulnerabilities, automating and scripting Metasploit, going further with Metasploit. | | 04 | |
| 3. Managing a | Planning a penetration test, structuring a penetration test, execution of a penetration test, information sharing during a penetration test, reporting the results of a penetration test. | CO3 | 02 | 07 |

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|---|---|---|---|---|
| **Penetration Test** | Basic Linux Exploits: Stack operations, buffer overflows, local buffer overflow exploits, exploit development process. | | **02** | |
| | Windows Exploits: Compiling and debugging Windows programs, writing Windows exploits, understanding Structured Exception Handling (SEH), understanding Windows memory protections (XP SP3, Vista, 7, and Server 2008)<br>Self-Learning:-Bypassing Windows memory protections. | | **03** | |
| **4.Web Application Security Vulnerabilities** | Overview of top web application security vulnerabilities, injection vulnerabilities, cross-site scripting vulnerabilities, | **CO4** | **01** | **06** |
| | Vulnerability Analysis: Passive analysis, source code analysis, binary analysis. | | **02** | |
| | The rest of the OWASP Top Ten, SQL injection vulnerabilities, cross-site scripting vulnerabilities. | | **03** | |
| **5. Client-Side Browser Exploits** | Why client-side vulnerabilities are interesting, Internet Explorer security concepts, history of client-side exploits and latest trends, finding new browser-based vulnerabilities, heap spray to exploit, protecting yourself from client-side exploit. | **CO5** | **04** | **07** |
| | Malware Analysis: Collecting malware and initial analysis, latest trends in honeynet technology, catching malware: setting the trap, initial analysis of malware. | | **03** | |
| **6. Mobile Application Security** | **Introduction to Mobile Application Security**<br>• Importance of mobile app security<br>• Mobile threat landscape<br>• Differences between web and mobile security<br>• OWASP Mobile Top 10 overview. | **CO6** | **02** | **08** |
| | **Mobile Operating System Security Architecture** Android security model: sandboxing, permissions, app signing<br>• iOS security model: code signing, app sandbox, data protection APIs | | **02** | |
| | **Common Mobile App Vulnerabilities**<br>• Insecure data storage | | **02** | |
| | • Insecure communication (HTTP, no SSL pinning)<br>• Insecure authentication and authorization<br>• Reverse engineering and code tampering<br>• Insufficient cryptography<br>• Examples from real-world apps | | | |
| | **Static and Dynamic Analysis of Mobile Apps**<br>• Introduction to reverse engineering tools (Apktool, jadx, MobSF)<br>• Dynamic analysis using emulators and debuggers<br>• Common techniques for malware and vulnerability detection<br>Self-Learning:-Introduction to Frida, Burp Suite for mobile testing | | **02** | |
| **Total Hours** | | | | **42** |
| **Books:** | | | | |

| | |
|---|---|
| **Text Books** | 1. GrayHatHacking- The Ethical Hackers Handbook, Allen Harper, Stephen Sims, Michael Baucom, 3rd Edition, Tata McGraw-Hill.<br>2. Discovering and Exploiting Security flaws, Dafydd Suttard, Marcuspinto, 1stEdition, Wiley Publishing. |
| **Reference books** | **1. Penetration Testing: A Hands-On Introduction to Hacking**<br>*Author: Georgia Weidman \| Publisher: No Starch Press \| Publication Date: June 14, 2014 \| ISBN-13: 978-1593275648*<br>**2.** The Pentester BluePrint: Starting a Career as an Ethical Hacker<br>Authors: Phillip L. Wylie and Kim Crawley \| Publisher: Wiley \| Publication Date: November 2020 \| ISBN-13: 978-1119684305 |
| | |

**Useful Links:**

https://owasp.org
https://academy.hackthebox.com
https://tryhackme.com
https://www.cybrary.it
https://metasploit.help.rapid7.com/docs
https://www.kali.org/docs
https://nvd.nist.gov
https://github.com/cheetz/TheHackerPlaybook
https://pentesterlab.com/exercises/from_sqli_to_shell/course https://portswigger.net/web-security

**Assessment:**

**Continuous Assessment for 40 marks:**

1. Test 1 – 20 marks
2. Test 2 20 marks

**End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.**

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEDLC5044 | Probabilistic Graphical Models | 3 - 0 - 0 |

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|---|---|
| **Prerequisite:** | 1. Discrete Structure<br>2. Engineering Mathematics |
| **Course Objectives:** | 1. To give comprehensive introduction of probabilistic graphical models.<br>2. To make inferences, learning, actions and decisions while applying these models.<br>3. To introduce real-world trade offs when using probabilistic graphical models in practice.<br>4. To develop the knowledge and skills necessary to apply these models to solve real world problems. |
| **Course Outcomes:** | **After the successful completion of this course, learner will be able to:**<br>1. Describe basic concepts of probabilistic graphical modelling.<br>2. Model and extract inference from various graphical models like Bayesian Network model and inference.<br>3. Perform learning and take actions and decisions using probabilistic graphical models - Markov Model.<br>4. Devise learning and take actions and decisions using probabilistic graphical models - Hidden Markov Model<br>5. Represent real world problems using graphical models; design inference algorithms; and learn the structure of the graphical model from data<br>6. Design real life applications using probabilistic graphical models. |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub topics | Total Hrs/ Module |
|---|---|---|---|---|
| **1.Introduction to Probabilistic Graphical Modeling** | Introduction to Probability Theory: Probability Theory, Basic Concepts in Probability, Random Variables and Joint Distribution, Independence and Conditional Independence, Continuous Spaces, Expectation and Variances, Theory of Predicate Calculus, Mathematical Induction. | **CO1** | **02** | **07** |
| | Introduction to Graphs: Nodes and Edges, Subgraphs, Paths and Trails, Cycles and Loops | | **02** | |
| | Introduction to Probabilistic Graph Models: Bayesian Network, Markov Model, Hidden Markov Model | | **02** | |
| | Applications of PGM | | **01** | |
| **2. Bayesian Network Model and Inference** | Directed Graph Model: Bayesian Network-Exploiting Independence,Properties, Naive Bayes Model, Bayesian Network Model, Reasoning Patterns, Basic independencies in Bayesian Networks, Bayesian Network Semantics, Graphs and Distributions. | **CO2** | **04** | **10** |
| | Modelling: Picking variables, Picking Structure, Picking Probabilities, D-separation | | **02** | |

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|---|---|---|---|---|
| | Local Probabilistic Models: Tabular CPDs, Deterministic CPDs, Context Specific CPDs, Generalized Linear Models | | **02** | |
| | Exact inference variable elimination: Analysis of Complexity, Variable Elimination, Conditioning, Inference with Structured CPDs | | **02** | |
| **3. Markov Network Model and Inference** | Undirected Graph Model : Markov Model-Markov Network, Parameterization of Markov Network, Gibb's distribution, Reduced Markov Network, Markov Network Independencies, From Distributions to Graphs, Fine Grained Parameterization, Over Parameterization | **CO3** | **04** | **08** |
| | Exact inference variable elimination: Graph Theoretic Analysis for Variable Elimination, Conditioning | | **04** | |
| **4. Hidden Markov Model and Inference** | Template Based Graph Model : HMM- Temporal Models, Template Variables and Template Factors, | **CO4** | **03** | **06** |
| | Directed Probabilistic Models, Undirected Representation, Structural Uncertainty | | **03** | |
| **5. Learning and Taking Actions and Decisions** | Learning Graphical Models: Goals of Learning, Density Estimation, Specific Prediction Tasks, Knowledge Discovery. Learning as Optimization: Empirical Risk, Over fitting, Generalization, Evaluating Generalization Performance, Selecting a Learning Procedure, Goodness of fit, Learning Tasks. Parameter Estimation: Maximum Likelihood Estimation, MLE for Bayesian Networks | **CO5** | **03** | **06** |
| | Causality: Conditioning and Intervention, Correlation and Causation, Causal Models, Structural Causal Identifiability, Mechanisms and Response Variables, Learning Causal Models. Utilities and Decisions: Maximizing Expected Utility, Utility Curves, Utility Elicitation. Structured Decision Problems: Decision Tree | | **03** | |
| **6. Applications** | Application of Bayesian Networks: Classification, Forecasting, Decision Making | **CO6** | **02** | **05** |
| | Application of Markov Models: Cost Effectiveness Analysis, Relational Markov Model and its Applications, Application in Portfolio Optimization | | **02** | |
| | Application of HMM: Speech Recognition, Part of Speech Tagging, Bioinformatics | | **01** | |
| **Total Hours** | | | | **42** |
| **Books:** | | | | |
| **Text Books** | 1.Daphne Koller and Nir Friedman, "Probabilistic Graphical Models: Principles and Techniques‖, Cambridge, MA: The MIT Press, 2009 (ISBN 978-0-262-0139- 2).<br>2.David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 1st edition, 2011. | | | |

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|---|---|
| **Reference Books** | 1. Finn Jensen and Thomas Nielsen, "Bayesian Networks and Decision Graphs (Information Science and Statistics )", 2nd Edition, Springer, 2007.<br>2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.<br>3. Martin Wainwright and Michael Jordan, M., "Graphical Models, Exponential<br>4. Families, and Variational Inference", 2008. |
| **Useful Links:** | |
| 1. https://www.coursera.org/specializations/probabilistic-graphical-models | |
| 2. https://www.mooc-list.com/tags/probabilistic-graphical-models | |
| 3. https://scholarship.claremont.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=2690&context=cmc_theses | |
| 4. https://www.upgrad.com/blog/bayesian-networks/ Draft Copy | |
| 5. https://www.utas.edu.au/_data/assets/pdf_file/0009/588474/TR_14_BNs_a_resour ce_guide.pdf | |
| 6. https://math.libretexts.org/Bookshelves/Applied_Mathematics/Book%3A_Applied_ Finite_Mathematics_(Sekhon_and_Bloom)/10%3A_Markov_Chains/10.02%3A_Applications_of_Markov_Chains/10.2.01%3A_Applications_of_Markov_Chains_(Exercises) | |
| 7. https://link.springer.com/chapter/10.1007/978-3-319-43742-2_24 | |
| 8. https://homes.cs.washington.edu/~pedrod/papers/kdd02a.pdf | |
| 9. https://core.ac.uk/download/pdf/191938826.pdf | |
| 10. https://cs.brown.edu/research/pubs/theses/ugrad/2005/dbooksta.pdf | |
| 11. https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/Reprints/tutorial%20on%20hmm%20and%20applications.pdf | |
| 12. https://mi.eng.cam.ac.uk/~mjfg/mjfg_NOW.pdf | |
| 13. http://bioinfo.au.tsinghua.edu.cn/member/jgu/pgm/materials/Chapter3-LocalProbabilisticModels.pdf | |
| **Assessment:** | |
| **Continuous Assessment for 40 marks:**<br>1. Test 1– 20 marks<br>2. Test 2– 20 marks | |
| **End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.** | |

# Sem V Multidisciplinary Course-III

| Course Code | Course Name | Credits (TH+P+TUT) |
|---|---|---|
| CEC5051 | Building Industry IoT applications and Application Bank | 3-0-0 |
| | | |
| **Prerequisite:** | Science and Maths till 12th STD or Diploma in Engineering and Fundamentals from earlier semester. | |
| **Course Objectives:** | The course aims to equip students with the skills to develop and deploy IoT applications,<br>with a focus on practical implementation and case studies, including applications in the banking sector. | |
| **Course Outcomes:** | Upon completing this course, students will be able to:<br>1. Design and develop IoT applications in various industries.<br>2. Analyze and evaluate the performance of IoT systems in real-world scenarios.<br>3. Integrate IoT technologies with existing systems to optimize operations. | |
| | | |

| Module No. & Name | Sub Topics | CO mapped | Hrs / Sub topics | Total Hrs / Module |
|---|---|---|---|---|
| **1.IoT Applications** | Home Security -Security solution using IR, Camera and Buzzer | **CO1** | **5** | **60** |
| | Home and Building - Energy Management with Smart Lighting | | **6** | |
| | Smart Irrigation Solution | | **6** | |
| | Agriculture- Water Quality Testing | | **6** | |
| | Healthcare -Smart Pulse Rate and Oxygen Monitoring Solution | | **6** | |
| | Healthcare- Smart Saline Monitoring Solution | | **6** | |
| | Healthcare- Assistive Communication Solution | | **6** | |
| | Weather Forecasting- Wind Speed and humidity measurement | | **6** | |
| | Agriculture- Smart Scalable Farming Solution | | **6** | |
| | Smart Energy Monitoring Solution | | **6** | |
| | Mobile Application Link | | | |

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|---|---|---|---|---|
| **2. IoT Application Bank (Additional Usecases for Self- Study and Practice)** | Home and Building Security- Alarm | | **NA** | **NA** |
| | Home Security Solution- Digital Lock | | | |
| | Agriculture- Smart Irrigation Solution | | | |
| | Home and Building Energy Management- Smart AC | | | |
| | Home and Building Fire Safety Solution | | | |
| | Transportation and Safety Solution | | | |
| | Public Safety-Smart Crowd Management System | | | |
| | Public Safety-Smart LPG Monitoring Solution | | | |
| | Smart City- Waste Management System | | | |
| | Home and Building- Water Management Solution | | | |
| | Smart City- Smart Parking Management System | | | |
| | Healthcare- Smart Stress Monitoring Solution | | | |
| | Mobile Application | | | |
| **Course Conclusion** | Recap of Modules, Outcomes, Applications, and Summarization. | | **1** | **1** |
| | | **Total Hours** | | **60** |

| Course Code | Course Name | Credits | | | |
|---|---|---|---|---|---|
| | | TH | P | TUT | Total |
| CEC5052 | Business Model Development and Prototyping | 03 | - | - | 03 |

| | |
|---|---|
| **Prerequisites:** | Design Thinking and Ideation |
| **Course Objectives (COBs):** | 1. To familiarize learners with business model fundamentals.<br>2. To introduce learners to minimum viable products (MVPs) and iterative prototyping.<br>3. To transition from MVP to a scalable product by identifying product-market fit.<br>4. To teach basic financial literacy for early-stage start-ups.<br>5. To provide an understanding of the incubation process and resources available to start-ups.<br>6. To deepen learning through start-up case studies and practical examples. |
| **Course Outcomes (COs):** | Upon completion of the course, the learners will be able to:<br>1. Design and develop a basic business model for a start-up.<br>2. Create and refine a minimum viable product (MVP) for a business concept<br>3. Create strategies to scale the MVP while managing risks.<br>4. Develop simple revenue and cost projections for a business.<br>5. Evaluate and assess the impact of incubation on start-up success.<br>6. Critique start-up strategies and propose improvements. |

| Module No. and Name | Subtopics | COs Mapped | Hours / Subtopic | Total Hours / Module |
|---|---|---|---|---|
| i. Prerequisites and Course Outline | Prerequisite Concepts and Course Introduction | - | 02 | 02 |
| 1. Introduction to Business Models | Business Model Canvas (BMC): Key Components, Types of Business Model | CO1 | 02 | 06 |
| | Value Proposition and Customer Segments | | 01 | |
| | Examples of Real-World Business Models | | 01 | |
| | Exercises on Building BMC | | 02 | |
| 2. Prototyping and MVP Development | Testing and Refining Prototypes, Iterative Prototyping | CO2 | 02 | 08 |
| | Concept of MVP and Rapid Prototyping | | 02 | |
| | Steps to Develop an MVP | | 02 | |
| | Hands-on: Creating and Iterating MVPs | | 02 | |
| 3. Scaling from MVP to Product-Market Fit | User-Centered Design | CO3 | 02 | 06 |
| | Defining and Measuring Product-Market Fit, Pivoting Strategies, Scaling MVP into Products | | 02 | |
| | Case Studies of Start-ups Scaled from MVP | | 01 | |
| | Go-To-Market (GTM) Strategy for Start-ups | | 01 | |
| 4. Financial Planning for Start-ups | Costing, Pricing, and Revenue Projections | CO4 | 01 | 06 |
| | Understanding Taxation and Unit Economics | | 02 | |
| | Introduction to Funding Stages: Angel Investors, VCs | | 02 | |
| | Case Studies of Financial Successes and Challenges | | 01 | |

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|---|---|---|---|---|
| 5. Pre-incubation and Incubation | Stages of Pre-incubation and Incubation | CO5 | 01 | 06 |
| | Resources and Support Mechanisms | | 01 | |
| | Case Studies of Start-ups in Incubation | | 02 | |
| | Group Activities: Pitching for Incubation | | 02 | |
| 6. Case Studies of Start-ups | Case Studies of Start-ups in India / abroad | CO6 | 02 | 07 |
| | Case Studies of Start-ups using BMC and MVPs | | 02 | |
| | Lessons from Real-World Start-up Failures | | 01 | |
| | Group Presentations and Feedback Sessions | | 02 | |
| ii. Course Conclusion | Recap of Modules, Outcomes, Applications, and Summarization | - | 01 | 01 |
| **Total Hours** | | | | **42** |

| | |
|---|---|
| **Text Books:** | 1. A. Osterwalder and Y. Pigneur, "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010.<br>2. E. Ries. "The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses." Crown Business, 2011. |
| **Reference Books:** | 1. K. Berman and J. Knight, "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers", Harvard Business Review Press, 2008.<br>2. S. Daniel, "How to Start a Business in India", Clever Fox Publishing, 2020. |
| **Useful Online Resource Links:** | 1. https://onlinecourses.nptel.ac.in/noc25_ge11/preview<br>2. https://onlinecourses.swayam2.ac.in/ntr24_ed05/preview<br>3. https://onlinecourses.swayam2.ac.in/ntr24_ed51<br>4. https://www.udemy.com/topic/minimum-viable product |
| **Term Work (TW):** | • Term work will consist of Presentations / Assignments / Class Participation and Performance / Group Activities / etc.<br>• Term work evaluation shall be for Total 50 Marks based on performance. |
| **End Semester Examination (ESE):** | End Semester evaluation shall be of Total 50 Marks in the form of Oral Examination. |

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| **CEL501** | **Computer Network Lab** | **1- 0** |
| **Lab Prerequisite:** | Network Concepts | |
| **Lab Objectives:** | 1. To practically explore OSI layers and understand the usage of simulation tools.<br>2. To analyze, specify and design the topological and routing strategies for an IP based networking infrastructure.<br>3. To identify the various issues of a packet transfer from source to destination, and how they are resolved by the various existing protocols | |
| **Lab Outcomes (LOs):** | **At the end of the course, the student will be able to**<br>1. Design and setup networking environment in Linux.<br>2. Use Network tools and simulators such as NS2, Wireshark etc. to explore networking algorithms and protocols.<br>3. Implement programs using core programming for understanding networking concepts.<br>4. Apply ethical principles like timeliness and adhere to the rules of the laboratory | |

| Lab No | Experiment Title | LO mapped | Hrs/ Lab |
|---|---|---|---|
| **0** | Prerequisite | **-** | **02** |
| **1** | Study of RJ45 and CAT6 Cabling and connection using crimping tool. | **LO1, LO4** | **02** |
| **2** | Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route ) | **LO1, LO4** | **02** |
| **3** | Build a simple network topology and configure it for static routing protocol using packet tracer. Setup a network and configure IP addressing, subnetting, masking. | **LO1, LO4** | **02** |
| **4** | Use Wire shark to understand the operation of TCP/IP layers :<br>• Ethernet Layer: Frame header, Frame size etc.<br>• Data Link Layer : MAC address, ARP (IP and MAC address binding)<br>• Network Layer : IP Packet (header, fragmentation), ICMP (Query and Echo)<br>• Transport Layer: TCP Ports, TCP handshake segments etc.<br>Application Layer: DHCP, FTP, HTTP header formats | **LO2, LO4** | **02** |
| **5** | Installation of Network Simulator (NS2) and create simple network | **LO3, LO4** | **02** |
| **6** | Use simulator (Eg. NS2) to understand functioning of any routing protocol(Stop & wait/Sliding Window) | **LO2, LO4** | **02** |
| **7** | Perform network discovery using discovery tools (eg. Nmap, mrtg | **LO2, LO4** | **02** |
| **8** | Socket programming using TCP or UDP | **LO3, LO4** | **02** |

| | | | |
|---|---|---|---|
| **9** | Perform File Transfer and Access using FTP | **LO2, LO4** | **02** |
| **10** | Perform Remote login using Telnet server | **LO2, LO4** | **02** |
| **11** | Visit-Based Learning: Real-Time Network Configuration and Server Infrastructure at KJSIT | **LO1,LO2, LO3, LO4** | **02** |

**Term work:**

1. Term work should consist of minimum 10 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course ―Computer Networks‖
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

**Practical & Oral :**

Practical & Oral examination will be based on theory and practical syllabus. **CEC503, CEL503**

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| CEL502 | Machine Learning Lab | 1-0 |

| | |
|---|---|
| **Prerequisite:** | 1. Linear Algebra<br>2. Calculus<br>3. Basic Probability and Statistics<br>4. Data Structures<br>5. Algorithms Data Mining<br>6. Python Programming |
| **Lab Objectives:** | 1. To introduce students to the basic concepts and techniques of Machine Learning.<br>2. To introduce Machine Learning Tools<br>3. To have comprehensive hands on with regression methods, classification, Ensemble Learning & clustering methods.<br>4. To demonstrate dimensionality reduction Techniques |
| **Lab Outcomes (LOs):** | **At the end of the course, the students will be able to**<br>1. Explore and utilize ML tools and libraries for model development.<br>2. Apply fundamental machine learning concepts to analyze and solve given problems.<br>3. Design and implement supervised learning algorithms such as regression and classification.<br>4. Implement unsupervised learning techniques like clustering<br>5. Apply ethical principles like timeliness and adhere to the rules of the laboratory |

| Lab No. | Experiment Title | LO mapped | Hrs / Lab |
|---|---|---|---|
| 1 | Exploratory Data Analysis (EDA) on a real-world dataset – data cleaning, feature engineering and outlier detection | LO1, LO2 LO5 | 02 |
| 2 | To implement Linear Regression and evaluate performance metrics (MSE, RMSE, $R^2$). | LO2, LO5 | 02 |
| 3 | Implement Logistic Regression for binary classification (e.g., breast cancer, bank loan dataset). | LO2, LO5 | 02 |
| 4 | Build and evaluate a Decision Tree Classifier with pruning. | LO2, LO5 | 02 |
| 5 | To implement Boosting technique using XGBoost for classification or regression. | LO1,LO3, LO5 | 02 |
| 6 | Explore machine learning models using Virtual Labs: Linear Regression, Logistic Regression, Decision Tree, and Random Forest. | LO1,LO3, LO5 | 02 |
| 7 | To implement Support Vector Machine (SVM) for classification. | LO2, LO5 | 02 |
| 8 | To implement various Clustering algorithm. | LO4,LO5 | 02 |
| 9 | To implement Association rule minging using Apriori algorithm on a transactional dataset | LO3,LO5 | 02 |

| | | | |
|---|---|---|---|
| **10** | To implement and evaluate the performance of Principal Component Analysis ( PCA) and Linear Discriminant Analysis(LDA) | **LO4,LO5** | **02** |
| **11** | To perform machine learning operations for Model Deployment | **LO1, LO2, LO3, LO4, LO5** | **02** |
| **Books:** | | | |
| **Text Books** | 1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition<br>2. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn and TensorFlow 2 3rd Edition | | |
| **Term work:** | | | |

1. Term work should consist of 10 experiments.
2. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
3. Total 25 Marks = 20 Marks for Experiments and 5 for Assignments

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| CEDLL5041 | **Advance Database Management System Lab** | **1- 0** |

| | |
|---|---|
| **Lab Prerequisite:** | Database Concepts |
| **Lab Objectives:** | 1. To build/design a distributed database and query it.<br>2. To write a program to simulate two phase commit protocol, deadlock detection & query optimization<br>3. To build/design NoSQL database and query it.<br>4. To study various replication and distribution techniques in Mongodb. |
| **Lab Outcomes (LOs):** | **At the end of the course, the student will be able to**<br>1. Design and implement distributed database for enterprise application<br>2. Implement two phase commit protocol, deadlock detection , query optimization<br>3. Use XML/JSON for schema integration using Mongodb.<br>4. Implement data modeling using NoSQL concept and implement NoSQL queries using Mongodb<br>5. Describe replication and sharding using Mongodb and<br>6. Apply ethical principles like timeliness and adhere to the rules of the laboratory |

| Lab No. | Experiment Title | LO mapped | Hrs/ Lab |
|---|---|---|---|
| **0** | Assign a case study for 2/3 students and perform the experiments 1,2,8 on their case-study: | **--** | **02** |
| **1** | Creation of centralized database (Global Schema) | **LO1, LO6** | **02** |
| **2** | Perform Fragmentation (PHF, DHF, VF, and HF) and allocation in DDBS design. | **LO1, LO6** | **02** |
| **3** | Implementations of two phase commit protocol. | **LO1, LO6** | **02** |
| **4** | Implementations of deadlock detection in DDB | **LO2, LO6** | **02** |
| **5** | Implementation of query processing | **LO3, LO6** | **02** |
| **6** | Installation:<br>1. Installation of MongoDB ver4.4<br>2. Basic Shell operations<br>3. Working with Shell – Downloading, connecting to the DB server, Creating, using and switching database, Remote access | **LO4, LO6** | **02** |
| **7** | Basic operations:<br>1. Populating database<br>2. Querying: simple search, projection<br>3. Conditional Querying, (and, or, in)<br>4. Advanced Queries: Query on array, Embedded document, NULL and missing fields<br>5. Reading data from json / XML object and querying it<br>6. Updation and deletion of collections | **LO3, LO4, LO6** | **02** |

| | | | |
|---|---|---|---|
| **8** | Data Modeling (To be taught)<br>1. Embedded and Nested schema (De-Normalized)<br>2. Different possible mapping and strategies for the given application | **LO4, LO6** | **02** |
| **9** | Replication and Sharding<br>1. Replication –Primary and Secondary Replica sets and Arbiter<br>2. Deployment: Three Member<br>3. Parameter: no. of members, Voting members, Fault tolerance, load balancing<br>4. High Availability is a major goal of sharding, Sharded Cluster – Shard, Mongo and Config server | **LO5, LO6** | **02** |

**Minor Project**

Minor Project should consist of small problem statement with entities having mulivalued, compound attribute- 1:N relationships etc.
One problem statement can be given to 3 to 4 groups, Each group can think for different design. Development of Front end and simple and few advance queries related to embedded documents and collections.

**Term work:**

1. Term work should consist of minimum 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course ―Advance Database Management System‖
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

**Useful Links:**

Installation

Ref: https://docs.mongodb.com/manual/installation/ Use Community edition
Ref: https://docs.mongodb.com/manual/reference/mongo-shell/

Use of mongoDb Cloud- atlas

Ref: Deployment on cloud: https://docs.atlas.mongodb.com/

Data Modeling:

Ref: https://docs.mongodb.com/manual/core/data-modeling-introduction/
https://www.mongodb.com/presentations/data-modeling-with-mongodb
PPT: mongodb_data_modeling_with_mongodb-44y55ekiu3.pdf

Replication and sharding:
Ref: https://docs.mongodb.com/manual/replication/ Ref:
https://docs.mongodb.com/manual/sharding/

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| CEDLL5052 | Internet Programming Lab | 0-1-0 |

| | |
|---|---|
| **Lab Prerequisite:** | Basics of Programming Languages |
| **Lab Objectives:** | 1. **To design and structure responsive web pages** using Figma, HTML5, and CSS3.<br><br>2. **To enhance user interfaces** through client-side scripting with JavaScript, jQuery, and Bootstrap 5.<br><br>3. **To implement asynchronous communication** using AJAX with PHP or jQuery for dynamic data updates.<br><br>4. **To perform server-side programming and database operations** using PHP with MySQL, and Node.js with MongoDB.<br><br>5. **To build and deploy full-stack web applications** using the MERN stack (MongoDB, Express, React, Node.js). |
| **Lab Outcomes (LOs):** | At the end of the course, the student will be able to<br><br>1. C**reate responsive and accessible web layouts** using HTML5, CSS3, and design tools like Figma.<br><br>2. Implement **form validation and UI interactivity** using JavaScript and jQuery.<br><br>3. Develop **dynamic web pages with real-time data loading** using AJAX and REST APIs.<br><br>4. Students will implement **server-side logic and database connectivity** using PHP-MySQL and Node.js-MongoDB.<br><br>5. Students will build and deploy **complete full-stack web applications**<br><br>6. Apply ethical principles like timeliness and adhere to the rules of the laboratory |

| Lab No | Experiment Title | LO mapped | Hrs/Lab |
|---|---|---|---|
| **0** | Lab Prerequisites | **-** | **02** |
| **1** | Designing a Responsive Portfolio Website Wireframe Using Figma and Implementing Layout with HTML5 | **LO1, LO6** | **02** |
| **2** | Applying CSS3 and Bootstrap 5 to Style and Enhance a Responsive Portfolio Website | **LO1, LO6** | **02** |
| **3** | Design Form Design and Client-Side Validation using:<br>a. Javascript and HTML5<br>b. Javascript and Jquery | **LO2, LO6** | **02** |

| | | | |
|---|---|---|---|
| **4** | Designing a dynamic web interface with AJAX and jQuery to demonstrate Rich Internet Application Features. | **LO3, LO6** | **02** |
| **5** | Design and develop basic calculator using PHP | **LO4, LO6** | **02** |
| **6** | Develop interactive web pages using PHP with database connectivity MYSQL | **LO4, LO6** | **02** |
| **7** | Creating a Complete CRUD Web Application with Node.js, Express, and MongoDB | **LO4, LO6** | **02** |
| **8** | Implement a web page using Ajax and PHP | **LO4, LO6** | **02** |
| **9** | Develop simple application using React js | **LO5, LO6** | **02** |
| **10** | Developing a Full-Stack MERN Application: Integrating React Frontend with Express and MongoDB Backend | **LO5, LO6** | **02** |

**Term work:**

1. Term work should consist of 10 experiments.
2. It should consist of minor project based on the content of the syllabus (Group of 2-3 students)
3. Journal must include at least 2 assignments on content of theory and practical of the course "Internet Programming"
4. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work, miniproject work and minimum passing marks in term work.
5. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| **CEDLL5043** | **Web Security Lab** | 1- 0 |
| | | |
| **Lab Prerequisite:** | **1. Computer Networks.**<br><br>**2. Cryptography and System Security** | |
| **Lab Objectives:** | 1. To provide hands-on experience in network monitoring and traffic analysis.<br>2. To train students in internal and external penetration testing methodologies.<br>3. To perform vulnerability scanning using industry-standard tools.<br>4. To assess the security of web applications. | |
| **Lab Outcomes (LOs):** | At the end of the course, the students will be able to<br><br>1. Design for monitoring network traffic.<br>2. Perform different penetration testing methods.<br>3. Design different types of vulnerabilities scanning.<br>4. Understand web application assessment.<br>5. Identify hosts and services using discovery techniques.<br>6. Analyze and interpret network security data. | |
| | | |

| Lab No | Experiment Title | LO mapped | Hrs/Lab |
|---|---|---|---|
| **1** | **Monitoring Network Traffic**<br>Use tools like Wireshark or TCPDump to capture and analyze network packets | **LO1,**<br><br>**LO7** | **2hrs** |
| **2** | **Host and Services Discovery using Nmap**<br>Perform host identification and enumerate running services. | **LO2,**<br><br>**LO7** | **2hrs** |
| **3** | **Vulnerability Scanning using OpenVAS**<br>Detect known vulnerabilities in networked systems using OpenVAS. | **LO2,**<br><br>**LO7** | **2hrs** |
| **4** | **Internal Penetration Testing**<br>a. Network Mapping<br>b. Scanning and Enumeration<br>c. Sniffing POP3/FTP/Telnet Passwords<br>d. ARP Poisoning<br>e. DNS Poisoning | **LO3,**<br><br>**LO7** | **2hrs** |

| | | | |
|---|---|---|---|
| **5** | **External Penetration Testing**<br>a. Evaluate External Infrastructure<br>b. Create Topological Map and Identify Target IP<br>c. Domain Registry Lookup<br>d. Examine IPv6 Usage at Remote Sites | **LO4, LO7** | **2hrs** |
| **6** | **Different Types of Vulnerability Scanning**<br>Compare passive and active scanning, authenticated vs unauthenticated scans. | **LO4, LO7** | **2hrs** |
| **7** | **Vulnerability Scanning with Nessus**<br>Use Nessus to identify vulnerabilities, misconfigurations, and compliance issues. | **LO4, LO7** | **2hrs** |
| **8** | **Web Application Assessment using Nikto**<br>Scan web applications for dangerous files, outdated server software, etc. | **LO1, LO4, LO7** | **2hrs** |
| **9** | **Web Application Assessment using Burp Suite**<br>Perform manual and automated testing of web application security | **LO1, LO4, LO7** | **2hrs** |
| **10** | **Report Generation and Remediation Suggestions**<br>Generate detailed reports from scans and provide mitigation strategies. | **LO5, LO6, LO7** | **2hrs** |
| **Term Work:** | | | |
| 1 | Term work should consist of 8 experiments. | | |
| 2 | Journal must include at least 2 assignments on content of theory and practical of "Web Security " | | |
| 3 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. | | |
| 4 | The distribution of marks for term work shall be as follows:<br>Lab Performance 15 Marks<br>Assignments 05 Marks<br>Attendance (Theory & practical) 05 Marks | | |

| Lab Code | Lab Name | Credits (P+TUT) |
|---|---|---|
| **CEDLL5044** | **Probabilistic Graphical Models Lab** | **1- 0** |

| | |
|---|---|
| **Lab Prerequisite:** | 1. Engineering Mathematics<br>2. Discrete Structure |
| **Lab Objectives:** | 1. To give comprehensive introduction of probabilistic graphical models.<br>2. To make inferences, learning, actions and decisions while applying these models<br>3. To introduce real-world trade offs when using probabilistic graphical models in practice<br>4. To develop the knowledge and skills necessary to apply these models to solve real world problems. |
| **Lab Outcomes (LOs):** | **At the end of the course, the student will be able to**<br>1. Explore probability theory and it uses.<br>2. Devise the functionality of Graph Theory<br>3. Implement Bayesian Network modelling.<br>4. Implement Markov Chain and HMM modelling<br>5. Implement the decision tree, maximum likelihood estimation.<br>6. Explore the problem of learning with optimization<br>7. Apply ethical principles like timeliness and adhere to the rules of the laboratory |

| Lab No | Experiment Title | LO mapped | Hrs/ Lab |
|---|---|---|---|
| **0** | Prerequisite | **-** | **02** |
| **1.** | Experiment on Probability Theory | **LO1,LO7** | **02** |
| **2.** | Experiment on Graph Theory | **LO2,LO7** | **02** |
| **3.** | Experiment on Bayesian Network Modelling | **LO3,LO7** | **02** |
| **4.** | Experiment on Markov Chain Modeling | **LO4,LO7** | **02** |
| **5.** | Experiment on HMM | **LO4,LO7** | **02** |
| **6.** | Experiment on Maximum Likelihood Estimation | **LO5,LO7** | **02** |
| **7.** | Decision Making using Decision Trees | **LO5,LO7** | **02** |
| **8.** | Case Study on Learning with Optimization | **LO6,LO7** | **02** |

**Term work:**

1. Term work should consist of minimum 08 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course ―Probabilistic Graphical Model‖
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

| Course code | Course Name | Credits (P+TUT) |
|---|---|---|
| **CEPR54** | **Community Engagement PBL - Minor Project** | **1 – 0** |

| | |
|---|---|
| **PBL Objectives:** | 1. To understand and identify the problem.<br>2. To apply basic engineering fundamentals and attempt to find solutions to the problems.<br>3. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach.<br>4. To develop communication skills and improve teamwork amongst group members and inculcate the process of self-learning and research. |
| **PBL Outcome:** | **Learner will be able to..**<br>1. Identify societal/research/innovation/entrepreneurship problems through appropriate literature survey.<br>2. Identify methodology for solving above problems and apply engineering knowledge to solve and validate the result using test cases /benchmark data/theoretical/inferences/ experiments/ simulations.<br>3. Use standard norms of engineering practices and project management principals to analyze and evaluate the impact of solution/product/research/innovation/entrepreneurship towards societal/environmental/sustainable development.<br>4. Communicate through technical report writing and oral presentation.<br>5. Gain technical competency towards participation in competitions, hackathons, etc.<br>6. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning to develop interpersonal skill to work as a member of a group or as a leader. |

**Guidelines for Minor Project**

| | |
|---|---|
| 1 | Minor project may be carried out in one or more form of following:<br>Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc. |
| 2 | Students shall form a group of 3 students, as it is a group activity. |
| 3 | Students should do survey and identify needs, which shall be converted into problem statement for minor project in consultation with faculty supervisor/head of department/internal committee of faculties. |
| 4 | Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of minor project. |

| | |
|---|---|
| 5 | The work may result in research/white paper/ article/blog writing and publication and also the work may result in business plan for entrepreneurship product created. The work may result in patent filing. |
| 6 | Faculty supervisor may give inputs to students during minor project activity; however, focus shall be on self-learning. |
| 7 | Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor. |
| 8 | Students shall convert the best solution into working model using various components of their domain areas and demonstrate. |
| 9 | The solution to be validated with proper justification and report to be compiled in standard Format. Software requirement specifications (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report. |
| 10 | With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Minor Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Minor Project 1 & 2 in semesters V and VI. |
| 11 | However, based on the individual students or group capability, with the mentor,,s recommendations, if the proposed Minor Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Minor Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis. |

**Term Work:**

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of minor project to be evaluated on continuous basis, based on the SRS document submitted. Minimum two reviews in each semester.

In continuous assessment focus shall also be on each individual student, assessment based on individual,,s contribution in group activity, their understanding and response to questions. It also based on the Log Book maintained by the students and weekly progress meeting.

| | **Distribution of Term work marks for both semesters shall be as below:** | **Marks** |
|---|---|---|
| 1 | Marks awarded by guide | 10 |
| 2 | Marks awarded by review committee | 10 |
| 3 | Quality of Project report | 05 |

Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines

## One-year project:

| | |
|---|---|
| 1 | In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.<br>• First shall be for finalization of problem<br>• Second shall be on finalization of proposed solution of problem. |

| | |
|---|---|
| 2 | In second semester expected work shall be procurement of component,,s/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.<br>• First review is based on readiness of building working prototype to be conducted.<br>• Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester. |
| **Half-year project:** | |
| 1 | In this case in one semester students,, group shall complete project in all aspects including,<br>• Identification of need/problem<br>• Proposed final solution<br>• Procurement of components/systems<br>• Building prototype and testing |
| 2 | Two reviews will be conducted for continuous assessment,<br>• First shall be for finalization of problem and proposed solution<br>• Second shall be for implementation and testing of solution. |
| **Assessment criteria of Minor Project.** | |
| **Minor Project** shall be assessed based on following criteria; | |
| 1 | Clarity of problem and quality of literature Survey for problem identification |
| 2 | Requirement gathering via SRS/ Feasibility Study |
| 3 | Completeness of methodology implemented |
| 4 | Design, Analysis and Further Plan |
| 5 | Novelty, Originality or Innovativeness of project |
| 6 | Societal / Research impact |
| 7 | Effective use of skill set : Standard engineering practices and Project management Standard |
| 8 | Contribution of an individual,,s as member or leader |
| 9 | Clarity in written and oral communication |
| 10 | Verification and validation of the solution/ Test Cases |
| 11 | Full functioning of working model as per stated requirements |
| 12 | Technical writing /competition/hackathon outcome being met |
| In one year project (sem V and VI), first semester evaluation may be based on first 10 criteria and remaining may be used for second semester evaluation of performance of students in minor projects. | |
| In case of half year projects (completing in VI sem) all criteria,,s in generic may be considered for evaluation of performance of students in minor projects. | |
| **Guidelines for Assessment of Minor Project Practical/Oral Examination:** | |
| 1 | Report should be prepared as per the standard format. |
| 2 | Minor Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by the head of Institution. |
| 3 | Students shall be motivated to publish a paper/participate in competition based on the work in Conferences/students competitions. |

| Course Code | Skill Based Learning | Credits (P+TUT) |
|---|---|---|
| **CEXS510** | **Aptitude/Logic Building and Competitive Programming skills** | **1+0** |
| **Skill Prerequisite** | 1. Knowledge of elementary mathematics (HSC level)<br>2. Knowledge of basic English grammar (SSC level)<br>3. Knowledge of Basic programming languages | |
| **Skill Objectives** | 1. To have the basic awareness about how to prepare for recruitment process<br>2. To introduce the students to computational skills required to appear for recruitment tests.<br>3. To introduce the students to coding skills required to appear for recruitment tests/ project /coding competitions. | |

| | |
|---|---|
| **Skill Outcomes** | Discuss the basic concepts of QUANTITATIVE ABILITY<br>Discuss the basic concepts of LOGICAL REASONING Skills<br>Acquire satisfactory competency in use of VERBAL REASONING<br>Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability<br>Use most common algorithms for competitive programming<br>Analyse data structures for competitive up solving. |

| Module No & Name | Sub Topics | SO mapped | Hrs /Sub topic | Total Hrs/ Module |
|---|---|---|---|---|
| 1. **Basics of Quantitative Abilities** | 1.1Problems on Number System Problems on HCF and LCM Problems on Average | **SO1, SO4** | **02** | **04** |
| | 1.2Problems on Ratio and Proportion, Problems on Percentage | | **02** | |
| 2. **Arithmetic Quantitative Abilities** | 2.1Problems on Ages, Problems on Profit and Loss | **SO1, SO4** | **02** | **04** |
| | 2.2Problems on Simple and Compound Interest, Problems on Time and Distance | | **02** | |
| 3. **Logical Reasoning and verbal reasoning** | 3.1Number Series, Alpha Numerical, Letter & Symbol Series | **SO2,SO3, SO4** | **02** | **02** |
| | 3.2 Numerical and Alphabet Puzzles, Seating Arrangem nt | | | |
| | 3.3 Verbal reasoning | | | |
| **4.** | 4.1What is Competitive Programming? | **SO5** | **02** | **05** |

| | | | | |
|---|---|---|---|---|
| **Programming Techniques** | Programming Contests, Language Features | | | |
| | 4.2 Recursive Algorithms, Bit Manipulation | | **03** | |
| **5. Sorting and Searching** | Sorting Algorithms, Solving Problems by sorting, Binary Search | **SO6** | **05** | **05** |
| | | | **Total:** | **20** |

**Text Books:**

1. Quantitative abilities by Arun Sharma
2. Quantitative Aptitude for Competitive Examinations by R S Agrawal
3. Verbal and Non-Verbal reasoning by R S Agrawal
4. Guide to Competitive Programming Learning and Improving Algorithms Through Contests Antti Laaksonen, Department of Computer Science, University of Helsinki, Finland

**Reference Books:**

1. Algorithms Illuminated by Tim Roughgarden
2. Algorithm Design, Jon Kleinberg and Éva Tardos
3. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein
4. Competitive Programming 4: The Lower Bound of Programming Contests in the 2020s by Steven Halim and Felix Halim
5. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests Antti Laaksonen.

**Useful Links:**

1. https://doi.org/10.1007/978-3-319-72547-5
2. Algorithms by Jeff Erickson (freely available online)
3. https://onlinecourses.nptel.ac.in/noc21_cs99/preview
4. https://unacademy.com/a/i-p-c-beginner-track

**Online Resources:**

| Sr. No. | **Courses Link** |
|---|---|
| 1 | https://onlinecourses.nptel.ac.in/noc22_hs84/preview |
| 2 | https://onlinecourses.nptel.ac.in/noc22_hs141/preview |
| 3 | https://onlinecourses.nptel.ac.in/noc22_hs123/preview |
| 4 | https://www.coursera.org/learn/spanish-vocabulary-meeting-people<br>https://www.coursera.org/learn/spanish-vocabulary-cultural-experience<br>https://www.coursera.org/learn/spanish-vocabulary-sports-travel-home<br>https://www.coursera.org/learn/spanish-vocabulary-careers<br>https://www.coursera.org/learn/spanish-vocabulary-project |

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| 5 | https://www.coursera.org/learn/korean-beginners<br>https://www.coursera.org/learn/learn-korean<br>https://www.coursera.org/learn/learn-speak-korean1 |
| | https://www.coursera.org/learn/the-korean-alphabet-an-introduction-to-hangeul |
| 6 | https://www.udemy.com/course/complete-french-course/ |
| 7 | https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/ |
| 8 | https://www.udemy.com/course/spanish-101-beginning-spanish-spanish-for-beginners/ |
| 9 | https://www.udemy.com/course/complete-japanese-course-learn-japanese-for-beginners-lvl-1/ |
| 10 | https://www.udemy.com/course/complete-korean-course-learn-korean-for-beginners-level-1/ |
| 11 | https://www.udemy.com/course/the-complete-russian-language-course/ |
| 12 | https://onlinecourses.nptel.ac.in/noc22_hs114/preview |
| 13 | https://onlinecourses.nptel.ac.in/noc22_hs85/preview |
| 14 | https://onlinecourses.nptel.ac.in/noc22_hs139/preview |

| Course code | Course Name | TH-P-T | Credits | Total |
|---|---|---|---|---|
| **CEXA511** | **Value Education – SAT XI: Activity Based Learning: Business Communication & Ethics** | **0-2-0** | **0-2-0** | **02** |
| **Prerequisite:** | Fundamental knowledge of Professional Communication Skills as acquired in semester II | | | |
| **Course Rationale:** | This curriculum is designed to build up a professional and ethical approach, effective oral and written communication with enhanced soft skills. Through practical sessions, it augments student's interactive competence and confidence to respond appropriately and creatively to the implied challenges of the global Industrial and Corporate requirements. It further inculcates the social responsibility of engineers as technical citizens. | | | |
| | | | | |
| **Course Objectives:** | 1. To discern and develop an effective style of writing important technical/business documents.<br>2. To investigate possible resources and plan a successful job campaign.<br>3. To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.<br>4. To develop creative and impactful presentation skills.<br>5. To analyze personal traits, interests, values, aptitudes and skills<br>6. To understand the importance of integrity and develop a personal code of ethics. | | | |
| | | | | |
| **Course Outcomes:** | **At the end of the course, the student will be able to**<br>1. Plan and prepare effective business/ technical documents which will in turn provide a solid foundation for their future managerial roles.<br>2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry.<br>3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.<br>4. Deliver persuasive and professional presentations.<br>5. Develop creative thinking and interpersonal skills required for effective professional communication.<br>6. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour. | | | |
| **Module** | **Contents** | **CO mapped** | **Hrs / Sub Topics** | **Total Hrs/ Module** |
| **i. Prerequisite and Course Outline** | Prerequisite Concepts and Course Introduction | **-** | **02** | **02** |
| **1. Advanced Technical Writing: Project/Problem Based** | **Classification of Reports:** Classification on the basis of Subject Matter (Technology, Accounting, Finance, Marketing, etc.) Time Interval (Periodic, One-time, Special) Function (Informational, Analytical, etc.)<br>Physical Factors (Memorandum, Letter, Short & Long) | **CO1, CO6** | **01** | **06** |

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| **Learning (Pbl)** | **Parts of a Long Formal Report:** Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter) | | **01** | |
| | **Language and Style of Reports:** Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables and Equations, Proofreading through Plagiarism Checkers | | **01** | |
| | **Definition, Purpose & Types of Proposals:** Solicited (in conformance with RFP) & Unsolicited Proposals Types (Short and Long proposals) | | **01** | |
| | **Parts of a Proposal**: Elements, Scope and Limitations, Conclusion | | **01** | |
| | **Technical Paper Writing:** Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References), Language and Formatting, Referencing in IEEE Format | | **01** | |
| **2. Employment Skills** | **Personal Interviews:** Planning and Preparation **,** Types of Questions , Types of Interviews (Structured, Stress, Behavioral, Problem Solving & Case-based), Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual | **CO2, CO4** | **01** | **06** |
| | **Cover Letter & Resume:** Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resume (Chronological, Functional & Combination) | | **01** | |
| | **Verbal Aptitude Test:** Modelled on CAT, GRE, GMAT exams | | **01** | |
| | **Group Discussions:** Purpose of a GD, Parameters of Evaluating a GD | | **01** | |
| | Types of GDs (Normal, Case-based & Role Plays) | | **01** | |
| | GD Etiquettes | | **01** | |
| **3.Business Meetings** | **Conducting Business Meetings**: Types of Meetings, Meeting etiquettes | **CO3, CO6** | **01** | **02** |
| | **Documentation:** Notice, Agenda, Minutes | | **01** | |
| **4. Technical/ Business Presentations** | **Effective Presentation Strategies**: Defining Purpose, Analyzing Audience, Location and Event, Gathering, Selecting & Arranging Material | **CO2, CO4** | **01** | **02** |
| | Structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a Presentation | | **01** | |
| **5.** | Emotional Intelligence | **CO5,** | **01** | **08** |

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| **Interpersonal Skills** | Motivation | **CO6** | **01** | |
| | Assertiveness | | **01** | |
| | Time Management | | **02** | |
| | Stress Management | | **02** | |
| | **Start-up Skills:** Financial Literacy, Risk Assessment , Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.) | **CO2, CO5** | **01** | |
| **6. Corporate Ethics** | **Intellectual Property Rights:** Copyrights, Trademarks, Patents | **CO1 to CO6** | **01** | **02** |
| | **Case Studies:** Cases related to Business/ Corporate Ethics | | **01** | |
| **ii. Course Conclusion** | Recap of Modules, Outcomes, Applications and Summarization. | **-** | **01** | **01** |
| **Total Hours** | | | | **28** |
| **Books:** | | | | |
| **Text Books** | 1. Sanjay Kumar &PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.<br>2. Bovée, C. L., &Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ: Pearson. | | | |
| **Reference Books** | 1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.<br>2. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.<br>3. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). Personal development for life and work. Mason: South-Western Cengage Learning.<br>4. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson.<br>5. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press<br>6. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness. Oxford University Press | | | |
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| **Activity .No** | **Activity/ AssignmentTitle**<br><br>**(In the form of Short Notes, Questionnaire/ MCQ Test, RolePlay,Case Study, Quiz, etc.)** | **Hrs/Lab** |
|---|---|---|
| 1 | Test of English as Foreign Language (TOEFL) | **2 hr** |
| 2 | Group discussion (Practice session)-I | **2 hr** |
| 3 | Group discussion (Practice session)-II | **2 hr** |

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| 4 | Final Group discussion-I | **2 hr** |
| 5 | Final Group discussion-II | **2 hr** |
| 6 | English Aptitude Test | **2 hr** |
| 7 | Resume Writing | **2 hr** |
| 8 | Mock interview | **2 hr** |
| 9 | Role play techniques for interpersonal skills | **2 hr** |
| 10 | Project Report Presentation-I | **2 hr** |
| 11 | Project Report Presentation -II | **2 hr** |
| 12 | Technical proposal | **2 hr** |
| 13 | Corporate Ethics/role play/case studies | **2 hr** |
| 14 | Business Meetings: case studies/role play | **2 hr** |

**Useful Video links:**

| **Sr. No.** | **Topic** | **Links** |
|---|---|---|
| 1 | TOEFL listening Skill | https://www.youtube.com/watch?v=jSUh0Civuv4 |
| 2 | MBA Interview | https://www.youtube.com/watch?v=cwW9QBNuwCw |
| 3 | How to write a successful CV | https://www.youtube.com/watch?v=U0JAfqEak2c |
| 4 | Interview techniques (How to answer tell me about yourself) | https://www.youtube.com/watch?v=m5kR7TPAkSw |
| 5 | The 4 types of team members youcan hire | https://www.youtube.com/watch?v=5bYYFfpbSqc |
| 6 | Every Meeting Ever | https://www.youtube.com/watch?v=K7agjXFFQJU |

**Assessment:**

**Term Work (25 Marks)**

Term work of 25 Marks shall consist of a minimum 8 Assignments.

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

Assignment : 15 Marks Book Report (hard copy) : 10 Marks

Note: The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Oral (25 Marks)**

Oral Examination will be based on a GD & the Project/Book Report presentation.

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| 1 | Group Discussion : 10 Marks |
| 2 | Project Presentation: 15 Marks |

***Note***:

1. The Main Body of the project/book report should contain a minimum ***25 pages*** (excludingFront and Back matter).
2. The group size for the final report presentation should not be less than 5 students or exceed 7students.
3. There will be an end–semester presentation based on the book report.