Program Structure for Third Year Computer Engineering
Semester-V - Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC501	Theory of Computer Science	3– 0 – 0	03	3– 0 – 0	03	PC
CEC502	Software Engineering	3– 0 – 0	03	3– 0 – 0	03	PC
CEC503	Computer Network	3– 0 – 0	03	3– 0 – 0	03	PC
CEC504	Data Warehousing and Mining	3– 0 – 0	03	3– 0 – 0	03	PC
CEDLC505	Department Level Elective -I	3 – 0 – 0	03	3 – 0 –0	03	PE/DLE
CEL502	Software Engineering Lab	0 – 2 –0	02	0 – 1 – 0	01	PC
CEL503	Computer Network Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL504	Data Warehousing and Mining Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEDLL505	Department Level Elective -I Lab	0 – 2 – 0	02	0 – 1 – 0	01	PE/DLE
CEL506	Business Communication & Ethics	0 – 4** – 0	04	0 – 2 – 0	02	BS
CEPR53	Project Based Learning- Minor Project Lab-I	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
CEXS57	Skill Based Learning (SAT-VII) Aptitude/Logic Building and Competitive Programming skills	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
CEXT58	Technology Based Learning (SAT-VIII) Courses like NPTEL, Coursera, etc.	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
INT51	Internship-IV	2 to 4 Weeks		--	--	INT
	Total	**15– 18 – 0**	**33**	**15- 09- 0**	**24**	

*Load of learner, not the faculty $SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.
**2 hours class wise and 2 hours batchwise

Minor Project I and II: Students can form groups with minimum 2 (Two) and maximum 4(Four)   Faculty Load: 1 hour per week per four groups

Semester-V- Examination Scheme

Course Code	Course Name	Marks									
		CA				ESE	TW	O	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA						
CEC501	Theory of Computer Science	30	30	30	10	60	--	--	--	--	100
CEC502	Software Engineering	30	30	30	10	60	--	--	--	--	100
CEC503	Computer Network	30	30	30	10	60	--	--	--	--	100
CEC504	Data Warehousing and Mining	30	30	30	10	60	--	--	--	--	100
CEDLC505	Department Level Elective-I	30	30	30	10	60	--	--	--	--	100
CEL502	Software Engineering Lab	--	--	--	--	--	25	25	--	--	50
CEL503	Computer Network Lab	--	--	--	--	--	25	--	--	25	50
CEL504	Data warehousing and mining Lab	--	--	--	--	--	25	--	--	--	25
CEDLL505	Department Level Elective -I Lab	--	--	--	--	--	25	--	--	--	25
CEL506	Business Communication & Ethics	--	--	--	--	--	25	25	--	--	50
CEPR53	Project Based Learning- Minor Project Lab-I	--	--	--	--	--	25	--	--	25	50
CEXS57	Skill Based Learning (SAT-VII) Aptitude/Logic Building and Competitive Programming skills	--	--	--	--	--	25	--	--	--	25
CEXT58	Technology Based Learning (SAT-VIII) Courses like NPTEL, Coursera, etc.)	--	--		--	--	25	--	--	--	25
INT51	Internship-IV	--	--	--	--	--	--	--	--	--	--
	Total	**150**	**150**	**150**	**50**	**300**	**200**	**50**	**--**	**50**	**800**

Department Level Elective Courses

Department Optional Courses	Semester	Group (A, B, C, D)	Choice of Group
Department Level Elective -I	V	CEDLC5051: Advance Database Management System CEDLC5052: Internet Programming CEDLC5053: Internet of Things CEDLC5054: Probabilistic Graphical Models	Group A: Databases/Data Science Group B: Network & Communications Group C: Security / IoT / Blockchain Group D: AI/ ML/ DL

Course Code	Course Name	Credits (TH+P+TUT)
CEC501	**Theory of Computer Science**	**4- 0 – 0**

Prerequisite:	Discrete Structure

Course Objectives:	1. Acquire conceptual understanding of fundamentals of grammars and languages. 2. Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata. 3. Develop understanding of different types of Turing machines and applications. 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:** 1. Describe concepts of Theoretical Computer Science, difference and equivalence of DFA and NFA. 2. Discuss key notions of regular expression and pumping lemma for regular language. 3. Design Context free and regular grammar to recognize the language. 4. Solve problems on push down Automata. 5. Develop an understanding of computation through Turing Machine. 6. Acquire fundamental understanding of decidability and undecidability.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction	-		02
1. Basic Concepts of a Finite Automata	Importance of TCS, Alphabets, Strings, Languages, Closure properties, Finite Automata (FA) and Finite State machine (FSM).	CO1	03	09
	Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, Equivalence between NFA with and without ε- transitions, NFA to DFA Conversion, Minimization of DFA, FSM with output: Moore and Mealy machines, Applications and limitations of FA.		06	
2. Regular Expressions and Languages	Regular Expression (RE), Equivalence of RE and FA, Arden's Theorem, RE Applications	CO2	03	07
	Regular Language (RL), Closure properties of RLs, Decision properties of RLs, Pumping lemma for RLs		04	
3. Grammar	Grammars and Chomsky hierarchy	CO3	02	08

	Regular Grammar (RG), Equivalence of Left and Right linear grammar, Equivalence of RG and FA		03	
	Context Free Grammars (CFG) Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity, Simplification and Applications, Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF), Context Free language (CFL) - Pumping lemma, Closure properties.		03	
4. Pushdown Automata (PDA)	Definition, Language of PDA, PDA as generator, decider and acceptor of CFG.	CO4	02	04
	Deterministic PDA, Non- Deterministic PDA, Application of PDA.		02	
5. Turing Machine (TM)	Definition, Design of TM as generator, decider andacceptor	CO5	04	09
	Variants of TM: Multitrack, Multitape, Universal TM, Applications, Power and Limitations of TMs.		05	
6. Undecidability	Decidability and Undecidability, Recursive and Recursively Enumerable Languages.	CO6	01	02
	Halting Problem,Rice's Theorem, Post Correspondence Problem		01	
ii. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	01
Total Hours				42

Books:	
Text Books	1. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2008. 2. Michael Sipser, "Theory of Computation", 3rd Edition, Cengage learning. 2013. 3. Vivek Kulkarni, "Theory of Computation", Illustrated Edition, Oxford University Press, (12 April 2013) India
Reference Books	1. J. C. Martin, "Introduction to Languages and the Theory of Computation", 4 th Edition, Tata McGraw Hill Publication. 2. Kavi Mahesh, "Theory of Computation: A Problem Solving Approach", Kindle Edition, Wiley-India, 2011.

Useful Links:
1. www.jflap.org
2. https://nptel.ac.in/courses/106/104/106104028/
3. https://nptel.ac.in/courses/106/104/106104148/

Assessment:

Continuous Assessment for 40 marks:
1. Test 1 – 30 marks 2. Test 2 – 30 marks

3. Internal assessment --10 marks
Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Course Code	Course Name	Credits (TH+P+TUT)
CEC502	**Software Engineering**	3 - 0 – 0

Prerequisite:	1. Object Oriented Programming with Java 2. Python Programming
Course Objectives:	1. To provide the knowledge of software engineering discipline. 2. To apply analysis, design and testing principles to software project development. 3. To demonstrate and evaluate real world software projects.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Identify requirements & assess the process models. 2. Plan, schedule, estimation and track the progress of the projects. 3. Design the software projects. 4. Do testing of software project. 5. Identify risks, manage the change to assure quality in software projects. 6. Explain the concept of maintenance and its types

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub topics	Total Hrs/ Module
i. Prerequisites and Course outline	Class, Objectst, Examples, Characterstics of OOPS	-	01	02
			01	
1. Introduction To Software Engineering and Process Models	Software Engineering-process framework, the Capability Maturity Model (CMM), Advanced Trends in Software Engineering.	CO1	01	07
	Prescriptive Process Models: The Waterfall, Incremental Process Models, Evolutionary Process Models: RAD & Spiral.		05	
	Agile process model: Extreme Programming (XP), Scrum, Kanban		01	
2. Software Requirements Analysis and Modeling	Requirement Engineering, Requirement Modeling, Data flow diagram.	CO1	01	04
	Scenario based model.		02	
	Software Requirement Specification document format(IEEE)		01	
3. Software Estimation Metrics	Software Metrics.	CO2	01	07
	Software Project Estimation (LOC, FP, COCOMO II)		05	
	Project Scheduling & Tracking		01	
4. Software Design	Design Principles & Concepts, Effective Modular Design	CO3	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	CO4	01	06

	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).	CO5, CO6	02	08
	Quality Concepts and Software Quality assurance Metrics, Formal Technical Reviews, Software Reliability,The Software Configuration Management (SCM)		02	
	Version Control and Change Control		02	
	Types of Software Maintenance, Re-Engineering, Reverse Engineering		02	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	01
Total Hours				42

Books:	
Text Books	1. Roger Pressman, "Software Engineering: A Practitioner's Approach", 9th edition ,McGraw-Hill Publications, 2019 2. Ian Sommerville, "Software Engineering", 9th edition, Pearson Education, 201. 3. Ali Behfrooz and Fredeick J. Hudson, "Software Engineering Fundamentals", Oxford University Press, 1997 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 2. Rajib Mall, "Fundamentals of Software Engineering", 5th edition, Prentice Hall India, 2014 4. Jibitesh Mishra and Ashok Mohanty, "Software Engineering", Pearson , 2011 5. Ugrasen Suman, "Software Engineering – Concepts and Practices", Cengage Learning,2013 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 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC503	**Computer Networks**	3 - 0 - 0

Prerequisite:	Digital Communication Fundamentals
Course Objectives:	1. To introduce concepts and fundamentals of data communication and computer networks. 2. To explore the inter-working of various layers of OSI. 3. To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite. 4. To assess the strengths and weaknesses of various routing algorithms. 5. To understand various transport layer and application layer protocols.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model with TCP/IP model. 2. Explore different design issues at data link layer. 3. Design the network using IP addressing and sub netting / supernetting schemes 4. Analyze various routing algorithms and protocols at network layer 5. Analyze transport layer protocols and congestion control algorithms. 6. Explore protocols at application layering.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	**02**	**02**
1. Introduction to Networking	Introduction to computer network, network application, network software and hardware components (Interconnection networking devices)	**CO1**	**01**	**05**
	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.	**CO1**	**03**	**04**
	Unguided Media		**01**	
3.Data Link Layer	DLL Design Issues (Services, Framing, Error Control, Flow Control)	**CO2**	**01**	**08**
	Error, Detection and Correction(Hamming Code, CRC, Checksum)		**04**	
	Elementary Data Link protocols , Stop and Wait, Sliding Window(Go Back N, Selective Repeat)		**03**	

4.Network Layer	Network Layer design issues, Communication Primitives: Unicast, Multicast,Broadcast.	CO3, CO4	01	11
	IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems IPv4 Protocol, Network Address Translation (NAT)		02	
	Routing algorithms : Shortest Path (Dijkastra's), Link state routing, Distance Vector Routing, Protocols - ARP,RARP, ICMP, IGMP		04	
	Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms		04	
5.Transport Layer	The Transport Service: Transport service primitives, Berkeley Sockets,Connection management (Handshake)	CO5	01	06
	UDP, TCP, TCP state transition, TCP timers,TCP Flow control (sliding Window)		03	
	TCP Congestion Control: Slow Start		02	
6. Application Layer	DNS: Name Space, Resource Record	CO6	01	05
	Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP		04	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	01
Total Hours				42

Books:

Text Books	1. A.S. Tanenbaum, —Computer Networks‖, Pearson Education, (4e)
	2. B.A. Forouzan, —Data Communications and Networking‖, TMH (5e)
	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
	2. Natalia Olifer & Victor Olifer,— Computer Networks: Principles, Technologies & Protocols for Network Design‖, Wiley India, 2011.
	2. 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   – 30 marks
2.   Test 2   – 30 marks
3.   Internal assessment --10 marks
Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Course Code	Course Name	Credits (TH+P+TUT)
CEC504	**Data Warehousing and Mining**	**3 - 0 - 0**

Prerequisite:	Database Concepts

Course Objectives:	1. To identify the significance of Data Warehousing and Mining. 2. To analyze data, choose relevant models and algorithms for respective applications. 3. To study web data mining. 4. To develop research interest towards advances in data mining.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Describe data warehouse fundamentals and design data warehouse with dimensional modelling and apply OLAP operations. 2. Illustrate data mining principles and perform Data preprocessing and Visualization. 3. Identify appropriate data mining algorithms to solve real world problems. 4. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining. 5. Describe complex information and social networks with respect to web mining.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	**02**	**02**
1. Data Warehousing Fundamentals	Introduction to Data Warehouse, Data warehouse architecture, Data warehouse versus Data Marts	**CO1**	**02**	**08**
	E-R Modeling versus Dimensional Modeling, Information Package Diagram, Data Warehouse Schemas; Star Schema, Snowflake Schema, Factless Fact Table, Fact Constellation Schema.		**03**	
	Update to the dimension tables. Major steps in ETL process, OLTP versus OLAP, OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot.		**03**	
2. Introduction to Data Mining, Data Exploration and Data Pre-processing	Data Mining Task Primitives, Architecture, KDD process, Issues in Data Mining, Applications of Data Mining,	**CO2**	**03**	**08**
	Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization,		**02**	
	Data Preprocessing: Descriptive data summarization, Cleaning, Integration & transformation, Data reduction, Data Discretization and Concept hierarchy generation.		**03**	

3.Classification	Basic Concepts, Decision Tree Induction, Naïve Bayesian Classification, Accuracy and Error measures	**CO3, CO4**	**02**	**06**
	Evaluating the Accuracy of a Classifier: Holdout & Random Subsampling,		**02**	
	Cross Validation, Bootstrap, Applications of classification.		**02**	
4. Clustering	Types of data in Cluster analysis, Partitioning Methods (k-Means)	**CO3, CO4**	**02**	**06**
	Partitioning Methods (k-Medoids),		**02**	
	Hierarchical Methods (Agglomerative, Divisive), Applications of Clustering.		**02**	
5. Mining frequent patterns and associations	Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Frequent Pattern Mining,	**CO3, CO4**	**02**	**06**
	Apriori Algorithm, Association Rule Generation, Improving the Efficiency of Apriori, Mining Frequent Itemsets without candidate generation,		**02**	
	Introduction to Mining Multilevel Association Rules and Mining Multidimensional Association Rules.		**02**	
6. Web Mining	Introduction, Web Content Mining: Crawlers, Harvest System	**CO5**	**02**	**05**
	Virtual Web View, Personalization		**01**	
	Web Structure Mining: Page Rank, Clever, Web Usage Mining		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
Text Books	1. Paulraj Ponniah, *"Data Warehousing: Fundamentals for IT Professionals"*, Wiley India. 2. Jiawei Han, Micheline Kamber, Jian Pei, *"Data Mining Concepts and Techniques"*, Morgan Kaufmann, Third edition. 3. M.H. Dunham, *"Data Mining Introductory and Advanced Topics"*, Pearson Education.
Reference Books	1. Reema Thareja, *"Data warehousing"*, Oxford University Press 2009. 2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *"Introduction to Data Mining"*, Pearson Publisher 2nd edition. 3. Ian H. Witten, Eibe Frank and Mark A. Hall, *"Data Mining"*, Morgan Kaufmann 3rd edition.
Useful Links:	
1. https://onlinecourses.nptel.ac.in/noc20_cs12/preview	
2. https://www.coursera.org/specializations/data-mining	

Assessment:

Continuous Assessment for 40 marks:
1. Test 1   – 30 marks
2. Test 2   – 30 marks
3. Internal assessment   --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Course code	Course Name	TH-P-T	Credits	Total
CEL506	**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. 2. To investigate possible resources and plan a successful job campaign. 3. To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement. 4. To develop creative and impactful presentation skills. 5. To analyze personal traits, interests, values, aptitudes and skills 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** 1. Plan and prepare effective business/ technical documents which will in turn provide a solid foundation for their future managerial roles. 2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry. 3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations. 4. Deliver persuasive and professional presentations. 5. Develop creative thinking and interpersonal skills required for effective professional communication. 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 Learning (Pbl)	**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.) Physical Factors (Memorandum, Letter, Short & Long)	CO1, CO6	01	06
	Parts of a Long Formal Report: Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts		01	

	(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	
	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	**06**
	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. Interpersonal Skills	Emotional Intelligence	CO5, CO6	01	**08**
	Motivation		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. 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. 2. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning. 3. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). Personal development for life and work. Mason: South-Western Cengage Learning. 4. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson. 5. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press 6. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness. Oxford University Press

Activity. No	**Activity/ AssignmentTitle** **(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**
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 you can 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.

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.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC5051	**Advance Database Management System**	**3 - 0 – 0**

Prerequisite:	Database Management System
Course Objectives:	1. To provide insights into distributed database management system 2. To specify the various approaches used for interoperability using XML and JSON technologies 3. To apply the concepts behind the various types of NoSQL databases and utilize it for Mongodb 4. To learn about the trends in advance databases
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Design distributed database using the various techniques for query processing 2. Measure query cost and perform distributed transaction management 3. Organize the data using XML and JSON database for better interoperability 4. Compare different types of NoSQL databases 5. Formulate NoSQL queries using Mongodb 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
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Distributed Databases	Introduction, Distributed DBMS Architecture,	CO1	01	03
	Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design.		02	
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 interoperabilit	XML Databases, Document Type Definition, XML Schema, Querying and Transformation using XPath and XQuery.	CO3	02	06

y:- XML and JSON				
	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	02	06
	Graph Database Introduction, Features, Transactions, consistency, Availability, Querying, Case Study Neo4J		02	
	Spatial database Introduction, data types, models, operators and queries		02	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	01
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.
	2. Adam Fowler, NoSQL for dummies, February 2015 , John Wiley & Sons, Inc.
	3. Shashank Tiwari, Professional NOSQL, 2011, John Willy & Sons. Inc
	4. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition TMH
	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:
4. Test 1 – 30 marks
5. Test 2 – 30 marks
6. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC5052	**Internet Programming**	**3-0-0**

Prerequisite:	Basics of Programming Languages

Course Objectives:	1. To get familiar with the basics of Internet Programming. 2. To acquire knowledge and skills for creation of web site considering both client and server Side programming 3. To gain ability to develop responsive web applications 4. To explore different web extensions and web services standards 5. To learn characteristics of RIA 6. To learn Reactive JS
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Design web page(s) using HTML,CSS 2. Apply the concept of client side validation and design dynamic web pages using JavaScript and JQuery 3. Demonstrate database connectivity using JDBC 4. Interpret Rich Internet Application using Ajax 5. Explore various Web Extensions 6. Develop web application using Reactive JS

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	**02**	**02**
1. Introduction to Web Technology	**Web Essentials**: Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers	**CO1**	**02**	**10**
	HTML5 – fundamental syntax and semantics, Tables, Lists, Image, HTML5 control elements, Semantic elements, Drag and Drop, Audio – Video controls		**04**	
	CSS3 – Inline, embedded and external style sheets – Rule cascading, Inheritance, Backgrounds, Border Images, Colors, Shadows, Text, Transformations, Transitions, Animation, Basics of Bootstrap.		**04**	
2.Front End Development	**Javascript**: 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	**CO2**	**05**	**07**
	JSON: An introduction, Syntax , Function Files, Http Request, SQL		**02**	

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3.Back End Development	**Servlets**: Java Servlet Architecture, Servlet Life Cycle, Form GET and POST actions, Session Handling, Understanding Cookies, Installing and Configuring Apache Tomcat Web Server	**CO3**	**03**	**07**
	Database Connectivity: JDBC perspectives, JDBC program example		**01**	
	JSP: Understanding Java Server Pages, JSP Standard Tag Library (JSTL), Creating HTML forms by embedding JSP code		**03**	
4.Rich Internet Application (RIA)	Characteristics of RIA, **Introduction to AJAX**: AJAX design basics, AJAX vs Traditional Approach, Rich User Interface using Ajax, jQuery framework with AJAX.	**CO4**	**04**	**04**
5.Web Extension: PHP and XML	XML –DTD (Document Type Definition), XML Schema, Document Object Model, Presenting XML, Using XML Parsers: DOM and SAX, XSL- eXtensible Stylesheet Language	**CO5**	**03**	**06**
	Introduction to PHP- Data types, control structures, built in functions, building web applications using PHP- tracking users, PHP and MySQL database connectivity with example.		**03**	
6.React js	Introduction, React features, App "Hello World" Application, Introduction to JSX (JavaScript XML), Simple Application using JSX.	**CO6**	**05**	**05**
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
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.
	2.	Achyut S Godbole and Atul Kahate, Web Technologies, Second Edition, Tata McGraw Hill, 2012.
	3.	Thomas A Powell, Fritz Schneider, ―JavaScript: The Complete Reference, Third Edition, Tata McGraw Hill, 2013
	4.	David Flanagan, ―JavaScript: The Definitive Guide, Sixth Edition, O'Reilly Media, 2011
	5.	Steven Holzner ―The Complete Reference - PHP, Tata McGraw Hill,2008
	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

Assessment:

Continuous Assessment for 40 marks:
1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment -- 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC5053	**Internet of Things**	3-0-0

Prerequisite:	1. C Programming 2. Digital Logic and Computer Architecture 3. Microprocessor 4. Computer Networks
Course Objectives:	1. To equip students with the fundamental knowledge and basic technical competence in the field of Internet of Things (IoT). 2. To emphasize on core IoT functional Stack to build assembly language programs. 3. To learn the Core IoT Functional Stack. 4. To understand the different common application protocols for IoT and apply IoT knowledge to key industries that IoT is revolutionizing. 5. To examines various IoT hardware items and software platforms used to develop useful projects or products.
Course Outcomes:	**On the completion of the course, the students will be able to..** 1. Illustrate the concepts of IoT 2. Describe fundamental field in Things in IoT. 3. Emphasize core IoT functional Stack. 4. Explain application protocols for IoT. 5. Apply IoT knowledge to key industries that IoT is revolutionizing. 6. Examines various IoT hardware items and software platforms used in projects.

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction	-	02	02
1. Introduction to Internet of Things (IoT)	What is IoT? - IoT and Digitization, IoT Impact – Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures	CO1	02	06
	Convergence of IT and OT, IoT Challenges, The oneM2M IoT Standardized Architecture,		02	
	The IoT World Forum (IoTWF) Standardized Architecture, IoT Data Management and Compute Stack.		02	
2. Things in IoT	Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications.	CO2	01	07
	Actuators -– Definition, Principles, Classifications, Types, Characteristics and Specifications .		01	
	Smart Object – Definition, Characteristics and Trends, Sensor Networks – Architecture of Wireless Sensor Network		01	

	Network Topologies , Enabling IoT Technologies - Radio Frequency Identification Technology.		02	
	Micro Electro-Mechanical Systems (MEMS), NFC (Near Field Communication), Bluetooth Low Energy (BLE), LTE-A (LTE Advanced), IEEE 802.15.4– Standardization and Alliances, ZigBee.		02	
3. The Core IoT Functional Stack	Layer 1 – Things: Sensors and Actuators Layer	CO3	01	06
	Layer 2 – Communications Network Layer, Access Network Sublayer , Gateways and Backhaul Sublayer , Network Transport Sublayer, IoT Network Management Sublayer		02	
	Layer 3 – Applications and Analytics Layer, Analytics Vs. Control Applications, Data Vs. Network Analytics, Data Analytics Vs. Business Benefits, Smart Services.		03	
4. Application Protocols for IoT	The Transport Layer, IoT Application Transport Methods , Application Layer Protocol Not Present	CO4	02	07
	SCADA - Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation,		03	
	SCADA Transport over LLNs with MAP-T, Generic Web-Based Protocols , IoT Application Layer Protocols – CoAP and MQTT		02	
5. Domain Specific IoTs	Home Automation – Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors . Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance.	CO5	02	07
	Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection . Energy – Smart Grids, Renewable Energy Systems, Prognostics .		02	
	Retail – Inventory Management, Smart Payments, Smart Vending Machines , Logistics – Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring , Agriculture – Smart Irrigation, Green House Control		02	
	Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring . Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics.		01	
6. Create your own IoT	IoT Hardware - Arduino, Raspberry Pi, ESP32, Cloudbit/Littlebits, Particle Photon, Beaglebone Black. , IoT Software - languages for programming IoT hardware, for middleware applications and API development, for making front ends, REST and JSON-LD	CO6	03	06

	A comparison of IoT boards and platforms in terms of computing , A comparison of IoT boards and platforms in terms of development environments and communication standards , A comparison of boards and platforms in terms of connectivity , A comparison of IoT software platforms.		**03**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
Text Books	1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017. 2. Hakima Chaouchi, "The Internet of Things - Connecting Objects to the Web", 1st Edition, Wiley, 2010. 3. Perry Lea, "Internet of things For Architects", 1st Edition, Packt Publication, 2018 4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – Hands-On Approach", 2nd Edition, Universities Press, 2016.
Reference Books	1. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", 1st Edition, Wiley, 2014. 2. Donald Norris, "Raspberry Pi – Projects for the Evil Genius", 2nd Edition, McGraw Hill, 2014. 3. Anand Tamboli ,"Build Your Own IoT Platform", 1st Edition, Apress, 2019.
Useful Links:	
1. https://nptel.ac.in/courses/106/105/106105166/	
2. https://nptel.ac.in/courses/108/108/108108098/	
3. https://nptel.ac.in/courses/106/105/106105195/	
4. https://www.coursera.org/specializations/IoT	
Assessment:	
Continuous Assessment for 40 marks:	
1.Test 1 – 30 marks 2.Test 2 – 30 marks 3.Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 03 hrs duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC5054	**Probabilistic Graphical Model**	3 - 0 - 0

Prerequisite:	1. Discrete Structure 2. Engineering Mathematics
Course Objectives:	1. To give comprehensive introduction of probabilistic graphical models. 2. To make inferences, learning, actions and decisions while applying these models. 3. To introduce real-world trade offs when using probabilistic graphical models in practice. 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:** 1. Describe basic concepts of probabilistic graphical modelling. 2. Model and extract inference from various graphical models like Bayesian Network model and inference. 3. Perform learning and take actions and decisions using probabilistic graphical models - Markov Model. 4. Devise learning and take actions and decisions using probabilistic graphical models - Hidden Markov Model 5. Represent real world problems using graphical models; design inference algorithms; and learn the structure of the graphical model from data 6. Design real life applications using probabilistic graphical models.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
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	05
	Introduction to Graphs: Nodes and Edges, Subgraphs, Paths and Trails, Cycles and Loops		01	
	Introduction to Probabilistic Graph Models: Bayesian Network, Markov Model, Hidden Markov Model		01	
	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			
	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		04	
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	01	04
	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	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	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). 2. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 1st edition, 2011.
Reference Books	1. Finn Jensen and Thomas Nielsen, "Bayesian Networks and Decision Graphs (Information Science and Statistics)", 2nd Edition, Springer, 2007. 2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012. 3. Martin Wainwright and Michael Jordan, M., "Graphical Models, Exponential 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_resource_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:
1. Test 1– 30 marks
2. Test 2– 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

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

Lab Code	Lab Name	Credits (P+TUT)
CEL502	**Software Engineering Lab**	1- 0

Lab Prerequisite:	1. Object Oriented Programming with Java 2. Python Programming
Lab Objectives:	1. To solve real life problems by applying software engineering principles 2. To impart state-of-the-art knowledge on Software Engineering
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Identify requirements and apply software process model to selected case study. 2. Develop architectural models for the selected case study. 3. Use computer-aided software engineering (CASE) tools. 4. Create test cases for case study using testing approaches. 5. Design timeline chart and network diagram, risk plan. 6. 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	To study of at least two traditional process models and Problem Definition of case study name. **-**	**LO1, LO6**	**02**
2	Preparation of software requirement specification (SRS) document in IEEE format.	**LO1, LO6**	**02**
3	To study and create Gantt chart/Time line chart for selected case study	**LO4, LO5, LO6**	**02**
4	To study and create structured data flow analysis. (DFD)	**LO2, LO6**	**02**
5	Use of metrics to estimate the cost.	**LO3, LO6**	**02**
6	To study and create network diagram of the project. (PERT / CPM)	**LO4, LO6**	**02**
7	To study and design test cases of selected case study .	**LO4, LO6**	**02**
8	To study and design test cases for white box testing.(Basisi path testing)	**LO4, LO6**	**02**
9	To prepare Risk Mitigation, Monitoring and Management Plan (RMMM).	**LO5, LO6**	**02**
10	To study and design version controlling of the project.	**LO3, LO6**	**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 "Software Engineering"
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)
5.

Oral :
    Oral examination will be based on theory and practical syllabus **CEC502, CEL502**.

Lab Code	Lab Name	Credits (P+TUT)
CEL503	Computer Network Lab	1- 0

Lab Prerequisite:	Network Concepts
Lab Objectives:	1. To practically explore OSI layers and understand the usage of simulation tools. 2. To analyze, specify and design the topological and routing strategies for an IP based networking infrastructure. 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** 1. Design and setup networking environment in Linux. 2. Use Network tools and simulators such as NS2, Wireshark etc. to explore networking algorithms and protocols. 3. Implement programs using core programming for understanding networking concepts. 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.	Perform network discovery using discovery tools (eg. Nmap, mrtg)	LO2, LO4	02
5.	Use Wire shark to understand the operation of TCP/IP layers : • Ethernet Layer: Frame header, Frame size etc. • Data Link Layer : MAC address, ARP (IP and MAC address binding) • Network Layer : IP Packet (header, fragmentation), ICMP (Query and Echo) • Transport Layer: TCP Ports, TCP handshake segments etc. Application Layer: DHCP, FTP, HTTP header formats	LO2, LO4	02
6.	Installation of Network Simulator (NS2) and crate simple network	LO3, LO4	02
7.	Use simulator (Eg. NS2) to understand functioning of any routing protocol(Stop & wait/Sliding Window)	LO2, LO4	02
8.	a. Set up multiple IP addresses on a single VLAN. b. Using nestat and route commands of Linux, do the following: • View current routing table Add and delete routes • Change default gateway	LO1, LO4	02

	c. Perform packet filtering by enabling IP forwarding using IPtables in Linux.		
9.	Design VPN (Any Tool)	**LO2, LO4**	**02**
10.	Socket programming using TCP or UDP	**LO3, LO4**	**02**
11.	Perform File Transfer and Access using FTP	**LO2, LO4**	**02**
12.	Perform Remote login using Telnet server	**LO2, 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)
CEL504	Data Warehousing and Mining Lab	1- 0

Lab Prerequisite:	Database Concepts

Lab Objectives:	1. Learn how to build a data warehouse and query it.
	2. Learn about the data sets and data preprocessing.
	3. Demonstrate the working of algorithms for data mining tasks such as Classification, clustering, Association rule mining & Web mining.
	4. Apply the data mining techniques with varied input values for different parameters.
	5. Explore open-source software (like WEKA) to perform data mining tasks.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to…**
	1. Design data warehouse and perform various OLAP operations.
	2. Implement data mining algorithms like classification.
	3. Explore open-source software to perform data mining algorithms.
	4. Implement clustering algorithms on a given set of data sample.
	5. Implement Association rule mining & web mining algorithm.
	6. 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.	Select a case study on building Data warehouse/Data Mart • Write Detailed Problem statement and design dimensional modelling (creation of star and snowflake schema)	LO1, LO6	02
2.	Implementation of all dimension table and fact table based on experiment 1 case study	LO1, LO6	02
3.	Implementation of OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot based on experiment 1 case study	LO1, LO6	02
4.	Implementation of Bayesian algorithm	LO2, LO6	02
5.	Implementation of Data Discretization (any one) & Visualization (any one)	LO3, LO6	02
6.	Perform data Pre-processing task and demonstrate Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA/R tool)	LO3, LO6	02
7.	Implementation of Clustering algorithm (K-means/K-medoids)	LO4, LO6	02
8.	Implementation of any one Hierarchical Clustering method	LO4, LO6	02
9.	Implementation of Association Rule Mining algorithm (Apriori)	LO5, LO6	02
10.	Implementation of Page rank/HITS algorithm	LO5, LO6	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 "Data Warehousing and Mining"
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)

Lab Code	Lab Name	Credits (P+TUT)
CEDLL5051	**Advance Database Management System Lab**	**1- 0**

Lab Prerequisite:	Database Concepts

Lab Objectives:	1. To build/design a distributed database and query it.
	2. To write a program to simulate two phase commit protocol, deadlock detection & query optimization
	3. To build/design NoSQL database and query it.
	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**
	1. Design and implement distributed database for enterprise application
	2. Implement two phase commit protocol, deadlock detection , query optimization
	3. Use XML/JSON for schema integration using Mongodb.
	4. Implement data modeling using NoSQL concept and implement NoSQL queries using Mongodb
	5. Describe replication and sharding using Mongodb and
	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: 1. Installation of MongoDB ver4.4 2. Basic Shell operations **3.** Working with Shell – Downloading, connecting to the DB server, Creating, using and switching database, Remote access	**LO4, LO6**	02
7	Basic operations: 1. Populating database 2. Querying: simple search, projection 3. Conditional Querying, (and, or, in) 4. Advanced Queries: Query on array, Embedded document, NULL and missing fields 5. Reading data from json / XML object and querying it	**LO3, LO4, LO6**	02

	6. Updation and deletion of collections		
8	Data Modeling (To be taught) 1. Embedded and Nested schema (De-Normalized) 2. Different possible mapping and strategies for the given application	**LO4, LO6**	**02**
9	Replication and Sharding 1. Replication –Primary and Secondary Replica sets and Arbiter 2. Deployment: Three Member 3. Parameter: no. of members, Voting members, Fault tolerance, load balancing 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 create web pages using HTML5 and CSS3
	2. To create web pages and provide client side validation
	3. To create dynamic web pages using server side scripting
	4. To expose JavaScript to develop interactive web page development
	5. To explore Rich Internet Application
	6. To explore REACT js for building user interfaces
Lab Outcomes (LOs):	**At the end of the course, the student will be able to**
	1. Design basic responsive web site using HTML5 and CSS3
	2. Apply the concept of client side validation and design dynamic web pages using JavaScript and Jquery
	3. Evaluate client and server side technologies and create Interactive web pages using PHP, AJAX with database connectivity using MySQL.
	4. Implement the concepts of XML, DTD and XSL and develop web pages using XML / XSLT.
	5. Develop simple web application using Reactive JS
	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	Create Simple web page using HTML5	**LO1, LO6**	**02**
2	Design and Implement web page using CSS3 and HTML5	**LO1, LO6**	**02**
3	Form Design and Client-Side Validation using: a. Javascript and HTML5 b. Javascript and Jquery	**LO2, LO6**	**02**
4	Develop interactive web pages using HTML 5 with JDBC database connectivity	**LO3, LO6**	**02**
5	Design and develop basic calculator using PHP	**LO3, LO6**	**02**
6	Develop interactive web pages using PHP with database connectivity MYSQL	**LO3, LO6**	**02**
7	Develop XML web page using DTD, XSL	**LO4, LO6**	**02**
8	Implement a web page using Ajax and PHP	**LO3, LO6**	**02**
9	Installation of the React DOM library.	**LO5, LO6**	**02**
10	Develop simple application using React js	**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)
CEDLL5053	Internet of Things Lab	1- 0

Lab Prerequisite:	1. Digital Logic and Computer Architecture 2. Microprocessor 3. Computer Networks
Lab Objectives:	1. To explore various components of Internet of things such as Sensors, internetworking and cyber space. 2. To design and implement IoT circuits and solutions.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Recognize various devices, sensors and applications (Knowledge). 2. Implement general concepts of Internet of Things. 3. Implementation of measuring distance using Sensors. 4. Perform the motion control experiment using actuator. 5. Implementation of IOT application. 6. Apply the ethical principles like timeliness and adhere to the rule of Laboratory

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Lab Prerequisite	-	2
1	Introduction to various sensors and various actuators & its Application (Students have to prepare Report for the same). Perform Experiment using Arduino Uno to measure the distance of any object using Ultrasonic Sensor. a) PIR Motion Sensor. b) Rain Drop Sensor. c) Moisture Sensor. d) Temperature Sensor. e) Touch Sensor. f) Infrared Sensor. g) Servo Moto. h) RFID Sensor. i) Bluetooth Module. j) Wi-Fi Module	LO1, LO6	2
2	Demonstrate Node MCU and its working and Getting Started with ESP8266 Wi-Fi SoC	LO2, LO6	2
3	Hands-on with on-board peripherals of ESP8266 and Demonstrate Arduino and its pins	LO2, LO6	2
4	Perform Experiment using Arduino Uno to measure the distance of any object using Ultrasonic Sensor	LO4, LO6	2
5	Create a circuit using Arduino and sensors. Perform experiment using Arduino Uno to Learn Working of Servo Motor	LO4.LO6	2
6	Creating a webpage and display the values available through Arduino.	LO4, LO6	2
7	Demonstration of Setup & Working of Raspberry Pi. (Students have to prepare the Report for the same.).	LO1, LO4, LO6	2
8	The actuator working like switch on and off the button.	LO1, LO4, LO6	2
9	Case Study for Industrial Internet of Things (like for Smart homes)	LO5, LO6	2
10	OPEN Ended problem: Students are required to submit an IOT based project using the Microcontroller or a Raspberry	LO4, LO6	2

	Pi and connecting various sensors and actuators. The data for the same should be displayed via a webpage or a web app		

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 "Internet of Things"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Term work carries 25 Marks (Experiments: 15-marks, Attendance (Theory & Practical): 05-marks, Assignments: 05-marks)

Lab Code	Lab Name	Credits (P+TUT)
CEDLL5054	**Probabilistic Graphical Model Lab**	**1- 0**

Lab Prerequisite:	1.Engineering Mathematics 2.Discrete Structure
Lab Objectives:	1.To give comprehensive introduction of probabilistic graphical models. 2. To make inferences, learning, actions and decisions while applying these models 3. To introduce real-world trade offs when using probabilistic graphical models in practice 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** 1. Explore probability theory and it uses. 2. Devise the functionality of Graph Theory 3. Implement Bayesian Network modelling. 4. Implement Markov Chain and HMM modelling 5. Implement the decision tree, maximum likelihood estimation. 6. Explore the problem of learning with optimization 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)
CEPR53	Project Based Learning- Minor Project Lab-I	1 – 0

PBL Objectives:	1. To understand and identify the problem. 2. To apply basic engineering fundamentals and attempt to find solutions to the problems. 3. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach. 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..** 1. Identify societal/research/innovation/entrepreneurship problems through appropriate literature survey. 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. 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. 4. Communicate through technical report writing and oral presentation. 5. Gain technical competency towards participation in competitions, hackathons, etc. 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: 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. • First shall be for finalization of problem • 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. • First review is based on readiness of building working prototype to be conducted. • 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, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • First shall be for finalization of problem and proposed solution • 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)
1UCEXS57	**Aptitude/Logic Building and Competitive Programming skills**	**1+0**
Skill Prerequisite	1. Knowledge of elementary mathematics (HSC level) 2. Knowledge of basic English grammar (SSC level) 3. Knowledge of Basic programming languages	
Skill Objectives	1. To have the basic awareness about how to prepare for recruitment process 2. To introduce the students to computational skills required to appear for recruitment tests. 3. To introduce the students to coding skills required to appear for recruitment tests/ project /coding competitions.	

Skill Outcomes	1. Discuss the basic concepts of QUANTITATIVE ABILITY 2. Discuss the basic concepts of LOGICAL REASONING Skills 3. Acquire satisfactory competency in use of VERBAL REASONING 4. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability 5. Use most common algorithms for competitive programming 6. 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**	1.1 Problems on Number System Problems on HCF and LCM Problems on Average	SO1, SO4	02	04
	1.2 Problems on Ratio and Proportion, Problems on Percentage		02	
2. **Arithmetic Quantitative Abilities**	2.1 Problems on Ages, Problems on Profit and Loss	SO1, SO4	02	04
	2.2 Problems on Simple and Compound Interest, Problems on Time and Distance		02	
3. **Logical Reasoning and verbal reasoning**	3.1 Number Series, Alpha Numerical, Letter & Symbol Series	SO2,SO3, SO4	02	02
	3.2 Numerical and Alphabet Puzzles, Seating Arrangement			
	3.3 Verbal reasoning			
4. **Programming Techniques**	4.1 What is Competitive Programming? Programming Contests, Language Features	SO5	02	05
	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 https://www.coursera.org/learn/spanish-vocabulary-cultural-experience https://www.coursera.org/learn/spanish-vocabulary-sports-travel-home https://www.coursera.org/learn/spanish-vocabulary-careers https://www.coursera.org/learn/spanish-vocabulary-project
5	https://www.coursera.org/learn/korean-beginners https://www.coursera.org/learn/learn-korean 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

Exposure Course Code	Exposure Course Name	Credits
CEXT58	**Technology Based Learning (SAT-VIII) Courses like Coursera, NPTEL etc.**	**01**

Prerequisite:	Basic Engineering and Technology courses.
TBL Objectives:	1. To acquire competency in emerging areas of technology. 2. To create a mindset for life-long learning required to persist technological shifts and be abreast with the market trends. 3. To facilitate learning at self-paced schedules. 4. To boost time management ability and self-discipline. 5. To provide opportunities of strengthening digital footprints by showcasing the additional proficiency acquired as well as improve connectivity and networking. 6. To enhance employment and entrepreneurial opportunities requiring specialization.
TBL Outcomes:	1. Explain concepts of the emerging technology learned through the pursued course. 2. Describe social, ethical, and legal issues surrounding the learned technology. 3. Demonstrate professionalism and skills of digital age learning and working. 4. Demonstrate knowledge in entrance exams for higher technical education, placement interviews, and other avenues. 5. Analyze real-world case studies in society/industry for applicability of sustainable technological solutions. 6. Apply the acquired knowledge in developing technology-based solutions to real-world problems or other projects at hand

Guidelines for Technology Based Learning:

1. Learners should enrol for an online course based on their area of interest concerning emerging areas of technology in consultation with Faculty Supervisor nominated by the Head of Department.
2. The course duration should be of minimum 04 weeks.
3. Students should watch all the videos of the course to learn the course in-depth and entirety.
2. Students should solve weekly assignments that are to be submitted online within the prescribed deadline.
3. Students should register and appear for the course certification exam on scheduled date and time.
4. Students should submit the certificate of course completion to the Faculty Supervisor.
5. Faculty Supervisor shall monitor students' participation and progress at every stage — from course enrolment to certification.

Useful Links:

1. https://swayam.gov.in
2. https://www.nptel.ac.in
3. https://www.coursera.org

Term Work:

Term Work shall be conducted for Total 25 Marks based on the following rubrics:

Performance Level	Not Qualifying	Poor	Acceptable	Good	Excellent
Marks	00	08	12	16	20
Compliance Status	Not Enrolled for any Course or Not Completed Course	Completed Course, Not Attempted Certification but Completed all Assignments.	Obtained Passing Grade or 40% of Total Score in Certification Exam **OR** Completed all Assignments with Score Above 70%.	Obtained First Class Grades or 60% of Total Score	Obtained Elite Grade or 75% of Total Score

Internship Code	Internship Name	Hours/Duration	Credits
INT54	Internship-IV	**80-160 hrs** (2 - 4 Weeks)	

Prerequisite:	List of probable industries and organizations offering internships in Engineering and Technology. Awareness about problem areas in rural India
Internship Objectives:	1. To get the awareness about engineer's responsibilities and ethics. 2. Opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
Internship Outcomes:	**Upon completion of the course, students will be able to:** **1.** Get an opportunity to practice communication and teamwork skills. 2. Get an opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.

Activity- Rural Internships &/ Internships	**Supporting Activities to be completed under Internship**
	1. Long Term Goal under Rural Development Internships or
	2. Mandatory internship for developing project with: ● Industries ● Government Sector ● Non-governmental Organization (NGO) ● MSMEs

Term Work Assessment:

Duration to be considered for assessment:
Week Ends/ Semester Break/End of Semester (After ESE & Before Next Term Start)

Guidelines:	1. Batch wise Faculty Supervisor who is the proctor (mentor) of the batch will be allotted as in-charge for the course, at start of the Academic year. 2. Students will submit the participation certificate of the activities to the faculty mentors. 3. For working in cells related activities, Cell coordinator will submit list of actively involved & participated students of each department, semester wise to all department HODs, verified and authenticated by Dean Students Welfare. 4. HOD will circulate the student list to all faculty mentors for consideration of Hours spends under mentioned department activities. 5. Department IIIC Cell coordinator will collect, maintain each student proofs/reports from all faculty mentors, department internship analysis report will be prepared & submitted to Dean, IIIC for AICTE-CII survey data 6. Students will submit evaluation sheet by attaching Xerox copies of all participation/ IPR/ Copyright certificates & faculty mentor will verify it with original copies, for assessment purpose.