Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

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दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
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जा.क्र./शि.वि/अं.म./ 608 दिनांक:— ०७/१०/२०२५

प्रति,

१. मा. संचालक / प्राचार्य,
सर्व संलग्नीत अभियांत्रीकी महाविद्यालये,
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२.प्र. संचालक,
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३.प्र. संचालक,
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शिवाजी विद्यापीठ, कोल्हापूर

विषय:— एम. टेक अभ्यासक्रमातील किरकोळ दुरुस्तीबाबत.

संदर्भ:— १.एसयु/बीओएस/सायन्स&टेक/३१७ व ५३४ दि.२३/५/२०२५ व दि.४/९/२०२५
२.एसयु/बीओएस/सायन्स&टेक/५३९ दि.०८/०९/२०२५

महोदय,

उपरोक्त संदर्भिय विषयास अनुसररुन आपणास आदेशान्वये कळविण्यात येते की, शैक्षणिक वर्ष २०२५—२६ पासून लागू करण्यात आलेल्या खालील **एम.टेक** अभ्यासक्रमामध्ये किरकोळ दुरुस्ती करण्यात आलेली आहे.

Sr.	Course/Syllabus	Sr.	Course/Syllabus
1	Enargy Technology (ON)	6	Rural Technology (ON)
2	Computer Science and Technology (ON)	7	Computer Science and Engineering (OFF)
3	Electronics and Telecommunication (ON)	8	Mechanical (CAD/CAM/CAE) (OFF)
4	Environmental Science and Technology (ON)	9	Electronics and Telecommunication Engineering (OFF)
5	Food Technology (ON)		

सोबत सदर अभ्यासक्रमाची प्रत जोडली आहे. तसेच विद्यापीठाच्या https://www.unishivaji.ac.in (NEP-2020@suk/ Online syllabus) या संकेस्थळावर ठेवण्यात आला आहे. सदर दुरुस्ती ही शैक्षणिक वर्ष २०२५—२६ पासून लागू राहील.

सदर अभ्यासक्रम सर्व संबधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावेत ही विनंती.

कळावे.

आपला विश्वासू,

डॉ. एस. एम. कुबल
उपकुलसचिव

सोबत — अभ्यासक्रमाची प्रत,

प्रत :— **माहितीसाठी व पुढील योग्यत्या कार्यवाहीसाठी**

मा. संचालक, परीक्षा व मुल्यमापन मंडळ	प्र. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा
अध्यक्ष, संबंधित अभ्यास /अस्थायी मंडळ	इतर परिक्षा ४ विभागास.
परीक्षक नियुक्ती ए व बी विभागास.	संलग्नता टी. १ व टी. २ विभागास
पीजी प्रवेश विभागास	पीजी सेमिनार विभागास
संगणक केंद्र / आयटी सेल	पात्रता विभागास

Shivaji University

Kolhapur

Revised Syllabus

M.Tech.

Computer Science and Engineering

To be implemented from

Academic Year 2025-26

Program Outcomes (POs):

PO1: Demonstrates in-depth knowledge and understanding of the chosen engineering discipline.

PO2: Analyzes complex engineering problems, evaluates information, and forms well-reasoned conclusions.

PO3: Identifies, formulates, and solves complex engineering problems using appropriate methods and tools.

PO4: Conducts research, analyzes data, and interprets findings to contribute to the advancement of knowledge.

PO5: Effectively utilizes modern engineering tools, software, and technologies.

PO6: Works effectively as a team member and leader in multidisciplinary environments.

PO7: Demonstrates knowledge of project management principles and applies them to engineering projects.

PO8: Effectively communicates technical information both orally and in writing.

PO9: Recognizes the need for continuous learning and professional development.

PO10: Applies ethical principles and understands the societal impact of engineering solutions.

SHIVAJIUNIVERSITY, KOLHAPUR
First Year M. Tech (Computer Science and Engineering) Part-I Semester - I
w. e. f. Academic Year 2025-26

Sr. No	Course Code	Course Title	Teaching Scheme (Hours/week)				Evaluation Scheme			
			L	T	P	Credits	Theory		Practical	
							Scheme	Max. marks	Scheme	Max. marks
1	CSEAC1	Research Methodology	2	-	-	2	---	---	IE	50
2	CSEC11	Mathematical Foundation of Computer Science	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
3	CSEC12	Algorithms and Complexity Theory	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
4	CSEC13	Advanced Databases	3		-	3	IE	40	--------	-------
							ESE	60	--------	-------
5	CSEE1	Elective-I	3		-	3	IE	40	--------	-------
							ESE	60	--------	-------
6	CSEOE1	Elective- II (Open Elective)	3	-	-	3	IE	40	--------	-------
							ESE	60		
7	CSEC14	Seminar-I	-	-	2	1	--------	-------	IE	50
8	CSEC15	Algorithms and Complexity Theory Lab	-	-	2	1	--------	-------	IE	50
9	CSEC16	Advanced Databases Lab	-	-	2	1	--------	-------	IE	50
Total			**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week=23*										

Elective – I
CSEE11. Artificial Intelligence
CSEE12. Data Science
CSEE13. Machine Learning
CSEE14. Advanced Network Protocol

Elective II (Open Elective): choose from list given below

Semester –I (Open Elective*)

Sr. No.	Elective-II (Open Elective*)	Branch
1	ETCOE11: Advanced Communication System	Electronics & Telecommunication Engineering
2	ETCOE12:Reconfigurable Computing	
3	ETCOE13:VLSI Testing & Testability	
4	MECADOE11: Design Of Hydraulic And Pneumatic Systems	CAD/CAM/CAE
5	MECADOE12: Mechatronic System Design	
6	MECADOE13: Advanced Finite Element Analysis	

SHIVAJIUNIVERSITY, KOLHAPUR
First Year M. Tech (Computer Science and Engineering) Part-I Semester - II
w. e. f. Academic Year 2025-26

Sr. No	Course Code	Course Title	Teaching Scheme (Hours/week)				Evaluation Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	CSEAC2	Intellectual Property Rights	2	-	-	2	---	---	IE	50
2	CSEC21	Parallel Computer Architecture	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
3	CSEC22	Computer Vision and Image Processing	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
4	CSEC23	Computer Security	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
5	CSEE2	Elective-III	3	-	-	3	IE	40	--------	-------
							ESE	60	--------	-------
6	CSEOE 2	Elective- IV (Open Elective)	3	-	-	3	IE	40	--------	-------
							ESE	60		
7	CSEC24	Seminar-II	-	-	2	1	--------	-------	IE	50
8	CSEC25	Computer Vision and Image Processing Lab	-	-	2	1	--------	-------	IE	50
9	CSEC26	Computer Security Lab	-	-	2	1	--------	-------	IE	50
Total			**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week=23*										

Elective - III
CSEE21. Data- Mining and Warehousing
CSEE22. Deep Learning
CSEE23. Cloud Computing
CSEE24. Business Analytics

Elective IV (Open Elective): Choose from list on next page

Semester –II (Open Elective*)

Sr. No.	Elective-IV (Open Elective*)	Branch
1	ETCOE21:Mimo Systems	Electronics & Telecommunication Engineering
2	ETCOE22:Satellite Communication	
3	ETCOE23:Smart And Phased Array Antenna Design	
4	MECADOE21: Product Life Cycle Management	CAD/CAM/CAE
5	MECADOE22: Rapid Manufacturing	
6	MECADOE23: Industrial Automation And Robotics	

SHIVAJIUNIVERSITY, KOLHAPUR
Second Year M. Tech (Computer Science and Engineering) Part-II Semester - III
w. e. f. Academic Year 2025-26

Sr. No	Course Code	Course Title	Teaching Scheme (Hours/week)				Evaluation Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	CSEC31	Industrial Training	-	-	2*	5**	--------	-------	IE	50
									EOE	50
2	CSEC32	Dissertation Phase-I	-	-	2*	15	--------	-------	IE	100
									EOE	100
Total			**-**	**-**	**4**	**20**				**300**
Total Contact hours per week=4*										

*Students are expected to do self-study for two hours as per the guidance given by the Project Guide and report to the department once in a week. Hence contact hours to be taken as two for the calculation of contact hours.

** Industrial Training of 8 to 12 weeks at the end of First Year
OR
Industrial training will be split into two slots for four weeks during semester III

Evaluation at end of semester III on the basis given report and Presentation to concern Guide.

SHIVAJIUNIVERSITY, KOLHAPUR
Second Year M. Tech (Computer Science and Engineering) Part-II Semester - IV
w. e. f. Academic Year 2025-26

Sr. No.	Course Code	Course Title	Teaching Scheme (Hours/week)				Evaluation Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	CSEC41	Dissertation Phase-II	-	-	4*	20	--------	-------	IE	150
									EOE	150
Total			**-**	**-**	**4**	**20**	--------	-------		**300**
Total Contact hours per week=4*										

*Students are expected to do self-study for four hours as per the guidance given by the project Guide and report to the department once a week. Hence contact hours to be taken as four for the calculation of contact hours.
Note:

$: Minimum 40% marks required in ESE as passing head.

• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

IE – Internal Evaluation,

IPE – Internal Practical Evaluation,

ESE –End Semester Examination,

EPE–External Practical Examination,

EOE–External Oral Examination

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Research Methodology**			***Course Code*:**	**:**	CSEAC1
Teaching Scheme (Hours)	**:**	Lecture:	2 Hrs./week		***Total Credits***	:	2
Evaluation Scheme (Marks)	**:**	IE= 50	ESE = NIL	Grand Total=50	---	**:**	--
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	The student should familiarize with basic of research.					
Course Domain	**:**	Audit Course					

Course Rationale: This course aims to lay a foundation for your research. The goal is to help you to design and develop your future research projects.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Familiarize students with basic of research and the research process.	**1.**	Understand basic concepts of research and its methodologies
2.	Familiarize Research Design.	**2.**	Select and define appropriate research problems and parameters
3.	Introduce measurement and scaling techniques in research.	**3.**	Apply Measurement and Scaling Techniques
4.	Familiarize methods of data collection and analysis	**4.**	Use Methods of Data Collection and Analysis
5.	Introducing techniques of hypotheses, parametric or standard tests	**5.**	Apply techniques of hypotheses, parametric or standard tests
6.	Help to analyze variance and co-variance	**6.**	Present and defend research ideas using Analysis of Variance and Co-variance

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1		2								
CO2				3						
CO3				2						
CO4				3						
CO5				3						
CO6				3						

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Research Methodology: An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem.	5
Unit II Research Design Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling	4
Unit III Measurement and Scaling Techniques Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.	3
Unit IV Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate methods, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation	4
Unit V Unit 5 Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parametric Test, Conversion of Chi to Phi, Caution in using Chi-square test.	4
Unit VI Unit 6 Analysis of Variance and Co-variance ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis	4

Suggested Textbooks:	
1.	"Research Methodology", C.R. Kothari, Wiley Eastern.
Suggested Reference Books:	
1.	"Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
2.	"Research in Education", John W Best and V. Kahn, PHI Publication.
3.	"Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education
4.	"Management Research Methodology-Integration of principles, methods and Techniques", K.N. Krishnaswami and others, Pearson Education.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Mathematical Foundation of Computer Science**			***Course Code*:**	**:**	CSEC11
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic mathematical operations, logic					
Course Domain	**:**	Core					

Course Rationale: In many ways, math is the foundation of computer science. The basic principles of mathematical logic laid the groundwork for the development of digital circuits and computers. Moreover, many of the algorithms and data structures that are essential to computer programming are based on mathematical concepts. Discrete mathematics, linear algebra, number theory, and graph theory are the math courses most relevant to the computer science profession. Different corners of the profession, from machine learning to software engineering, use these types of mathematics.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Acquaint the students with mathematical/logical fundamentals including numerical techniques.	**1.**	Apply mathematical/logical fundamentals including numerical techniques
2.	Introduce DFA, NFA, PDA and CFG	**2.**	Apply DFA, NFA, PDA and CFG to solve various problems.
3.	Familiarize Turing machines	**3.**	Apply Turing machines to solve various complex engineering problems.
4.	Introduce the concept of Decidability and Reducibility	**4.**	Apply FA, PDA, TM for implementing Decidability and Reducibility
5.	Introduce Computability theory	**5.**	Use Computability theory for computing different mathematical functions.
6.	Help to learn Computational Complexity	**6.**	Calculate Computational Complexity

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3									
CO2	2		3							
CO3			3							
CO4	2		2							
CO5	2		3							
CO6			3							

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction Mathematical notions and terminology of sets, sequences and tuples, functions and relations graphs, strings and languages. Boolean logic properties and representation. Definitions, Theorems and types of proofs, formal proofs, deductive, reduction to definition, proof by construction, contradiction, induction, indirect, automatic, counter-examples.	5
Unit II State Machines Types of Languages, recurrence relations, Regular expressions, Regular Languages, Finite State Machines, DFA, NFA, NFA-/\ Equivalence of DFA & NFA., Kleen's Theorem, pumping Lemma, Applications.	7
Unit III Push down automata and CFG PDA, N-PDA, CFG, Types of Grammar, CNF, Parsers: Top-down, Bottom-up, applications.	6
Unit IV Turing Machines Turing machines, variations of TMs, Combining TM's, programming techniques for TMs, Universal Turing Machines, computing function with TM, recursive and recursively enumerable languages.	6
Unit V Decidability and Reducibility Decidable languages, decidable problems concerning context-free languages, FA, PDA, Turing Machines, Undecidable problems from language theory, A simple undecidable problem (PCP), The halting problem- Diagonalization method, Reduction problems, mapping reducibility.	6
Unit VI Computability Primitive recursive functions, computable functions, primitive recursive functions. Computability examples, the recursion theorem. **Computational Complexity** Tractable and intractable problems, growth rates of functions. Time complexity of TM. Tractable decision problems.	6

Suggested Textbooks:	
1.	Concrete Mathematics: A Foundation for Computer Science – Graham, Knuth & Patashnik
2.	Mathematics for Computer Science – Lehman, Leighton & Meyer
Suggested Reference Books:	
1.	"Introduction to Theory of Computation", Michael Sipser, Thomson Brools Cole.
2.	"Introduction to Automata Theory, Language and Computations", J.E. Hoperoft, Rajeev Motwani& J.
3.	"Introduction to Languages and Theory of Computation", John. Martin MGH.3rd Edition.
4.	"Discrete Mathematical Structures with Applications to Computer Science", J. P. Trembley and R. Manohar.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Algorithms and Complexity Theory**			***Course Code*:**	**:**	CSEC12
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Programming Language, Data Structure, Mathematical Logic					
Course Domain	**:**	Core (Algorithm)					

Course Rationale: The course on "Algorithms and Complexity Theory" is designed to provide students with a strong foundation in algorithm design, analysis, and complexity theory. By offering a comprehensive study of algorithms and complexity theory, the course aims to provide students with a solid understanding of efficient problem solving, algorithm analysis, complexity bounds, and the ability to design and implement effective algorithms. These skills are vital for success in computer science, software engineering, and related fields where algorithmic thinking and problem-solving abilities are highly valued.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with a understanding of mathematical foundations relevant to algorithms and complexity theory including asymptotic notation, standard notation, common functions, summations, and solving recurrences	**1.**	Develop analytical skills by understanding the growth of functions using asymptotic notation.
2.	Enable students to analyze the time and space requirements of algorithms.	**2.**	Gain the ability to analyze the worst-case, average-case, and amortized complexities of algorithms.
3.	Equip students with a range of algorithm design techniques including divide and conquer and the greedy method	**3.**	Acquire proficiency in various algorithm design techniques, including divide and conquer and the greedy method
4.	Foster students' problem-solving abilities by introducing Dynamic programming, Graphs and Traversals techniques	**4.**	To apply Dynamic programming, Graphs and Traversals techniques to solve complex computational problems efficiently.
5.	Introduce Backtracking, Branch-and-bound to solve complex computational problems efficiently.	**5.**	To apply Backtracking, Branch-and-bound to solve complex computational problems efficiently.
6.	Introduce students to complexity theory concepts, including lower-bound arguments, NP-completeness, and reducibility.	**6.**	Understand the complexity theory including lower-bound arguments, NP-completeness.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3		1							
CO2	2		3	2						
CO3	2	3		2						
CO4	3	3	1	1						
CO5	2	3	2	3						
CO6	2	3	2	3	2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Unit-I: Mathematical Foundation Growth of functions – Asymptotic notation, Standard notation and common functions, Summations, solving recurrences.	6
Unit II Unit-II: Analysis of Algorithms Necessity of time and space requirement analysis of algorithms, Worst case analysis of common algorithms and operations on elementary data structures (e.g. Heapsort), Average case analysis of Quicksort, Amortized analysis.	7
Unit III Standard Design Techniques-I Divide and Conquer, Greedy method.	6
Unit IV Standard Design Techniques-II Dynamic programming, Graphs and Traversals	5
Unit V Standard Design Techniques-III Backtracking, Branch-and-bound.	6
Unit VI Complexity Theory Lower-bound arguments, Introduction to NP-Completeness, Reducibility (SAT, Independent Set, 3VC, Subset Su, Hamiltonian Circuit etc.), Introduction to approximation algorithms.	6

Suggested Text Books:	
1.	Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, "Introduction to Algorithms" , PHI
2.	Introduction to Algorithms (CLRS) by Cormen, Leiserson, Rivest & Stein
3.	Algorithm Design by Jon Kleinberg & Éva Tardos
Suggested Reference Books:	
1.	E. Horowitz and S. Sahni. "Fundamentals of Computer Algorithms" , Galgotia, 1991
2.	Computational Complexity: A Modern Approach Sanjeev Arora and Boaz Barak 1st Edition (2009)

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Advanced Databases**			***Course Code*:**	**:**	CSEC13
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Database Engineering, Database Management System					
Course Domain	**:**	Core					

Course Rationale: This course will introduce the students to various types of database systems with advanced querying for decision support system and information retrieval etc.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide good understanding of emerging database technologies.	**1.**	Describe different database concepts and issues related to Transaction and Concurrency control in databases.
2.	Design databases in a variety of technologies like xml, object oriented etc.	**2.**	Identify object-oriented, relational, parallel and distributed databases and database technologies like xml.
3.	Provide in-depth information about system implementation techniques and database system architecture. Also elaborate parallel DB principals.	**3.**	Design and implement parallel database systems with evaluating different methods of storing, managing of parallel database.
4.	Explain study and designing of distributed database with its applications.	**4.**	Assess and apply database functions of distributeddatabase.
5.	Teach advanced querying with Decision support system and information retrieval.	**5.**	Familiarize yourself with concepts of data mining and knowledge discovery.
6.	Describe recommending and implementing procedures including database tuning, backup, query processing, query optimization and recovery.	**6.**	Apply various backup and recovery techniques in a database.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2			2						
CO2	2		2							
CO3		3	2							
CO4			2						2	
CO5	2	2								
CO6		2							2	

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction: Database System Concepts and Architecture, Data Independence, Data Models, SQL: DDL, DML, DCL, Database Integrity, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF. **Advanced Transaction Processing and Concurrency Control:** Transaction Concepts, Concurrency Control: Locking Methods, Timestamping Methods, Optimistic Methods for Concurrency Control, Concurrency Control in Distributed Systems.	6
Unit II Object Oriented and Object Relational Databases: Object Oriented Concepts with respect to Database Systems, Object Oriented Data Model, OODB, OODBMS, ODMG, ODL, OQL, ORDBMS, ORDBMS Design, ORDBMS Query Language.	7
Unit III Parallel and Distributed Databases: Parallel Databases, Distributed Databases, Differences between them, Architecture of Distributed Databases, Architecture of Parallel Databases, Key elements of Parallel Database Processing, Fragmentation, Replication and Allocation for distributed databases, Intra-query parallelism, Inter-query parallelism, Intra-operation parallelism, Inter-operation parallelism.	7
Unit IV Advanced Transaction Processing: Transaction Processing Monitors, Transactional workflows, Real time transactions, Transaction management in commercial databases	6
Unit V Backup and Recovery Techniques: Backup and Recovery Concepts, Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management, Recovery Control in Distributed Systems. **XML and Internet Databases:** Structured, Semi Structured, and Unstructured Data, XML Hierarchical Data Model, XML Documents, DTD, XML Schema, XML Querying: XPath, XQuery.	7
Unit VI Emerging Database Technologies: Introduction to Deductive Database Systems, Temporal Databases, Multimedia Databases, Mobile Databases, Main Memory Databases, Spatial and Multidimensional Databases. **Data Warehousing and Mining:** Introduction to OLAP, OLTP and differences between them, Data Warehouse, Data Warehouse Architecture, Data Marts, Data Mining, Data Mining Process, Knowledge Discovery.	6

Suggested list of Tutorials and Assignments: Students have to perform 6-8 tutorials based on the curriculum.	
Suggested Text Books:	
1.	Silberschatz, Korth, Sudarshan – 4th Edition Database system concepts – (MGH).
2.	Raghu Ramkrishnan Database Management System – (MGH).
Suggested Reference Books:	
1.	Thomas Connolly & Carolyn Begg (Pearson) Third Edition Database Systems: A practical approach to design, implementation & Management.
2.	Ramez Elmasri and Shamkant Navathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.
3.	Distributed Database Principals and systems - Stephan ceri, Giuseppe Pelagatti. (McGraw Hill)
4.	Principals of distributed Database system (2nd edition) - M. Tamer Ozsu. Patrick valduriez (Pearson)
5.	Object Oriented Interface and Databases - Rajesh Narang, Prentic Hall of India.
6.	Date, C.J., 1975. An introduction to database systems. Pearson Education India.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective-I Artificial Intelligence**			***Course Code*:**	**:**	CSEE11
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Programming, Mathematics, Data analysis and machine learning, Algorithms and Data structure.					
Course Domain	**:**	Core					

Course Rationale: The course aims to provide students with a solid foundation in the fundamental concepts and theories of AI. The course allows students to explore various AI techniques and algorithms used in solving complex problems.AI has rapidly become a crucial field in various industries, including healthcare, finance, marketing, and manufacturing.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with a solid understanding of the fundamental concepts, theories, and methodologies underlying AI.	**1.**	Design, develop, and implement AI systems and applications.
2.	Students should acquire knowledge of various AI techniques and algorithms used to solve complex problems.	**2.**	Critically evaluate the performance and limitations of AI models and algorithms.
3.	Enable students to apply AI techniques to real-world scenarios and domains.	**3.**	Identify opportunities for AI deployment in various industries and use cases, and propose and develop AI solutions that address specific challenges in those domains.
4.	Stimulate critical thinking and creativity by challenging students to analyse AI problems, propose novel solutions, and think critically about the strengths and limitations of AI technologies.	**4.**	Effectively communicate technical concepts related to AI to both technical and non-technical audiences.
5.	Prepare students for careers in AI-related fields.	**5.**	Effectively contribute to team-based AI initiatives, demonstrate teamwork skills, and engage in collaborative problem-solving.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1			2							
CO2										
CO3			3							
CO4			2		2					
CO5			2		2					
CO6					3					

Curriculum Content	Hours
Unit I Introduction: Artificial Intelligence, AI Problems, AI Techniques, The Level of the Model, Criteria For Success. Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis	7
Unit II Knowledge Representation: Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms	6
Unit III Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction; Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, CYC	7
Unit IV Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics; Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems	6
Unit V Natural Language Processing: Role of Knowledge in Language Understanding, Approaches Natural Language Understanding, steps in The Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis, NLP Understanding Systems; Planning: Components of a Planning System, Goal Stack Planning, Hierarchical Planning, Reactive Systems	7
Unit VI Machine Learning: Knowledge and Learning, learning by Advise, Examples, learning in problem Solving, Symbol Based Learning, Explanation Based Learning, Version Space, ID3 Decision Based Induction Algorithm, Unsupervised Learning, Reinforcement Learning, Supervised Learning: Perceptron Learning, Back propagation Learning, Competitive Learning, Hebbian Learning.	8
Suggested list of Tutorials and Assignments: The tutorial consists of a set of minimum 8-10 Tutorials / Research Problems based on the syllabus.	

Suggested Text Books:	
1.	Artificial Intelligence, George F Luger, Pearson Education Publications
2.	Artificial Intelligence, Elaine Rich and Knight, Mcgraw-Hill Publications
Suggested Reference Books:	
1.	Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI 2.
2.	Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss.G, MIT Press.
3.	Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective -1 Data Science**			***Course Code*:**	**:**	CSEE12
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Database Management System, Computer Science basics					
Course Domain	**:**	Core					

Course Rationale: This course deals with the principles of data science and strengthens the students' ability to carry out Collect, explore, clean, and manipulate data.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide you with the knowledge and expertise to become a proficient data scientist.	**1.**	Demonstrate understanding of the mathematical foundations needed for data science.
2.	To strengthen the students' ability to carry out Collect, explore, clean, manage and manipulate data.	**2.**	Explain how data is collected, managed and stored for data science.
3.	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science	**3.**	Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists
4.	Produce Python code to statistically analyze a dataset	**4.**	Implement data collection and management scripts using MongoDB
5.	Critically evaluate data visualizations based on their design and use for communicating stories from data;	**5.**	Build data science applications using Python based toolkits.
6.	To make the student aware of Build data science applications using Python based toolkits.	**6.**	Design end-to-end data science solutions by integrating data preprocessing, model building, and result interpretation.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3			2						
CO2	2	2	2							
CO3	2	3	2							
CO4			2	2						
CO5		2	2	2						

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	4
Unit II Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.	5
Unit III Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	8
Unit IV Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	9
Unit V Applications of Data Science, Technologies for visualization, Bokeh (Python)	5
Unit VI Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.	5

Suggested list of Tutorials and Assignments: Students have to perform 6-8 tutorials based on the curriculum.	
Suggested Text Books:	
1.	Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2.	AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3.	Jain V.K., "Data Sciences", Khanna Publishing House, Delhi
Suggested Reference Books:	
1.	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2.	Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective-I Machine Learning**			***Course Code*:**	**:**	CSEE13
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Mathematics, Probability and statistics, Programming skills					
Course Domain	**:**	Elective					

Course Rationale: By offering a course in machine learning, students can gain a comprehensive understanding of the principles, techniques, and applications of this dynamic field. The course prepares them to leverage machine learning for data analysis, predictive modeling, decision-making, and innovation. Moreover, it equips them with skills that are highly valued in today's data-driven and AI-driven world.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with a thorough understanding of various supervised learning algorithms, including regression and classification methods.	**1.**	Gain a comprehensive understanding of supervised learning algorithms, including regression and classification methods.
2.	Enable students to apply unsupervised learning techniques effectively	**2.**	Develop proficiency in unsupervised learning techniques such as clustering, dimensionality reduction, matrix factorization, and generative models.
3.	Teach students how to evaluate and select machine learning models	**3.**	Learn how to evaluate machine learning algorithms, perform model selection, and understand the importance of model evaluation metrics.
4.	Provide students with a comprehensive understanding of sparse modeling and estimation techniques	**4.**	Gain an understanding of sparse modeling and estimation techniques, which are useful for high-dimensional datasets
5.	Equip students with the ability to analyze and model sequence and time-series data effectively	**5.**	Learn techniques for modeling sequence and time-series data
6.	Expose students to advanced topics and applications in machine learning	**6.**	Gain insights into the latest trends in machine learning and classification methods

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	3							
CO2	2	2	3							
CO3	2	2			2					
CO4		2	3							
CO5		3	2		2					
CO6	2	2	2		2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	7
Unit II Unsupervised Learning Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)	7
Unit III Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
Unit IV Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.	7
Unit V Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.	7
Unit VI Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.	5

Suggested list of Tutorials and Assignments: Students have to perform 6-8 tutorials based on the curriculum.	
Suggested Text Books:	
1.	Machine Learning, Tom M. Mitchell, 1st Edition (1997)
2.	Pattern Recognition and Machine Learning, Christopher M. Bishop
Suggested Reference Books:	
1.	Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning,

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective-I** **Advanced Network Protocol**			***Course Code*:**	**:**	CSEE14
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Operating Systems Fundamentals, Programming skills					
Course Domain	**:**	Elective					

Course Rationale: This course provides an in-depth study of modern and emerging network protocols beyond the traditional TCP/IP suite. It explores advanced transport, routing, and application-layer protocols, as well as the design principles, implementation strategies, and performance considerations of next-generation networking.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand network protocols, architectures and applications	**1.**	Explain the design principles, architectures, and functionalities of advanced network protocols.
2.	To study the functionality of various layers of the OSI model / TCP/IP model and understand the interactions between them	**2.**	Compare and evaluate traditional TCP/IP protocols with advanced transport, routing, and application protocols.

3.	To Study the various Routing protocols in the Internet and the working of ATM.	**3.**	Demonstrate the configuration and working of MPLS, BGP, SDN, and QoS protocols in simulated environments.
4.	To understand the networking management principals	**4.**	Assess the performance of network protocols using metrics such as throughput, latency, congestion, and reliability.
5.	Familiarize students with secure communication protocols and their role in protecting network infrastructures.	**5.**	Design and implement secure communication protocols integrating IPSec, SSL/TLS, QUIC, or similar mechanisms.
6.	Encourage research, innovation, and critical thinking in the development and evaluation of emerging protocols.	**6.**	Critically analyze emerging protocol trends (IPv6, SCTP, IoT, 5G) and propose innovative solutions for modern networking challenges.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	3							
CO2	2	2	3							
CO3	2	2			2					
CO4		2	3							
CO5		3	2		2					
CO6	2	2	2		2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Advanced Networks Concept: VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, and MPLS based VPN, overlay networksP2P connections.-IPv4 and IPV6 addressing.	6
Unit II The WAN Protocol Introducing ATM Technology, basic concepts of ATM Networking, Exploring the ,B-ISDN reference model, ATM Physical Layer, ATM Layer, ATM Adaptation , Layer, Frame Relay, X.25, LAPB, HDLC, SDLC, PPP.	6
Unit III Routing Protocols Intra and interdomain routing; Unicast Routing Protocols: RIP, OSPF, BGP; Multicast Routing Protocols: MOSPF, DVMRP. Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes. IP over ATM, Multi protocol Label switching (MPLS)	6
Unit IV Transport Layer Protocols The Transport service primitives **UDP:** Process to Process communication, User Datagram Format, Operation and uses of UDP. **TCP:** TCP Services and Features, TCP segment format, TCP Connections, Flow and error control in TCP, TCP Timers.	6
Unit V Network Management Tools and Systems Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management and Enterprise Management Solutions , SNMP: Concept, Management components, SMI, MIB, SNMP format, Messages.	6
Unit VI Traffic Engineering and Capacity Planning Traffic Engineering Basics: Requirement, Traffic sizing, characteristics, Protocols, Time Delay considerations, Connectivity, Reliability, Availability and Maintainability, Throughput calculations.	6

Suggested list of Tutorials and Assignments: Students have to perform 6-8 tutorials based on the curriculum.	
Suggested Text Books:	
1.	Computer Networking: A Top-Down Approach *by James F. Kurose and Keith W. Ross*
2.	Computer Networks by Andrew S. Tanenbaum and David J. Wetherall
Suggested Reference Books:	
1.	Computer Networks: Principles, Technologies and Protocols for Network design, (N. Olifer, V. Olifer), Wiley India.
2.	High Performance Communication Networks, (J. Walrand, P. Varaiya), Morgan Kaufmann
3.	High-Speed Networks and Internets, Performance and Quality of Service, - William Stallings, Pearson Education

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**				
Course Title	**:**	**Elective-II (Open Elective) Advanced Operating Systems**		***Course Code*:**	**:**	CSEOE11
Teaching Scheme (Hours)	**:**	Lecture:	03 Hrs./week	***Total Credits***	**:**	03

Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	rand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic Knowledge of Computer Architecture, Operating Systems and Computer Networking is required					
Course Domain	**:**	Elective-I					

Course Rationale: The course aims to provide students with a solid foundation in distributed computing concepts, principles, and techniques. It prepares them to understand and tackle the complexities of developing and managing distributed systems in various domains

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide the knowledge of principles and concepts of distributed computing systems, models, design issues and environments.	**1.**	Explain the fundamental concepts, principles, and models underlying distributed computing systems
2.	Give the knowledge of communication protocols, algorithms and Distributed Shared Memory used in distributed systems.	**2.**	Distinguish the fundamentals of message passing, remote procedure calls and design and implementation Issues of DSM
3.	Provide the knowledge of synchronization mechanisms, distributed algorithms for consensus, mutual exclusion, and coordination**.**	**3.**	Analyze the fundamentals of distributed algorithms for consensus, mutual exclusion, and coordination used in distributed systems.
4.	Provide the Knowledge of Resource Management and Process Management in distributed system.	**4.**	Analyze the fundamentals of Load balancing and Load-Sharing approach used in distributed systems for task assignment.
5.	Familiarize the students about Distributed File	**5.**	Discuss the distributed file systems and their

	Systems and Security.		design principles for data replication , fault tolerance, data consistency, scalability, Cryptography and Digital Signatures,
6.	Introduce the students the Case study of commercial distributed system.	**6.**	Apply their theoretical knowledge, deepen their understanding for real-world challenges in the design and implementation of distributed systems**.**

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	1	2								
CO2	1	2	2		1					
CO3	1	1	2	2						
CO4	1	1	1	1	2					
CO5	1	1	1	1	1					3
CO6	1	1	1	1	1		1	1	1	2

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I- Distributed Computing System Fundamentals Introduction to distributed computing systems. Models, popularity, distributed operating system. Design issues of distributed operating system. Distributed computing environment.	04
Unit II-Communication Techniques in Distributed Computing Systems **Message Passing**: Features of a good message-passing system. Issues in IPC by Message Passing. Synchronization, Buffering, Multidatagram Messages. Encoding and Decoding of Message Data, process addressing, failure handling, group communication. **Remote Procedure Calls**: RPC model. Implementing RPC mechanism. Stub generation, RPC messages, marshaling arguments and results. Server management. Parameter-passing semantics, call semantics. Communication protocols for RPCs, Client-Server Binding, Exception handling. Security, Special types of RPC, RPC in heterogeneous Environments, lightweight RPC. **Distributed Shared Memory:** General Architecture of DSM systems. Design and implementation Issues of DSM. Granularity, Structure of Shared Memory Space, Consistency models, Replacement strategy, Thrashing	12
Unit III- Synchronization Clock synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms	04
Unit IV- Resource and Process Management **Resource Management**: Features of global scheduling algorithm. Task assignment approach, Load –balancing and Load-Sharing approach. **Process Management**: Introduction, Process Migration, Threads	08
Unit V- Distributed File System and Security Issues **Distributed File Systems**: Features of Good DFS, File models, File- Accessing models. File-Sharing Semantics. File-Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions,	08

Design principles, **Case study**: DCE Distributed File Service. **Security**: Potential Attacks to Computer systems, Cryptography, Authentication, Access Control, Digital Signatures, Design Principles, Case Study: DCE Security service	
Unit VI- Case Study Case study of any commercial distributed system	03

Suggested list of Tutorials and Assignments: This Course consists of a set of minimum 5 to 6 Tutorials based on the following topics 1. Introduction to Distributed Computing Systems 2. Message Passing and Remote Procedure Call and DSM 3. Synchronization in Distributed Computing Systems 4. Source and Process Management 5. Distributed File System and Security 6. Case Study of Distributed Computing Systems	
Suggested Text Books:	
1.	"Distributed Operating Systems Concepts and Design", P. K. Sinha, PHI.
Suggested Reference Books:	
1.	"Modern Operating System", Singhal
2.	"Distributed Systems Concepts and Design", G. Coulouris, J. Dollimore& T. Kindberg
3.	"Modern Operating Systems", A. S. Tanenbaum, PHI.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective-II (Open Elective) Internet of Things**			***Course Code*:**	**:**	CSEOE12
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(If any)*	**:**	Basic Knowledge of Distributed System, Basic Knowledge of Java Programming, Basic Knowledge of Programming of application for mobile devices.					
Course Domain	**:**	Elective					

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Explain the fundamental principles of IoT, its architecture, and its role in modern technology ecosystems.	**1.**	Identify and understand the unique charterships and components of IoT
2.	Explore hardware components like sensors, actuators, microcontrollers, and IoT boards (e.g., Arduino, Raspberry Pi)	**2.**	Compare various development board Arduino, Raspberry Pi, Beagle bone.
3.	Provide hands-on training on IoT platforms such as AWS IoT, Google Cloud IoT, or Azure IoT.	**3.**	Design a middleware for IoT.
4.	Discuss IP addressing, IPv6, and IoT-specific networking challenges.	4.	Analyze various protocols for IoT.
5.	Introduce methods for collecting, processing, and storing data from IoT devices.	**5.**	Compare various IoT communication technologies and design various IoT applications.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3		2				3			
CO2	3	3						2		
CO3	3		3							
CO4	3			2			2			
CO5	3			2			2			

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I -FUNDAMENTAL OF INTERNET OF THINGS(IoT) Definition and characteristics of IoT, Technical building blocks of IoT, Device, Communication technologies, Data, Physical design of IoT, IoT enabling technologies, IoT issues and challenges-Planning, costs and quality, security and privacy risks,	06
Unit II-IoT DESIGN METHDOLOGY IoT systems management, IoT Design methodology: Specifications, Integration and Application development	06
Unit III-COMMUNCATION OF IoT IoT protocols: MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT communication technologies: Bluetooth, LTE-A, DTLS, Zigbee, Z wave, NFC, LiFi, Wi-Fi, Interfacing of Wi-Fi, RFID, Zigbee, NFC with development board.	06
Unit IV-BULIDING IoT WITH RASPBERRY AND GALILEO/ARUNIDO Physical device, Raspberry PI Interfaces: Programming -APIs/Packages, Web services, Intel Galileo Gen2 with Arduino: Interfaces, Arduino IDE, Programming APIs and Hacks, IoT standards, Cloud Computing for IoT, Bluetooth Low energy, Beacons.	06
Unit V-THE INTERNET OF THINGS TO THE WEB OF THINGS Resource-oriented Architectures and Best Practices-Designing RESTful smart things-web enabling, constrained devices-the future web of things.	06
Unit VI -IoT APPLICATIONS AND CASE STUDIES Various real time applications of IoT, case studies: smart agricultural: characteristics and applications- scarecrow, smart irrigation system, crop water management, integrated pest management, sensor based filed and resource mapping, remote equipment monitoring. e-health: characteristics of e-health and applications-monitoring of health parameters, smart medicine box, elderly people monitoring, challenges, smart metering, smart home automation, smart cards, IoT in sports, IoT in smart cities/Transportation, smart parking.	06

Suggested Text Books:	
1.	ArshdeepBahga,VijayMadisetii,"Internet of Things-A hands on approach", Universities Press.
2.	BerendScholz-Reiter, Lorain Michahelles." Architecting the Internet of Things", Springer.
Suggested Reference Books	
1.	CunoPfister, Getting started with the Internet of Things, O'Reilly Media.
2.	Internet of Things: converging technologies for smart environments and intergernedecosystems,Dr,OvidiuVermesan ,Dr.Peter
3.	"The Internet of Things Connecting Objects to the web" HakimaChaouchi, Willy Publications.
4.	"Intel® Galileo and Intel® Galilelo Gen 2: APL Features and Ardunio Projects for Linux Programmers",Manoel Carlos Ramon Apress.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Elective-II (Open Elective) Data Analytics**			***Course Code*:**	**:**	CSEOE13
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	:	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic knowledge of programming concepts and familiarity with Python programming language. Basic knowledge of mathematics and statistics					
Course Domain	**:**	Elective					

Course Rationale: It allows researchers to understand the information gathered, test hypotheses, and draw conclusions. Analysis is the process of interpreting raw data through logical reasoning and applying various statistical and analytical techniques to understand patterns, relationships, and trends within the data.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss fundamentals of data analytics, discuss constraints for data collection. Give opportunity to explore different types of datasets and features.	**1.**	Identify and assess the opportunities, needs and constraints for data collection, and explore various types of datasets and features.
2.	Equip students with different data analytics techniques using python.	**2.**	Analyze the business issues that data science and analytics can address and resolve.
3.	Foster correlated data analysis, regression analysis and other techniques related to it.	**3.**	Identify the methods by which data can be collected, stored, secured, analyzed, interpreted, forecasted, visualized, reported and applied in a business environment
4.	Introduce decision tree and cluster analysis concepts. Introduce basic clustering algorithms.	**4.**	Describe how data can be interpreted beyond its basic analysis to tell a story relevant and meaningful to its organization, and how these stories can be utilized to gain competitive advantage through strategic application
5	Discuss social media analysis, leaning models and validation rules in it.	**5.**	Design case studies on social media analytics.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	1		2						
CO2	1	2	2	2	3					
CO3	1	2	2	3	3					

CO4	1	3	2	3	3					
CO5	1	2	3	3	3					

LevelofMappingas:Low1,Moderate2,High3

Curriculum Content	**Hours**
Unit I: Fundamentals of Data Analytics Data Analytics Basics, Data Types, Analytics Types, Data Analytics Steps: Data Pre-Processing, Data Imputation, Data Cleaning, Data Transformation, Data Visualization, and Data Engineering. Descriptive, Predictive, and Prescriptive Analytics.	**7**
Unit II: Data Analytics with Python Data Analytics using Python, Statistical Procedures, Web Scraping in Python, Advanced analytics, NumPy, Pandas, SciPy, Matplotlib	**6**
Unit III: Correlated Data Analysis Analysis of Variance and Co-Variance, ANOVA results, Chi-Square Statistical Test, Examine Regression results, Regressing Analysis, Linear Regression and its analysis, Logistic Regression and its analysis	**6**
Unit IV: Decision Trees Decision Tree Problem Analysis, Decision tree Construction, Decision Tree Algorithms;	**5**
Unit V: Cluster Analysis Applications of Cluster Analysis, Definition of Cluster, representing clusters, Clustering Techniques, K-Means Algorithm for Clustering, Advantages and Disadvantages of K-Means Clustering.	**6**
Unit VI: Social Media Analytics Datasets, Analysis of Social Network Dataset Features, Learning Models and Validation, Association Rule Mining, artificial Neural Networks for web analytics.	**6**

Suggested Text Books/ Reference Books/Manual	
1	Anil Maheshwari, "Data Analytics made accessible," Amazon Digital Publication, 2014.
2	Song, Peter X. -K, "Correlated Data Analysis: Modeling, Analytics, and Applications", Springer-Verlag New York 2007
3	Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining", Wiley 2009
Reference Books	
1	Thomas H. Davenport, Jeanne G. Harris and Robert Morison, "Analytics at Work: Smarter Decisions, Better Results", Harvard Business Press, 2010
2	Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'REILLY, 2006.
3	Shamanth Kumar Fred Morstatter Huan Liu "Twitter Data Analytics", Springer-Verlag, 2014.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Seminar-I**			***Course Code*:**	**:**	CSEC14
Teaching Scheme (Hours)	**:**	Practical:	02 Hrs./week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE= 50	EPE/EOE= NIL	Total= 50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Soft Skills					
Course Domain	**:**	Management					

Course Rationale: The course aims to emphasize the value and significance of the seminar in the M. Tech program, showcasing how it contributes to the overall learning experience and the professional growth of the students.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study.	**1.**	Demonstrate the ability to perform close and critical readings.
2.	Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem-solving.	**2.**	Demonstrate the ability to consider critically the motives and methods of scholarship and the relationship between them.
3.	Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience.	**3.**	Demonstrate the ability to distinguish opinions and beliefs from researched claims and evidence and recognize that kinds of evidence will vary from subject to subject.
4.	Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations.	**4.**	Ask disciplinarily appropriate questions of the material and recognize when lines of inquiry fall outside of disciplinary boundaries.
5	Explore and discuss the latest trends, advancements, and challenges in the field.	**5.**	Evaluate, credit, and synthesize sources

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1							3			
CO2							3			
CO3							3			3
CO4							3			
CO5							2			

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content
Seminar-I shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review, and develop confidence to present the material by the student. The seminar-I shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both sides printed, well formatted preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Algorithms and Complexity Theory Lab**			***Course Code*:**	**:**	CSEC15
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	:	1
Evaluation Scheme (Marks)	**:**	IE=50	EPE/EOE=Nil	Total= 50	----	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025

Pre-requisites *(if any)*	**:**	Programming Language, Data Structure, Mathematical Logic
Course Domain	**:**	Core

Course Rationale: The course on "Algorithms and Complexity Theory" is designed to provide students with a strong foundation in algorithm design, analysis, and complexity theory. The course ensures that students have the opportunity to put theory into practice, enhance their programming skills, deepen their understanding of algorithmic concepts, and develop critical thinking and problem-solving abilities. The laboratory experiences contribute to a well-rounded learning experience that prepares students for real-world algorithmic challenges and future research or professional endeavors.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with a understanding of mathematical foundations relevant to algorithms and complexity theory including asymptotic notation, standard notation, common functions, summations, and solving recurrences	**1.**	Develop analytical skills by understanding the growth of functions using asymptotic notation.
2.	Enable students to analyze the time and space requirements of algorithms.	**2.**	Gain the ability to analyze the worst-case, average-case, and amortized complexities of algorithms.
3.	Equip students with a range of algorithm design techniques including divide and conquer and the greedy method	**3.**	Acquire proficiency in various algorithm design techniques, including divide and conquer and the greedy method
4.	Foster students' problem-solving abilities by introducing Dynamic programming, Graphs and Traversals techniques	**4.**	To apply Dynamic programming, Graphs and Traversals techniques to solve complex computational problems efficiently.
5	Introduce Backtracking, Branch-and-bound to solve complex computational problems efficiently.	**5.**	To apply Backtracking, Branch-and-bound to solve complex computational problems efficiently.
6.	Introduce students to complexity theory concepts, including lower-bound arguments, NP-completeness, and reducibility.	**6.**	Understand the complexity theory including lower-bound arguments, NP-completeness.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3		1							
CO2	2		3	2						
CO3	2	3		2						
CO4	3	3	1	1						
CO5	2	3	2	3						
CO6	2	3	2	3	2					

Level of Mapping as: Low1, Moderate2, High3

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials /Research Problems and simulations based on the following topics:	
Sr. No.	**List of Experiments**
1.	Implement and compare the performance of different sorting algorithms such as Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, and Quick Sort.
2.	Implement and compare the performance of different sorting algorithms such as Merge Sort, and Quick Sort.
3.	Implement and compare the efficiency of different searching algorithms such as Linear Search, Binary Search, and Hashing-based search.
4.	Implement and analyze graph traversal algorithms such as Depth-First Search (DFS)
5.	Implement and analyze graph traversal algorithms such as Breadth-First Search (BFS)
6.	Implement dynamic programming algorithms for problems like the Fibonacci sequence
7.	Implement and analyze recursive algorithms for problems like factorial computation
8.	Implement algorithms for NP-complete problems such as the Traveling Salesman Problem
9.	Implement Job sequencing with deadlines
10.	Implement Minimum cost spanning trees
11.	Analyze lower bounds for certain computational problems.
12.	Implement All pairs shortest paths

Suggested Text Books/ Reference Books/Manual	
1.	Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, “Introduction to Algorithms” , PHI
2.	E. Horowitz and S. Sahni. “Fundamentals of Computer Algorithms” , Galgotia, 1991

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-I**					
Course Title	**:**	**Advanced Databases Lab**			***Course Code*:**	**:**	CSEC16
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	:	1
Evaluation Scheme (Marks)	**:**	IE=50	EOE=Nil	Total=50	--	**:**	--
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	SQL, Database System Concepts					
Course Domain	**:**	Core					

Course Rationale: This lab work will enhance database handling, data manipulation and data processing skills through SQL & PL/SQL, which will help them in developing data centric computer applications.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To explore the features of a Database Management Systems.	**1.**	Ability to use databases for building web applications.
2.	To interface a database with front end tools.	**2.**	Gaining knowledge about the internals of a database system.
3.	To understand the internals of a database system.		

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1		2	3							
CO2	2	2	2							

Level of Mapping as: Low1, Moderate2, High3

List of Experiments	
Sr. No.	
1.	Familiarization of the SQL database – creation and manipulation of tables.
2.	Analyze a given situation, develop an ER model and convert the ER model to Relational model.
3.	Implement Design and Normalization.
4.	Developing a data flow diagram for the problem specification.
5.	Implement the database using SQL and manipulate the tables using SQL commands.
6.	Implementation of Concurrency and Transactions.
7.	Implementation of Indexing techniques and Query Processing with SQL.
8.	Implementation of designing front end pages.

9.	Implementation of Accessing Databases from Programs using JDBC.
10.	Building Web Applications using PHP & MySQL.
11.	Implementation of server side pages and verifying the normalization

General Instructions: Students have to perform 8-10practicalsfromthelist.	
Suggested Text Books/ Reference Books/Manual	
1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2.	RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition,

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Intellectual Property Rights**			***Course Code*:**	**:**	CSEAC2
Teaching Scheme (Hours)	**:**	Lecture:	2 Hrs./week		***Total Credits***	**:**	2
Evaluation Scheme (Marks)	**:**	IE=50	ESE = NIL	Grand Total=50	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic Legal Awareness, Digital Literacy					
Course Domain	**:**	Audit Course					

Course Rationale: The course on Intellectual Property Rights (IPR) is designed to provide students with an in-depth understanding of the importance of intellectual property in fostering innovation, creativity, and economic development. As the global economy becomes increasingly knowledge-driven, protecting and managing intellectual property is critical for individuals, organizations, and nations.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Provide a comprehensive understanding of the concept, origin, and types of Intellectual Property Rights (IPR) and their significance in the global context.	**1**	Explain the fundamental concepts, origin, and significance of various types of Intellectual Property Rights (IPRs) in protecting innovations and creations.
2	Introduce the legal framework of IPR, including the TRIPS agreement and its relationship with the WTO.	**2**	Apply the knowledge of patent laws, registration procedures, and infringement remedies in the protection of inventions and technologies.
3	Familiarize students with the processes and laws related to patents, copyrights, and trademarks, along with their infringements and remedies.	**3**	Demonstrate an understanding of copyright laws, including software copyrights, piracy issues, and the remedies for infringement.
4	Understand the significance of designs, geographical indications, and layout designs, as well as their protection under international and national laws.	**4**	Analyze and manage issues related to trademarks, including registration, infringement, and offenses in cyberspace, such as domain name disputes.
5	Explore the legal provisions and ethical considerations related to the Information Technology Act, 2000, including cybercrime, e-commerce, and digital signatures.	**5**	Evaluate the legal framework for design protection, including the Semiconductor Integrated Circuits Layout Design Act and international conventions.
6	Develop the ability to identify, register, and manage intellectual property rights in various domains, including traditional knowledge and moderntechnologies.	**6**	Assess the implications of the Information Technology Act, 2000, particularly in the areas of e-governance, e-commerce, digital signatures, and combating cybercrime.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1						2				
CO2						2				3
CO3										2
CO4										2
CO5										2
CO6						2				2

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant. Varieties and Traditional Knowledge.	4
Unit II Patent Rights and Copy Rights— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.	4
Unit III Copy Right—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & license, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.	4
Unit IV Trade Marks: Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.	4
Unit V Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.	4
Unit VI Basic Tenants Of Information Technology Act-2000, IT Act - Introduction, E-Commerce and legal provisions, E- Governance and legal provisions, Digital signature and Electronic Signature. Cybercrimes.	4

Suggested Text Books :	
1.	Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2.	Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
Suggested Reference Books :	
1.	IPR by P. Narayanan
2.	Law of Intellectual Property, Asian Law House, Dr. S. R. Myneni.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Parallel Computer Architecture**			***Course Code*:**	**:**	CSEC21
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Advanced Computer Architecture, Computer Organization					
Course Domain	**:**	Core					

Course Rationale: The goal of this course is to build a strong understanding of the fundamentals of the architecture of parallel computers and efficient programming for them. We will examine how architectures are designed to exploit and extract different types of parallelism. The focus will be on fundamentals, trade-offs in parallel architecture design, and cutting-edge research. Architectures studied may include parallel microprocessors, GPUs and FPGAs.

Course Objectives: The Course teacher will		*Course Outcomes:* Students will be able to	
1	Discuss history, evolution, classifications & current trends of Computer Architecture. Summarize and analyze the most important parallel architectures in order to distinguish their main differences	**1**	Understand the history, evolution, classifications & current trends of Computer Architecture; Learn to evaluate & compare System's performance using standard benchmarks
2	Explain advanced microprocessor techniques & the salient features of state-of-the- art processors deployed in current High Performance Computingsystems	**2**	Describe the basics of advanced microprocessor techniques & the salient features of state-of-the- art processors deployed in current High Performance Computingsystems
3	Discuss the details about System Area Networks, Storage Area Networks	**3**	Discuss the details about System Area Networks, Storage Area Networks
4	Introduce Internal/ External, Disk Storage, Network Attached Storage (NAS) and Direct AttachedStorage	**4**	Identify Internal/ External, Disk Storage, Network Attached Storage (NAS) and Direct AttachedStorage
5	Describe the System Software Architecture, various parallel programming models, message passing paradigms & typical HPCC software stack.	**5**	Analyse and implement the System Software Architecture, various parallel programming models, message passing paradigms & typical HPCC software stack.
6	Discuss a supercomputer case study.	**6**	Analyse A typical Pet flop System based on Hybrid CPU/GPU Architectures and Design case studies on supercomputer.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3									
CO2	2			2	2					
CO3	2				2					
CO4	2				2					
CO5	2	3	3	3	3					
CO6		3		3	3					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit 1: System Architecture History /Evolution, Definition: Hardware /Software Architecture Flynn's Classification: SISD, SIMD, MISD, MIMD, Physical Models: PVP, MPP, SMP, Cluster of Workstations (COW). Memory Architectures: Shared, Distributed & Hybrid, UMA, NUMA, CC-NUMA, Performance Metrics & Benchmarks, Architectural Trends based on TOP500 List of Supercomputers.	7
Unit 2: Advanced Microprocessor Techniques CISC, RISC, EPIC, Superscalar, Super pipelined, ILP, TLP. Power Wall, Moore's Law redefined, Multicore Technologies Intel's Tick Talk Model. Study of State-of-the –Art Processors: Intel//AMD x86 Series, Intel //IBM Itanium// POWER series, Introduction to Graphics Processing Units (GPU: NVIDIA)	7
Unit 3: System Interconnects SAN: System Area Networks, Storage Area Networks including InfiniBand, Gigabit Ethernet. Scalable Coherent Interface (SCI) Standard.	4
Unit 4: Storage Internal/ External, Disk Storage, Areal Density, Seek Time, Disk Power, Advanced RAID Levels, SATA vs SAS Disks, Network Attached Storage (NAS) and Direct Attached Storage, I/O Performance Benchmarks.	4
Unit 5: Software Architecture Parallel Programming Models: Message Passing, Data Parallel, MPI /PVM Typical HPCC Software Stack including Cluster Monitoring Tools e.g. GANGLIA CUDA Programming Environment.	7
Unit 6: Case Studies A typical Pet flop System based on Hybrid CPU/GPU Architectures, IBM SP System, C-DAC's latest PARAM System.	7

Suggested Text Books:	
1.	John L. Hennesy and David Patterson, Computer Architecture : A Quantitative Approach, 4th Edition, 2007
2.	Kai Hwang and Zhiwei Xu, Scalable Parallel Computers, McGraw- Hill, 1998.
3.	Data Manuals of respective Processors available at Website.
Suggested Reference Books:	
1.	Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Elsevier Series, 2011, ISBN:978-0-12-374260-5.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Computer Vision and Image Processing**			***Course Code*:**	**:**	CSEC22
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Probability, statistics, linear algebra, calculus and basic statistical knowledge are prerequisites of getting into the domain.					
Course Domain	**:**	Core					

Course Rationale: In this course we will introduce the basic notions in image processing and computer vision in such a way that a student will be able to use them for practical purposes and have an understanding of the theoretical (mathematical) basics.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Introduce basic digital image processing fundamentals.	**1**	Learn basics of digital image processing fundamentals.
2	Familiarize students with different image transform techniques.	**2**	Apply different image transform techniques.
3	Explain different techniques employed for the enhancement of images.	**3**	Learn different techniques employed for the enhancement of images.
4	To familiarize students with image compression and restoration techniques.	**4**	Apply image compression and restoration techniques.
5	Introduce Image Analysis techniques and Computer Vision approaches	**5**	Apply Image Analysis techniques and Computer Vision approaches
6	Familiarize students with different Emerging IT applications	**6**	Develop IT applications using image processing and computer vision.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	2							
CO2	2	2	3		2					
CO3	2	2	3		2					
CO4		2	3	2	3					
CO5		2	2	2	3					
CO6		2	2	3	3					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Digital Image Fundamentals Digital image Representation, Functional Units of an Image processing system, Visual perception, Image Model, Image sampling and Quantization, grayscale resolution, pixel relationship, image geometry.	6
Unit II Image Transforms Unitary Transform, Discrete Fourier Transform, Cosine Transform, Sine Transform, Hadamard Transform, Slant and KL Transform.	6
Unit III Image Enhancement Histogram processing, Spatial operations, Image smoothing, Image Sharpening, Colour Image Processing methods, Colour Image Models.	6
Unit IV Image restoration and compression Image restoration and compression Degradation Model, Discrete Formulation, Circulant matrices, Constrained and Unconstrained restoration, geometric transformations fundamentals, Compression Models, Error Free Compression, Lossy Compression, lossless compression, International Image Compression Standards.	7
Unit V Image Analysis and Computer Vision Spatial feature Extraction, transform feature, Edge detection, Boundary Representation, Region Representation, Moment Representation Structure, Shape Features, Texture Scene Matching and Detection, Image Segmentation, Classification techniques, Morphology, Interpolation.	6
Unit VI Emerging IT applications Recognition of characters, Fingerprints and faces-Image databases.	5

Suggested Text Books:	
1.	Fundamentals of Digital Image Processing-A.K.Jain
2.	Image Processing and machine vision-Milan Sonka, VaclavHlavae
3.	Pattern Recognition Principles-J.T. Tou and R.C.Gonzalez
4.	Syntactic Pattern Recognition and applications.-King Sun Fun
5.	Computer vision-Fairhurst (PHI).
Suggested Reference Books:	
1.	Digital Image Processing *by Rafael C. Gonzalez and Richard E. Woods,*
2.	Computer Vision: Algorithms and Applications *by Richard Szeliski*

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Computer Security**			***Course***	**:**	CSEC23
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs/week		***Total Credits***	**:**	03
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Engineering Mathematics					
Course Domain	**:**	CORE					

Course Rationale: This course is designed to provide students with a solid foundation in information security. They will acquire knowledge about the basic principles, security threats, various modes of attack, and cryptographic models. The course also covers important topics such as access control, identification, and authentication. In addition, students will gain an understanding of network security, operating system (OS) hardening techniques, as well as intrusion detection and prevention methods.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Equip students with understanding of the fundamental concepts of cryptography and introduce them to essential encryption techniques.	1	Understand of the fundamental terminology used in cryptography, as well as the principles behind classical cryptosystems.
2	Provide a thorough explanation of modern cryptosystems.	2	Analyse advanced cryptographic systems used to secure information in today's digital world.
3	Engage in a discussion on the concepts of finite mathematics and number theory, as well as delve into the principles of public key cryptography.	3	Explore mathematical structures, discrete mathematics, number systems, and their applications in the context of public key cryptography.
4	Cover a comprehensive discussion on various security policies, including authentication, integrity, and confidentiality.	4	Understand their role in system security, authentication mechanisms, data integrity techniques, and confidentiality preservation.
5	Provide students with a solid understanding of key management and key distribution.	5	Learn principles, best practices, and protocols for secure key management, distribution, integrity, and confidentiality throughout the key lifecycle
6	Discuss network and Web security protocols.	6	Gain knowledge of how these protocols are implemented and their significance in maintaining the confidentiality, integrity, and authenticity of network and web communications.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	3	2							
CO2	3	3	2	2						
CO3	2	3	3	2	3					
CO4	3	2	3	2	2					
CO5		3	2	2						
CO6		2	2	2	2					

Level of Mapping as: Low1, Moderate2, High3

Suggested list of Tutorials and Assignments:

1. Computer Security Overview.
2. Computer Security elements and terminologies.
3. Encryption and Decryption.
4. Asymmetric Key Cryptography.
5. Cryptographic Data Integrity.
6. Network and Internet Security.

Suggested Text Books:

1.	"Cryptography and Network Security Principles and Practices", Williams Stallings (LPE).

Suggested Reference Books:

1.	"Handbook of Applied Cryptography", Menezes, A. J., P. C. Van Oorschot, and S. A. Vanstone.
2.	"Applied Cryptography: Protocols & Algorithms", Schneier, Bruce.
3.	Cryptography and network security – AtulKahate (TMGH)

Curriculum Content	**Hours**
Unit I Overview and Classical Encryption Techniques Overview: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Threats and vulnerabilities, CIA triad (Confidentiality, Integrity, Availability) Security Services, Security Mechanisms, A Model for Network Security Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines	6
Unit II Block Ciphers and Advanced Encryption Standard Block Cipher Principles, The Data Encryption Standard (DES), A DES Example, The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles Block cipher modes of operations, Introduction to AES	6
Unit III Number Theory and Asymmetric Key Cryptography: Prime Number, relatively prime numbers, Modular Arithmetic, Fermat's and Eulers Theorem, The Chinese Remainder Theorem, Discrete logarithms, Public Key Cryptography and RSA - Principles of Public Key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange	8

Unit IV Cryptographic Data Integrity Algorithms Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA), Types of SHA, SHA-3Message Authentication Code: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC Digital Signatures: Elgamal Digital Signature Scheme, DSS, NIST Digital Signature Algorithm	8
Unit V Mutual Trust and Key Management Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure.	5
Unit VI Network and Internet Security Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites	6

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-III Data-Mining and Warehousing**			***Course Code*:**	**:**	CSEE21
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Database Engineering, Database Management System, Advanced Databases					
Course Domain	**:**	Elective					

Course Rationale: This course will introduce the students to database technology for data mining and development and apply critical thinking, problem-solving, and decision-making skills.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Describe the concepts of database technology for the need of data mining and its applications.	**1**	Understand the role of data warehousing and enterprise intelligence in industry.
2	Elaborate different models used for OLAP and data pre-processing. Apply pre-processing statistical methods for any given large amount of raw data.	**2**	Compare and contrast the dominant data mining algorithms.
3	Explains the performance of different data mining methods and tools.	**3**	Evaluate and select appropriate data-mining algorithms and apply, and interpret, report the output appropriately.
4	Help the study students, various developing areas in data mining as web mining, text mining, spatial mining, temporal mining and Identifying business applications of data mining.	**4**	Design and implement of a data-mining application using sample, realistic data sets and modern tools.
5	Explain critical thinking, problem-solving, and decision-making skills.	**5**	Evaluate and implement a wide range of emerging and newly adopted methodologies and Technologies to facilitate the knowledge discovery.
6	To interpret the contribution of data warehousing and data mining to the decision support level of organizations.	**6**	

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	2		2						
CO2	2	2								
CO3	2		2							
CO4			2	2						
CO5			2	2	2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I **Introduction to Data Mining** Data Flood, Data Mining and Knowledge Discovery, Data Mining Tasks Data Preparation for Knowledge Discovery, Data understanding, Data cleaning, Data transformation, False "predictors" , Feature reduction, Randomization.	4
Unit II **Knowledge Representation** Decision tables, Decision trees, Decision rules, Rules involving relations, Instance-based representation, Classification -Statistical Based Algorithms, Decision Trees Based Algorithms, Neural Networks Based Algorithms, Rules, Regression, Instance-based (Nearest neighbor), Case study	6
Unit III **Clustering** Introduction, Clustering Methods, Ways of scaling clustering algorithms, Case study	6
Unit IV **Associations** Associations, Transactions, Frequent item sets, Association rules, Applications	6
Unit V Data warehousing, OLAP and Data mining, web warehousing, Schema integration and data cleaning, Deduplication, Data marts: Multidimensional databases (OLAP) Advanced topics: ETL, Integrating OLAP and mining, Online aggregation, Recap, future and visions.	8
Unit VI Advanced Topics: Mining Multimedia Databases, Text Mining, Web Mining, Spatial Mining, Temporal Mining Data Mining Applications, Additional Themes on Data Mining, Social impacts of Data Mining, Trends in Data Mining	8

Suggested list of Tutorials and Assignments: Students have to perform 6-8 tutorials based on the curriculum.

Suggested Text Books:	
1.	Jiawei Han, Micheline Kamber. Data Mining: Concepts and Techniques. Morgan-Kaufmann,
2.	Margaret H. Dunham. Data Mining: Introductory and Advanced Topics, Pearson Education, 2003
Suggested Reference Books:	
1.	Heikki Mannila, Padhraic Smyth, David Hand. Principles of Data Mining, MIT Press, 2001.
2.	Soumen Chakrabarti. Mining the Web- Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003
3.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2006
4.	Ian H. Witten &Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan-Kaufmann, 2000.
5.	T Hastie, R Tibshirani, J H Friedman, The Elements of Statistical Learning: Data Mining,Inference, and Prediction, Springer Verlag, 2001.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-III Deep Learning**			***Course Code*:**	**:**	CSEE22
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basics in mathematics such as linear algebra, calculus and probability theory, Machine Learning, Neural Networks					
Course Domain	**:**	Elective-II					

Course Rationale: The increasing demand for deep learning expertise in industries, the interdisciplinary nature of deep learning applications, the emphasis on research and innovation, the practical skill development required to address complex problems, and the need to prepare students for the future of artificial intelligence**.**

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Give the fundamental knowledge to the students about Neural Networks	**1**	Understand the fundamentals of neural networks**.**
2	Provide the knowledge to the students about Feedforward Networks	**2**	Design feed forward networks with backpropagation.
3	Introduce to the students about optimization techniques in Neural networks	**3**	Analyse neural networks for performance
4	Provide the knowledge to the students about Autoencoders.	**4**	Apply the knowledge to tackle real-world problems using autoencoders
5	Provide the knowledge to the students of Convolutional Neural Networks (CNN)	**5**	Demonstrate the skills to design and implement CNN architectures for variety of computer vision, natural language processing, and other relevant tasks.
6	Provide the knowledge to the students of Recurrent Neural Networks (RCNN)	**6**	Demonstrate the skills to design and implement RCNN architectures for a wide range of sequential and time-dependent tasks

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	1	2			1					
CO2	1	2	1	1	1					
CO3	1	1	1	2						
CO4	1	1	1	1	1					
CO5	1	1	1	1	1	3				3
CO6	1	1	1	1	1	2	1	1	1	2

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I- Basics Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.	4
Unit II-Feedforward Networks Introduction to neural network and multilayer perceptron's (MLPs) , representation power of MLPs, sigmoid neurons, gradient descent, feedforward neural networks representation, Backpropagation.	6
Unit III-Optimization Techniques Gradient Descent, Batch Optimization, Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).	8
Unit IV-: Autoencoders Autoencoders, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Trade-off, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.	10
Unit V-Convolutional Neural Networks (CNN) Introduction to CNN, Building blocks of CNN, Transfer Learning, LeNet, Alex Net, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing CNNs, Guided Backpropagation, Fooling Convolutional Neural Networks	8
Unit VI-Recurrent Neural Networks (RCNN) Introduction to RCNN, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs, Encoder Decoder Models, Attention Mechanism.	8

Suggested list of Tutorials and Assignments: This Course consists of a set of minimum 5 to 6 Tutorials based on the following topics

1 Neural Networks
2.Feed Forward Networks
3.Optimization Techniques
4.Autoencoders
5.Convolution Neural Networks
6. Recurrent Neural Networks (RCNN)

Suggested Text Books:

1.	Deep Learning- Ian Goodfelllow, YoshuaBenjio, Aaron Courville, The MIT Press

Suggested Reference Books:

1.	Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2.	Pattern Recognition and Machine Learning, Christopher Bishop, 2007

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-III Cloud Computing**			***Course Code*:**	**:**	CSEE23
Teaching Scheme (Hours)	**:**	Lecture:	03 Hrs/week		***Total Credits***	**:**	03
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Operating System, Computer Networking					
Course Domain	**:**	CORE					

Course Rationale: Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as Services in an on-demand manner. Students will be exposed to the current practices in cloud Computing. Topics include distributed computing models and technologies, service model, Virtualization, security and privacy issues, performance and systems issues. It also covers challenges in clouds, data centers, cloud hosted applications and advanced topics in cloud Computing.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Explain the fundamental concepts and characteristics of cloud computing	1	Compare cloud computing with other computing technologies.
2	Define virtualization and its significance and the role of virtualization in enabling key features of cloud computing.	2	Illustrate the virtualization technologies and its role in enabling the cloud computing system model.
3	Evaluate the suitability of different cloud service and deployment models for scientific, business, and consumer applications.	3	Identify and compare different cloud service and deployment models for scientific, business and consumer applications.
4	Demonstrate how to develop different applications using the Aneka platform.	4	Describe Aneka platform as a service to design different applications.
5	Compare different cloud services, such as storage, computing, networking, and databases, across multiple cloud providers.	5	Compare different cloud services with pros and cons from multiple cloud providers.
6	Discuss the use of artificial intelligence, machine learning, and big data analytics in cloud computing.	6	Describe recent advances in cloud framework/services for solving scientific and Business applications.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	3		2					
CO2			2		3					
CO3		2			2					
CO4			2		2					
CO5					2					
CO6			2		3					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction Eras of Computing, defining a cloud, cloud computing reference model, Historical developments: Distributed Systems, Virtualization, Web 2.0, Service Oriented Computing, Utility Oriented Computing.	6
Unit II Cloud Computing Architecture Introduction, Architecture, IaaS, PaaS, SaaS. Types of Clouds: Public, Private, Hybrid and Community Clouds, Economics of the Cloud, Open Challenges.	6
Unit III Virtualization Introduction, Characteristics of virtualized Environments, Taxonomy Virtualization techniques, Virtualization and Cloud computing, Pros and Cons virtualization, Technology Examples Xen: Paravirtualization, VMware Virtualization, Microsoft Hyper-V.	6
Unit IV Programming Enterprise Clouds using Aneka Introduction, Aneka Architecture, Aneka Deployment, Parallel Programming Models, Thread Programming using Aneka, Task Programming using Aneka, and MapReduce Programming using Aneka, Parallel Algorithms, Parallel Data mining, Parallel Mandelbrot, and Image Processing.	6
Unit V Cloud Infrastructure and Platforms in Industry Open Stack: Introduction to open stack, components of open stack, Dev stack. Amazon Web Services: Compute Services; Storage Services; Communication Services and Additional services. Google App Engine: Architecture and Core concepts, Application Life Cycle, Cost Model. Microsoft Azure: Azure Core concepts and SQL Azure, Windows azure platform appliance.	6
Unit VI Advanced Topics and Cloud Applications Healthcare/agriculture/government data analysis using Cloud/Fog computing, Social networking applications, Cloud automation tools and Dev ops concepts.	6

Suggested list of Tutorials and Assignments:

1. Understand the fundamental concepts and characteristics of cloud computing.
2. Identify and compare different cloud service and deployment models for scientific, business, and consumer applications.
3. Explore virtualization technologies and their role in enabling the cloud computing system model.
4. Understand the Aneka platform as a service and its application design capabilities.
5. Compare different cloud services offered by various providers.
6. Explore recent advances in cloud frameworks and services for scientific and business applications.

Suggested Text Books:

1.	RajkumarBuyya, Christian Vecchiola, and ThamaraiSelvi, Mastering Cloud Computing, Tata McGraw Hill.

Suggested Reference Books:

1.	Judith Hurwitz, R.Bloor, M.Kanfman and F.Halper, Cloud Computing for Dummies, Wiley India.
2.	J.Vette, Toby J. Vette and Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-III** **Business Analytics**			***Course Code*:**	**:**	CSEE24
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Mathematics & Statistics, Programming Skills, Database Management					
Course Domain	**:**	Elective					

Course Rationale: This course provides an in-depth understanding of data-driven decision-making using business analytics tools and techniques. It covers statistical methods, predictive modeling, optimization, and visualization to solve real-world business problems, enabling students to bridge the gap between data science and management strategies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the foundations of business analytics and its role in strategic decision-making.	**1.**	Explain the principles, scope, and applications of business analytics.
2.	Provide knowledge of statistical, machine learning, and optimization methods for analyzing business data.	**2.**	Apply statistical and machine learning techniques to analyze and interpret business data.
3.	Develop proficiency in using tools such as R, Python, Tableau, and Power BI for data analysis and visualization.	**3.**	Use analytics tools to visualize, report, and communicate insights effectively.
4.	Enable students to apply predictive and prescriptive analytics for real-world business scenarios.	**4.**	Evaluate predictive and prescriptive models for decision-making in business operations.
5.	Enhance problem-solving, critical thinking, and analytical skills in business contexts.	**5.**	Design and implement end-to-end analytics solutions for business case studies.
6.	Encourage innovation and research in emerging areas such as big data analytics, AI-driven business solutions, and data ethics.	**6.**	Critically assess emerging trends and ethical challenges in business analytics.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	3							
CO2	2	2	3							
CO3	2	2			2					
CO4		2	3							
CO5		3	2		2					
CO6	2	2	2		2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I Introduction: Introduction to Business Analytics (BA) – Need, Components, Types and Techniques (Descriptive, Predictive and Prescriptive); Business Enterprise, Organization, its functions and core business processes, Key Purpose of Using, IT in Business; Information Users and Their Requirements. Framework for data-driven decision making.relationship – image geometry. Image Transforms – Unitary Transform, Discrete Fourier Transform, Cosine Transform, Sine Transform, Hadamard Transform, Slant and KL Transform.	6
Unit II Digital data Types of Digital Data – Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi-Structured Data; On Line Analytical Processing (OLAP) versus Online Transaction Processing (OLTP); Data Models for OLTP and OLAP	6
Unit III Business Intelligence Definitions and Examples in Business Intelligence, Data Mining, Big Data, Web and Social Media Analytics, Machine Learning, Data Science, Looking at Data from Various Perspectives of Managing Data; Need, Features and Use of Business Intelligence (BI); BI Component Framework; Business Intelligence versus Business Analytics.	6
Unit IV Basics of Data Integration Need for Data warehouse, Definition of data warehouse, Data Mart, Goals of Data warehouse, Data sources, Extract ,Transform, Load, Data Integration and its technologies, Data quality, Data profiling	6
Unit V Multidimensional Data Modeling : Data modeling basics, Types of data model, Data Modelling techniques, Fact table, Dimension Table, Typical Dimensional models, Dimensional Modeling Lifecycle, Designing the dimensional Model.	6
Unit VI Applications of Analytics Analytics in Business Support Functions – Human Capital Analytics, IT Analytics, Sales & Marketing Analytics; Analytics in Industries – Telecom, Retail, Healthcare; Analytical Application Development; Anatomy of Social Media Analytics, anatomy of recommendation system and its components	6

Suggested list of Tutorials and Assignments: The tutorial consists of a set of minimum 8-10 Tutorials / Research Problems and based on the syllabus.	
Suggested Text Books:	
1.	Business Analytics: Data Analysis and Decision Making *by S. Christian Albright and Wayne L. Winston*
2.	Business Analytics: The Science of Data-Driven Decision Making *by U. Dinesh Kumar*
Suggested Reference Books:	
1.	"Business Analytics", Sahil Raj, Cengage Learning.
2.	"Business Analytics", James R Evans , Pearson Education Asia, 2nd Edition.
3.	"Business Analytics for Managers: Taking Business Intelligence Beyond ", Jesper Thorlund & Gert H.N. Laursen, Wiley publication

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective- IV (Open Elective) Geographical Information Systems**			***Course Code*:**	**:**	CSEOE21
Teaching Scheme (Hours)	**:**	Lecture:	03 Hrs./week		***Total Credits***	**:**	03
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Database					
Course Domain	**:**	**Open Elective**					

Course Rationale: By studying GIS, student will gain the skills to harness the power of spatial data and technology, contributing to better decision-making, improved efficiency, and sustainable development across sectors such as geography, computer science, environmental studies, urban planning, public health, and many other fields**.**

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Introduce fundamentals of GIS, Spatial Data, Spatial Data Modelling, and Attribute Data Management to the students.	**1**	Demonstrate a solid understanding of fundamental GIS concepts, including spatial data models, coordinate systems, map projections, and the basic components of a GIS.
2	Provide the knowledge of Data, Input, Editing and Data Analysis to the students.	**2**	Effectively use GIS tools to perform tasks such as data collection, data management, spatial analysis, and data visualization**.**
3	Introduce to the students about Analytical Modelling in GIS, From New Maps to Enhanced decisions	**3**	Gather, preprocess, and structure data from field surveys, remote sensing, and other sources for analysis.
4	Provide the knowledge of Development of Computer methods for handling spatial data to the students.	**4**	Conduct spatial analysis using GIS techniques such as spatial querying, overlay analysis, proximity analysis, spatial interpolation, network analysis
5	Provide the knowledge of Data quality issues, Human and Organizational issues to the students.	**5**	Learn to acquire, preprocess, manipulate, convert, integrate, and assess vector and raster data quality.
6	Provide the knowledge about GIS project Design and Management to the students.	**6**	Use GIS tools to address spatial challenges in urban planning, environmental management, and resource management.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	1	2		1						
CO2	1	1	2	1	1					
CO3	1	2	1	2	1					
CO4	1	1	1	1	1					
CO5	1	1	1	1	1	3				3
CO6	1	1	1	1	1	2	1	1	1	2

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I-Introduction to GIS, Spatial Data, Spatial Data Modeling, Attribute Data Management.	6
Unit II-Data, Input, Editing, Data Analysis.	6
Unit III-Analytical Modelling in GIS. Output: From New Maps to Enhanced decisions.	7
Unit IV-Development of Computer methods for handling spatial data**.**	6
Unit V- Data quality issues, Human and Organizational issues.	6
Unit VI-GIS project Design and Management, Future of GIS.	6

Suggested list of Tutorials and Assignments: This Course consists of a set of minimum 5 to 6 Tutorials based on the following topics:

1. Introduction to GIS
2. Data Input Editing and Analysis
3. Analytical Modelling in GIS
4. Spatial Analysis
5. Spatial Data Collection
6. Geospatial Python Programming

Suggested Text Books:

1.	"An Introduction to Geographical Information Systems", Ian Heywood, Sarah Cornelius& Steve Carver, Pearson Education.
2.	Concepts and Techniques of Geographic Information Systems *by C.P. Lo and Albert K.W. Yeung,*

Suggested Reference Books:

1.	Principles of Geographical Information Systems *by Peter A. Burrough and Rachael A. McDonnell*
2.	Fundamentals of Geographic Information Systems *by Michael N. DeMers*

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-IV (Open Elective) Natural Language Processing**			***Course Code*:**	**:**	CSEOE22
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Proficiency in at least one programming language, such as Python, is essential for implementing NLP algorithms and working with libraries like NLTK, SpaCy, and Hugging Face.					
Course Domain	**:**	**Open Elective**					

Course Rationale: Natural Language Processing (NLP) is one of the most important technologies of the information age. it gives deep understanding of the fundamental concepts of NLP and its role in current and emerging technologies. Understanding complex language utterances is also inckuded in addition course discusses syntactic parsing, sematic parsing and machine translation issues.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Introduce the fundamental concepts and techniques of Natural Language Processing, including syntax, semantics, and pragmatics.	**1**	Acquire knowledge of the fundamental mathematical models and algorithms in the field of NLP.
2	Provide an understanding of language models, parsing methods, and linguistic structures used in NLP systems.	**2**	Apply these mathematical models and algorithms in application in software design and implementation of NLP.
3	Develop skills in applying statistical and machine learning methods for text analysis and language understanding.	**3**	Apply deep learning models to solve machine translation and conversion problems.
4	Enable students to build applications such as sentiment analysis, machine translation, text summarization, and question answering using NLP techniques.	**4**	Apply deep structured sematic models on information retrieval and natural language application.
5	Familiarize students with state-of-the-art NLP tools, frameworks, and libraries for solving real-world problems.	**5**	Acquire knowledge of the design and implementations issues in various NLP application such as information extraction and machine translation.
6	Explore recent advancements in NLP, including transformer-based models and their applications in various domain.	**6**	Explore recent advancements in NLP

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1		2	2							
CO2			2		2					
CO3			3		3					
CO4		2	2		2					
CO5			2		2					
CO6			3		3					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit I -INTRODUCATION NLP tasks in syntax, semantics and pragmatics. Applications such as information extraction, question answering and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the filed.	6
Unit II-LANGUAGE MODELS The role of language models. Simple N-gram models. Estimating parameters and smoothing evaluating language models.	6
Unit III-PART OF SPEECH TAGGING AND SEQUIENCE LABELING Stochastic formalisms and treebanks, efficient parsing for context free grammar (CFG), statistical parsing and probabilistic CFGs (PCFGs), lexicalized PCFGs, and neural shifts reduce dependency parsing.	6
Unit IV-SYNTACTIC PARSING Different parsing algorithms, Parsing in case of ambiguity, Probabilistic parsing, CKY algorithm, Issues in parsing, Dependency parsing- Syntactic structure, Parsing methodology, Transition-Based Dependency Parsing, Graph-Based dependency parsing, Evaluation.	6
Unit V-SEMATIC ANALYSIS Lexical semantics and word sense disambiguation, computational semantics, sematic role labeling and sematic parsing.	4
Unit VI -INFORMATION EXTRACTION(IE) Named entity reorganization and relation extraction, IE using sequence labeling MACHINE TRANSLATION(MT) basic issues in MT, statistical translation, word alignment, phrase-based translation and synchronous grammars case study of typical NLP applications using deep learning.	8

Suggested Text Books:	
1.	Daniel jurafsky and james H Martin Speech and language processing, Person Education.
Suggested Reference Books:	
1.	James A. Natural language understanding, Person Education.
2.	Bharti A., Sangal R.,Chaitnya Natural Language processing :a paninian perspective, PHI
3.	Siddiqui T.,Tiwary,U.S.,Natural Language Processing and Information retrieval, OUP.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Elective-IV (Open Elective) Blockchain Technology**			***Course Code*:**	**:**	CSEOE23
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs./week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Expertise In Programming, Basic Knowledge of Computer, Cryptography, Networking, Concurrent or Parallel Programming					
Course Domain	**:**	**Open Elective**					

Course Rationale: Blockchain is an emerging technology platform for constructing decentralized apps and data storage. This platform's central concept is that it enables the creation of a distributed and replicated ledger of events, transactions, and data generated by various IT processes, with strong cryptographic assurances of tamper resistance, immutability, and verifiability. Even when untrusted people are participants of distributed apps with the ability to transact on the network, public blockchain systems allow us to ensure these qualities with overwhelming probabilities. Even though blockchain technology is best known for its use in the implementation of crypto currencies like Bitcoin and Ethereum.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Summarize the cryptographic building blocks of block chain Technology	1.	Discuss the cryptographic building blocks of block chain Technology
2.	Describe fundamental concepts of block chain Technology	2.	Explain the fundamental concepts of block chain Technology
3.	Analyze basic block chains. Develop simple applications using Solidity language on Ethereum platform.	3.	Compare basic block chains. Develop simple applications using Solidity language on Ethereum platform.
4.	Discuss the concepts of general and decentralized blockchain applications	4.	Discuss the concepts of general and decentralized blockchain applications
5.	Identify and discuss the concepts of general and decentralized blockchain applications	5.	Explain Discuss the concepts of general and decentralized blockchain applications
6.	Summarize privacy and security issues in blockchain	6.	Summarize privacy and security issues in blockchain

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2			1						
CO2	2	1		1						
CO3	2	2	2	2	2					
CO4	2	2	2		1					
CO5	2	2			2					
CO6	2	2	2	2	2					

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content	**Hours**
Unit-I Introduction History of Blockchain - Types of Blockchain, Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Blockchain based cryptocurrency, Technologies Borrowed in Blockchain - hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.	7
Unit II Basic Distributed Computing Atomic Broadcast, Consensus, Byzantine Models of fault tolerance **Basic Crypto primitives:** Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems	5
Unit III Blockchain Technology versions **Blockchain 1.0 :** Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use **Blockchain 2.0** : Ethereum and Smart Contracts: Components of Ethereum Ecosystem - Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts Blockchain 3.0 : Hyperledger fabric, the plug and play platform and mechanisms in permissioned Blockchain	6
Unit IV Blockchain Technology Applications Introduction to Decentralized Applications, Blockchain Mining, Whisper, Swarm, Forks. Medical Record Management System. Domain Name Service and future of Blockchain	6
Unit V Case Studies of Blockchain in Cognitive Applications IBM Block Chain, Blockchain in Health care Innovation, Al Marketplaces, Investment Management Platforms, Future of Al and Block Chain	6
Unit VI Privacy, Security issues in Blockchain Pseudo-anonymity vs. anonymity, ZCash and Zk-SNARKS for anonymity preservation, attacks on Blockchains - such as Sybil attacks, selfish mining, 51% attacks - -advert of algorand and Sharding based consensus algorithms to prevent these	6

Suggested Text Books:	
1.	Artemis Caro, "Blockchain: The Beginners Guide the Understanding the Technology Behind Bitcoin & Cryptocurrency", Create Space Independent Publishing Platform
2.	Scott Marks, "Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology", Create Space Independent
3	Arvind Narayanto, Joseph Boansas, Beward Felton, Andrew Miller and Stevia Soldiered, "Bitcoin and Crypto currency Technology: A Comprehensive Introduction", Princeton University Press
Suggested Reference Books:	
1.	Mark Watney, "Block chain for Beginners".
2.	Alwyn Bishop, "Block chain Technology Explained".
3.	J.H. Huiwitz, M.Kaufman, A.Boales, Cognitive Computing de Big Data Analyses", Wiley Publication.
4.	MOOC/ NPTEL Courses: • NPTEL Course Introduction to Block Chain Technology & Applications" https://nptol.sc.in/exucsss/106/104/106?04220Y • NPTEL Course Architecture* Use Cases" ws-hoptel.ag.in/courses/106/10S/106105184

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Seminar-II**			***Course Code*:**	**:**	CSEC24
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	**:**	01
Evaluation Scheme (Marks)	**:**	IE= 50	EPE/EOE=NIL	Total= 50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Soft Skills					
Course Domain	**:**	Management					

Course Rationale: The course aims to emphasize the value and significance of the seminar in the M. Tech program, showcasing how it contributes to the overall learning experience and the professional growth of the students.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study.	1.	Acquire a comprehensive understanding of the seminar topic, its theoretical foundations, and its practical applications within their field of study.
2.	Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem-solving.	2.	Develop improved research skills, including the ability to critically analyze existing literature, design experiments or investigations, collect and analyze data, and draw meaningful conclusions.
3.	Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience.	3.	Effectively present and communicate their research findings, ideas, and arguments through oral presentations and written reports.
4.	Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations.	4.	Interact and establish connections with experts, professionals, and fellow researchers in the field, potentially
5.	Explore and discuss the latest trends, advancements, and challenges in the field, providing students with exposure to cutting-edge research and industry practices.	5.	Develop critical thinking skills and the ability to identify and solve complex problems within their area of specialization.
		6.	Gain knowledge on latest developments, trends, and challenges within their field, enabling them to contribute to the advancement of knowledge and industry practices.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1							3		2	
CO2							3		2	
CO3							3		2	3
CO4							3		2	
CO5							2		3	
CO6							2			

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content
Seminar-II shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review, and develop confidence to present the material by the student. The seminar-II shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, well formatted preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Computer Vision and Image Processing Lab**			***Course Code*:**	**:**	CSEC25
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE=50	EOE=Nil	Total=50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Probability, statistics, linear algebra, calculus and basic statistical knowledge are prerequisites of getting into the domain.					
Course Domain	**:**	Core					

Course Rationale: In this course we will introduce the basic notions in image processing and computer vision in such a way that a student will be able to use them for practical purposes and have an understanding of various image processing and computer vision techniques using programming languages like Python, MATLAB.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce basic digital image processing fundamentals.	**1**	Learn basics of digital image processing fundamentals.
2.	Familiarize students with different image transform techniques.	**2**	Apply different image transform techniques.
3.	Explain different techniques employed for the enhancement of images.	**3**	Learn different techniques employed for the enhancement of images.
4.	To familiarize students with image compression and restoration techniques.	**4**	Apply image compression and restoration techniques.
5	Introduce Image Analysis techniques and Computer Vision approaches	**5**	Apply Image Analysis techniques and Computer Vision approaches
6.	Familiarize students with different Emerging IT applications	**6**	Develop IT applications using image processing and computer vision.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	2	2							
CO2	2	2	3		2					
CO3	2	2	3		2					
CO4		2	3	2	3					
CO5		2	2	2	3					
CO6		2	2	3	3					

Level of Mapping as: Low1, Moderate2, High3

List of Experiments	
Sr. No.	
1.	Study of basic image processing functions. (imread(), imshow(), imwrite(), rgb2gray(), imhist(), imadjust(), im2bw())
2.	Write a program to implement Discrete Fourier Transform (DFT).
3.	Write a program to implement Discrete Cosine Transform (DCT).
4.	Write a program to perform intensity (gray level) transformations (Using negative, log, gamma and contrast stretching).
5.	Write a program for histogram equalization, contrast & brightness.
6.	Write a program to implement image smoothing & sharpening.
7.	Write a program for removing noise in RGB image.
8.	Write a program for geometric transformation (rotate, resize, crop & translate).
9.	Write a program to implement lossy& lossless image compression.
10.	Write a program for edge detection for different operators - prewitt, sobel, roberts, canny & montage.
11.	Write a program for image segmentation using local & global thresholding & region growing.
12.	Write a program to implement morphological operations- image dilation, image erosion & image thinning.
General Instructions: Students have to perform above experiments using Python or MATLAB.	
Suggested Text Books/ Reference Books/Manual	
1.	Fundamentals of Digital Image Processing-A.K.Jain
2.	Image Processing and machine vision-Milan Sonka,VaclavHlavae
3.	Pattern Recognition Principles-J.T. Tou and R.C.Gonzalez
4.	Syntactic Pattern Recognition and applications.-King Sun Fun
5.	Computer vision-Fairhurst (PHI).

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part I, Sem-II**					
Course Title	**:**	**Computer Security Lab**			***Course Code*:**	**:**	CSEC26
Teaching Scheme (Hours)	**:**	Practical:	02 Hrs/week		***Total Credits***	**:**	01
Evaluation Scheme (Marks)	**:**	IE=50	EOE= Nil	Total=50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Engineering Mathematics					
Course Domain	**:**	Core					

Course Rationale: This course is designed to provide students with a solid foundation in information security. They will acquire knowledge about the basic principles, security threats, various modes of attack, and cryptographic models. The course also covers important topics such as access control, identification, and authentication. In addition, students will gain an understanding of network security, operating system (OS) hardening techniques, as well as intrusion detection and prevention methods.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Identify and explain the concepts, policies, and technologies associated with a layered and diversified defence-in-depth strategy.	**1.**	Apply various access control techniques to ensure authenticity.
2.	Discuss the objectives of access control methods and describe how the available methods are implemented in the defence of a network.	**2.**	Explore techniques for integrity management.
3.	Identify the impact of a layered defence on the performance of the network.	**3.**	Explain the different types of attacks and
4.	Define the concepts of auditing in a network, including the types of audits and the handling of data.	**4.**	Explore the use of security tools in defending user/group accounts.
		5.	Demonstrate the use of logging, auditing, and backup techniques for security
		6.	Explain the basic cryptography concepts.

Course Outcome and Program Outcome Mapping

PO→ CO ↓	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	3	2							
CO2	3	3	2	2						
CO3	2	3	3	2	3					
CO4	3	2	3	2	2					
CO5		3	2	2						
CO6		2	2	2	2					

(1-low, 2-medium, 3-high, 0-No correlation)

List of Experiments	
Sr. No.	
1.	Perform encryption, decryption using the following substitution techniques (i) Ceaser cipher, (ii) Playfair cipher iii) Hill Cipher
2.	Perform encryption and decryption using Rail fence transposition techniques
3.	Implement DES algorithm
4.	Apply AES algorithm for practical applications.
5.	Implement the Diffie-Hellman Key Exchange algorithm.
6.	Perform encryption and decryption using RSA algorithm
7.	Calculate the message digest of a text using the SHA-1 algorithm.
8.	Implement the Signature Scheme - Digital Signature Standard
9.	Study of Kerberos. How version 5 is different from version 4?
10.	Discuss examples of applications of IPsec.
11.	List and briefly define the principal categories of SET participants.
12.	Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)
Suggested Text Books/ Reference Books/Manual	
1.	“Cryptography and Network Security Principles and Practices”, Williams Stallings (LPE).
2.	"Handbook of Applied Cryptography", Menezes, A. J., P. C. Van Oorschot, and S. A. Vanstone.
3.	"Applied Cryptography: Protocols & Algorithms", Schneier, Bruce.
4.	IP security-Case study, tools from appropriate white papers or journal papers from internet

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part II, Sem-III**					
Course Title	**:**	**Industrial Training**			***Course Code*:**	**:**	CSEC31
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	**:**	5
Evaluation Scheme (Marks)	**:**	IE= 50	EOE= 50	Total= 100	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Technical Knowledge and Skills, Communication and Interpersonal Skills					
Course Domain	**:**	Core					

Course Rationale: By including industrial training in the curriculum, students can gain practical experience, industry exposure, and relevant skills that prepare them for successful careers in their chosen field. Industrial training enhances their employability, facilitates networking, and cultivates the necessary attributes for professional growth and development.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with an opportunity to apply the theoretical knowledge gained during their coursework to a real-world software development project	1.	Apply the theoretical concepts and skills learned during their training to develop a software project
2.	Offer students hands-on experience in various aspects of software development, including requirements gathering, system design, coding, testing, and documentation.	2.	Gain hands-on experience in various aspects of software development
3.	Develop students' collaborative and professional skills	3.	Learn to collaborate effectively with team members, communicate their ideas, and participate in project discussions
4.	Enhance students' problem-solving abilities by exposing them to complex real-world problems	4.	Analyze complex problems, break them down into manageable tasks, and develop innovative solutions
5	Develop students' project management skills by engaging in a software development project	5.	Practice project management skills, including task planning, time management, and resource allocation
6.	Enhance students' technical writing and presentation skills	6.	Submit a comprehensive report of their development work

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3						3			
CO2						2			2	
CO3						3		3	3	
CO4									2	
CO5						3		2	2	
CO6						3		2	2	

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content

The student shall undertake software development project at any of the industry/research organization/software company under the guidance of internal guide and a suitable Co-guide from that industry/research organization/software company for duration of eight weeks at the end of first year (during summer). The report of the development work is to be submitted to the University in the first week of semester III.

(Student is expected to submit Industrial Training report in Latex/Microsoft word in the standard format style file available in the department)

Industrial Training of Eight weeks at the end of First Year

OR

Industrial training will be split in two slots of four weeks during semester III

Evaluation at end of III semester on the basis given report and Presentation to concern Guide.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part II, Sem-III**					
Course Title	**:**	**Dissertation Phase-I**			***Course Code*:**	**:**	CSEC32
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	**:**	15
Evaluation Scheme (Marks)	**:**	IE= 100	EOE= 100	Total= 200	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Research Skills and Methodology, Domain-Specific Knowledge					
Course Domain	**:**	Core					

Course Rationale: This course develop essential research skills, demonstrate their ability to formulate research questions and proposals, and gain a comprehensive understanding of the research process. The rationale behind this course is to prepare students for the subsequent stages of their dissertation, ensuring they have the necessary knowledge, skills, and tools to undertake rigorous and meaningful research.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Develop students' research competence by providing them with the opportunity to engage in independent research.	1.	Develop research skills through conducting a literature survey, critically analyzing existing literature, identifying research gaps, and proposing a dissertation topic.
2.	Enable students to prepare and deliver effective research proposals.	2.	Gain proficiency in preparing and delivering a presentation to propose a dissertation title.
3.	Equip students with project planning and execution skills.	3.	Demonstrate the ability to plan and execute a research project by preparing a synopsis, outlining research objectives, methodology, and expected outcomes
4.	Foster students' ability to monitor and report their research progress effectively.	4.	Develop skills in monitoring and documenting their research progress by submitting monthly progress reports
5	Enhance students' research presentation and communication skills.	5.	Develop effective presentation and communication skills by delivering an end-of-semester presentation summarizing the progress of their dissertation work
6.	Assess students' research work and their ability to defend their findings.	6.	Gain valuable research experience, contribute to their chosen field of study, and develop essential skills for future academic and professional pursuits.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	3		2		2	2			
CO2		3		3						
CO3	2					2		2	2	
CO4			2			2		2	3	
CO5						3	3		3	
CO6			3			3		3	3	

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content

The dissertation title should be identified on the basis of the literature survey and a presentation be delivered. The synopsis of the dissertation be prepared and submitted to the University for its Approval.

The student shall carry work related to the dissertation with the consent of the guide. This work shall include related hardware/software assignments, field work (if required) as decided by the guide.

The student shall be allowed to submit the dissertation phase I report only after the completion of minimum 50% work of the total project with intermediate /partial results of the dissertation project to the concern guide. The student shall deliver a presentation at the end of Semester III submitting the progress of the work done. The work is to be jointly assessed for oral examinations by internal (guide) and external examiners appointed by the University.

(Student is expected to submit dissertation report in Latex/Microsoft word in the standard format style file available in the department)

Students are expected to do self-study for two hours as per the guidance given by the Project Guide and report to the department once in a week. Hence contact hours to be taken as two for the calculation of contact hours.

Class, Part & Semester	**:**	**First Year M. Tech (Computer Science and Engineering), Part II, Sem-IV**					
Course Title	**:**	**Dissertation Phase-II**			***Course Code*:**	**:**	CSEC41
Teaching Scheme (Hours)	**:**	Practical:	4 Hrs./week		***Total Credits***	**:**	20
Evaluation Scheme (Marks)	**:**	IE= 100	EOE= 200	Total= 300	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Research Skills and Methodology, Domain-Specific Knowledge Research Ethics, Research Methods or Analysis					
Course Domain	**:**	Core					

Course Rationale: The course rationale is to provide students with a comprehensive learning experience that combines theoretical knowledge with practical application, enabling them to become proficient researchers capable of conducting rigorous research, producing high-quality academic writing, delivering effective presentations, and publishing their work in reputable outlets.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Enable students to acquire the necessary skills and knowledge to conduct high-quality research in their chosen field of study.	1.	Develop research skills by conducting comprehensive study, collecting relevant data, and analyzing findings to contribute to the field of study.
2.	Foster the ability to produce well-structured and coherent written reports, including monthly progress reports.	2.	Enhance presentation skills by delivering a comprehensive presentation of the dissertation work at the end of Semester IV
3.	Help to develop effective oral communication and presentation skills.	3.	Gain experience in publishing research work by submitting a paper on the thesis work to either National or International Conference proceedings
4.	Encourage students to contribute to the academic community by publishing their thesis work in conference proceedings.	4.	Develop proficiency in using LaTeX or Microsoft Word to create dissertation reports in the standard format style file provided by the department.
5	Help to develop proficiency in using LaTeX or Microsoft Word for the creation of seminar reports	5.	Cultivate effective time management skills by submitting monthly progress reports
6.	Help to cultivate effective time management skills by submitting monthly progress reports	6.	Acquire proficiency in technical writing by preparing monthly progress reports,

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	3		2		2	2			
CO2		3		3						
CO3	2					2		2	2	
CO4			2			2		2	3	
CO5						3	3		3	
CO6			3			3		3	3	

Level of Mapping as: Low1, Moderate2, High3

Curriculum Content

The student shall submit monthly progress report to the department and shall deliver a presentation of the work at the end of Semester IV submitting the report on the dissertation work.

A publication of a paper on the thesis work in a National/International Conference proceedings with presentation certificate **OR** a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of IVth semester is mandatory.

The student shall be allowed to submit the dissertation phase II report only after the full-fledge demonstration of his /her work to the concerned guide. A pair of referees, as appointed by the University, one of which will be the guide and the other – external examiner will access the dissertation work during the oral examination.

(Student is expected to submit dissertation phase- II report in Latex/Microsoft word in the standard format style file available in the department)

Students are expected to do self-study for four hours as per the guidance given by the Project Guide and report to the department once in a week. Hence contact hours to be taken as four for the calculation of contact hours.