Rayat Shikshan Sanstha's

Karmaveer Bhaurao Patil, College of Engineering, Satara.

An Autonomous Institute & Affiliated to DBATU Lonere

Accredited by NAAC with "B++" Grade

Two Years Master of Technology
in

Computer Science & Engineering

Structure & Curriculum

(w.e.f. A.Y. 2026-27)

As Per NEP 2020

NCrF Level 7.0

Recommended in BOS (CSE) Meeting Dated: 18th June 2026
&
Approved in Academic Council Meeting Dated: 20th July 2026

Dr. G. D. Dangat	**Dr. S. J. Modi**	**Dr. A. C. Attar**
BOS Chairman (CSE)	**Member Secretary**	**Principal**
	Academic Council	

Rayat Shikshan Sanstha's

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING, SATARA

Accredited by NAAC with B++ Grade

(An Autonomous Institute and Affiliated to DBATU, Lonere)

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

STRUCTURE AND CURRICULUM

For

Master of Technology In
COMPUTER SCIENCE & ENGINEERING

(w.e.f. Academic Year 2026 - 2027)

Programme Outcomes (POs)

The post-graduate students will demonstrate:

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the programme.

Programme Educational Objectives (PEOs)

PEO1: Excel in professional careers by applying knowledge and skills in Computer Science and Engineering to develop effective computing solutions.

PEO2: Pursue higher education, research, innovation, and lifelong learning to address emerging technological challenges.

PEO3: Demonstrate leadership, teamwork, and entrepreneurial capabilities in multidisciplinary and professional environments.

PEO4: Uphold ethical values and social responsibility while contributing to sustainable technological advancement and societal well-being.

Correlation between the PEOs and the Pos			
	PO1	PO2	PO3
PEO1	3	2	3
PEO2	3	2	3
PEO3	2	3	2
PEO4	2	2	2

Correlation Levels

- 3 – High Correlation
- 2 – Moderate Correlation
- 1 – Low Correlation

Programme Specific Outcomes (PSOs)

PSO1

Apply advanced computing, artificial intelligence, cloud computing, and data analytics techniques to solve complex engineering problems.

PSO2

Design and develop innovative research-oriented solutions using emerging technologies and interdisciplinary approaches.

PSO3

Conduct independent research leading to quality publications, patents, and technological innovations.

Correlation between the PEOs and the PSOs			
	PSO1	PSO2	PSO3
PEO1	3	2	2
PEO2	2	3	3
PEO3	2	2	2
PEO4	2	2	3

Correlation Levels

- **3 – High Correlation**
- **2 – Moderate Correlation**
- **1 – Low Correlation**

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M.Tech. in Computer Science & Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Programme Details

Particular	Details
Programme Name	MTech. in Computer Science & Engineering
Duration	2 Years
Number of Semesters	4
NCrF Level	Level 7
Total Credits	80 Credits
Curriculum Pattern	CBCS + OBE + NEP Framework
Mode	Full-Time
Structure	Theory + Practical + Seminar + Dissertation

Curriculum Framework

List of Abbreviations

Sr. No.	Abbreviation	Type of Course
1	PCC	Programme Core Course
2	PEC	Programme Elective Course
3	RM	Research Methodology
4	RS	Research Seminar
5	DP	Dissertation Phase
6	AEC	Ability Enhancement Course

M.Tech. (Computer Science & Engineering)

(For Autonomous Engineering Institutes as per NEP 2020, UGC CCFPG, AICTE Model Curriculum and CBCS Framework)

The Curriculum and Credit Framework for the Postgraduate Programme shall consist of a two-year (four-semester) M.Tech. Programme with a total credit requirement of 80 credits.

Credit Distribution for M.Tech. Programme

Sr. No.	Curriculum Component	Category	Percentage	Credits
1	Programme Core Courses (PCC – Theory + Laboratory)	Course Work (60%)	33.75%	27
2	Programme Elective Courses (PEC)		21.25%	17
3	Research Methodology(RM)		3.75%	03
4	Ability Enhancement Course(AEC)		1.25%	01
5	Dissertation Phase-I (DP)-I	Research (40%)	37.50%	30
6	Dissertation Phase-II (DP)-II			
7	Research Seminar(RS)		2.50%	02
		Total Credits	**100%**	**80**

Semester-Wise Credit Structure for M.Tech. Programme

Semester	Components	Credits
Semester I	Core Courses + Labs	20
Semester II	Core Courses + Labs + Programme Electives +AEC	20
Semester III	Programme Elective + Dissertation Phase-I + Seminar	20
Semester IV	Dissertation Phase-II	20
	Total	**80 Credits**

Credit Norms (as per UGC/AICTE Practices)

Activity	Credit Norm
1 Hour Theory / Week	1 Credit
2 Hours Laboratory / Week	1 Credit
1 Hour Tutorial / Week	1 Credit

UGC's revised PG curriculum framework under NEP 2020 recommends flexible and research- oriented postgraduate programmes and an approximate **80-credit structure for a 2-year PG degree**.

Evaluation Scheme

For Theory Courses

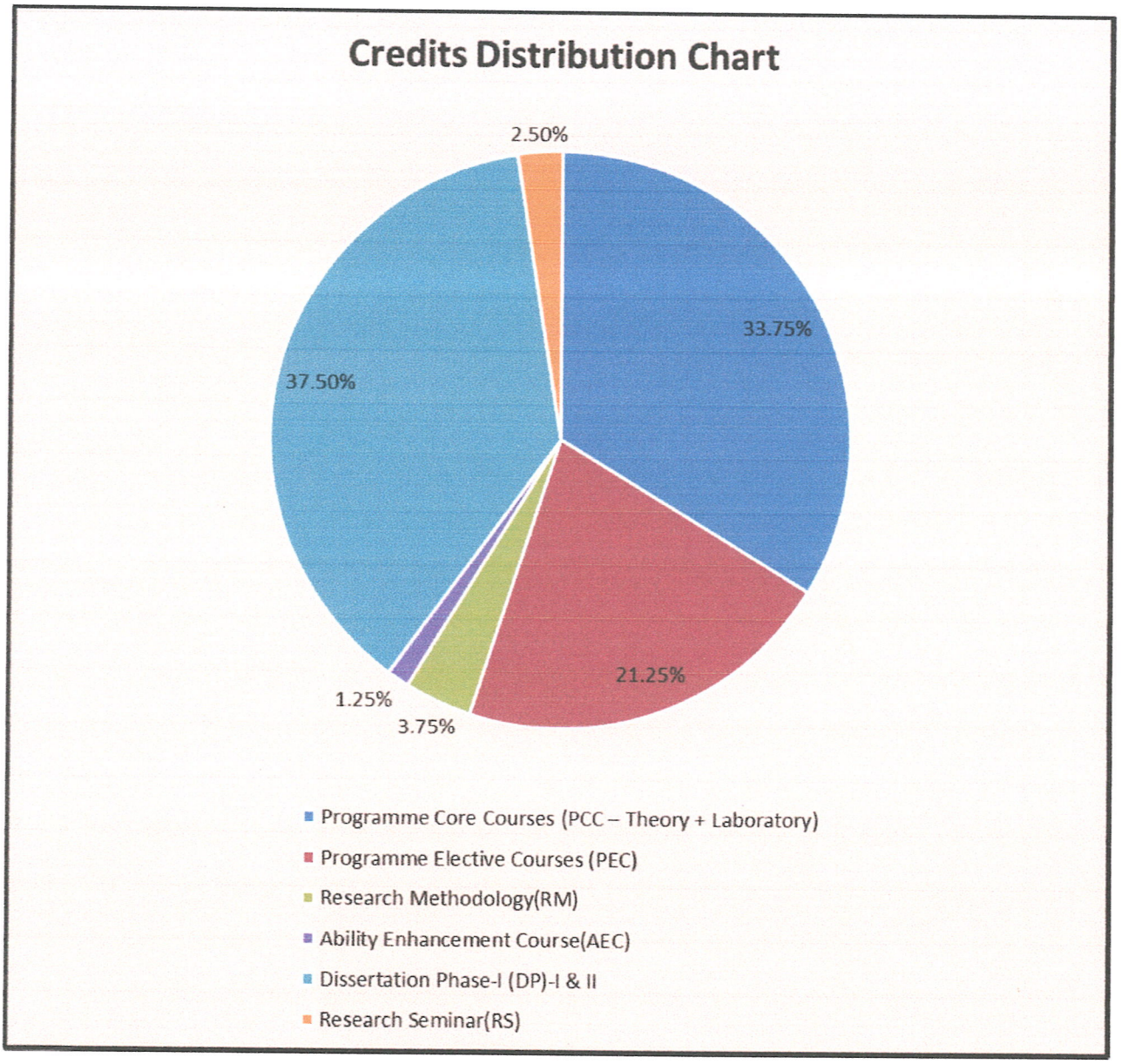
Component	Weightage
Continuous Assessment	10%
Mid Semester Examination	30%
End Semester Examination	60%

For Laboratory Courses

Component	Weightage
Continuous Assessment	60%
End Semester Examination	40%

Other Courses

Component	Weightage
Seminar / Presentation / Viva Voce	As per course structure
Dissertation Evaluation	Internal + External Assessment


Credits Distribution Chart
2.50%
33.75%
37.50%
21.25%
1.25%
3.75%
Programme Core Courses (PCC – Theory + Laboratory)
Programme Elective Courses (PEC)
Research Methodology(RM)
Ability Enhancement Course(AEC)
Dissertation Phase-I (DP)-I & II
Research Seminar(RS)

Semester-wise Basket Themes for Emerging Technology Specialization

Bucket	Courses	Suggested Theme Name
Bucket I	Cyber Security & Blockchain Technologies	1. Information Security 2. Cryptography & Network Security 3. Cyber Security & Network Audit 4. Blockchain and its Applications 5. Ethical Hacking & Penetration Testing
Bucket II	Artificial Intelligence System & Industry 4.0	1. Advanced Graph Theory 2. Advanced Artificial Intelligence 3. Advanced Cloud Computing 4. Introduction to Industry 4.0 and Industrial Internet of Things 5. Machine Learning for Engineering & Science Applications
Bucket III	High-Performance Computing	1. Natural Language Processing with Deep Learning 2. Computer Vision 3. GPU Architecture & Programming 4. Advanced Distributed Systems 5. Parallel Computer Architecture
Bucket IV	Advanced Computing & Geospatial Technologies	1. Edge Computing 2. Quantum Computing 3. Geographic Information Systems (GIS) 4. Remote Sensing: Principles and Applications 5. Digital Image Processing

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Semester-I

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Core Course(PCC)	26203PCC101	Probability, Statistics & Queuing Theory	3	1	-	1	4	10	30	60	100
2		26203PCC102	Advanced Computer Architecture	3		-	1	3	10	30	60	100
3		26203PCC103	Advanced Computer Networks	3		-	1	3	10	30	60	100
4		26203PCC104	Advanced Algorithms	3	-	-	1	3	10	30	60	100
5		26203PCC105	Modern Database Systems	3	-	-	1	3	10	30	60	100
6		26203PCC106L	Modern Database Systems Laboratory	-	-	2		1	60	-	40	100
7	Research Methodology (RM)	26203RM107	Research Methodology	3	-	-	1	3	50	-	-	50
			Total	**18**	1	**2**	**6**	**20**	**160**	**150**	**340**	**650**

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **Cr**-Credits **S**-Self Study

- **Total Contact Hours/Week: 21**
- **Cumulative Credits:20**
- **ISE: In Semester Evaluation**
- **-ESE: End Semester Examination**

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Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Semester-II

Sr. No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Core Course (PCC)	26203PCC201	Big Data Analytics & Data Science	3			1	3	10	30	60	100
2		26203PCC202	Parallel Programming	3			1	3	10	30	60	100
3		26203PCC203	Modern Operating System	3				3	10	30	60	100
4		26203PCC204L	Big Data Analytics & Data Science Laboratory		-	2		1	60	-	40	100
5	Programme Elective Course (PEC)	26203PEC205	Programme Elective-I	3		-		3	10	30	60	100
6		26203PEC206	Programme Elective-II	3				3	10	30	60	100
7		26203PEC207	Programme Elective-III	3		-		3	10	30	60	100
8	Ability Enhancement Course(AEC)	26203AEC208	Technical Communication		-	2		1	50		-	50
			Total	**18**	**-**	**4**	**2**	**20**	**170**	**180**	**400**	**750**

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **Cr**-Credits **S**-Self Study

- **Total Contact Hours/Week: 22** **-Cumulative Credits:20+20=40**
- **ISE: In Semester Evaluation** **-ESE: End Semester Examination**

Programme Electives Bucket

Programme Elective Bucket-I			Programme Elective Bucket-II		
Sr. No	**Course Code**	**Course Title**	**Sr. No**	**Course Code**	**Course Name**
1	26203PEC205A	Information Security	1	26203PEC206A	Cryptography & Network Security
2	26203PEC205B	Advanced Graph Theory	2	26203PEC206B	Advanced Artificial Intelligence
3	26203PEC205C	Natural Language Processing with Deep Learning	3	26203PEC206C	Computer Vision
4	26203PEC205D	Edge Computing	4	26203PEC206D	Quantum Computing

Programme Elective Bucket-III		
Sr. No	**Course Code**	**Course Title**
1	26203PEC207A	Cyber Security &Network Audit
2	26203PEC207B	Advanced Cloud Computing
3	26203PEC207C	GPU Architecture & Programming
4	26203PEC207D	Geographic Information Systems (GIS)

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Curriculum Structure & Evaluation Scheme

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Semester-III

Sr No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Elective Course (PEC)**	26203PEC301	Massive Open Online Course-I	4	-	-	-	4	-	-	100	100
2		26203PEC302	Massive Open Online Course-II	4	-	-	-	4	-	-	100	100
3	Research	26203RS303	Research Seminar	-	-	4	-	2	60	-	40	100
4		26203DP304	Dissertation Phase-I	-	-	20	-	10	60	-	40	100
			Total	**8**	**-**	**24**	**-**	**20**	**120**	**-**	**180**	**400**

**** Note: 100% ESE of 3 hours or credit transfer**

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **Cr**-Credits **S**-Self Study

- **Total Contact Hours/Week: 32** - **Cumulative Credits:40+20=60**
- **ISE: In Semester Evaluation** -**ESE: End Semester Examination**

Massive Open Online Course –I & II

Massive Open Online Course-I			NPTEL Course
Sr. No	**Course Code**	**Course Title**	
1	26203PEC301A	Blockchain and its Applications	https://nptel.ac.in/courses/106105235
2	26203PEC301B	Introduction to Industry 4.0 and Industrial Internet of Things	https://nptel.ac.in/courses/106105195
3	26203PEC301C	Advanced Distributed Systems	https://nptel.ac.in/courses/106102237
4	26203PEC301D	Remote Sensing: Principles and Applications	https://nptel.ac.in/courses/105101206

Massive Open Online Course-II			NPTEL Course
Sr. No	**Course Code**	**Course Title**	
1	26203PEC302A	Ethical Hacking & Penetration Testing	https://www.nptel.ac.in/courses/106105217
2	26203PEC302B	Machine Learning for Engineering & Science Applications	https://onlinecourses.nptel.ac.in/noc26_cs76/preview
3	26203PEC302C	Parallel Computer Architecture	https://nptel.ac.in/courses/106103359
4	26203PEC302D	Digital Image Processing	https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee126

**Note for Programme Elective Course

The Programme Elective Course offered in Semester–III of the M.Tech. programme shall be mandatorily completed through the SWAYAM/NPTEL platform. Every student shall enroll in and successfully complete an approved SWAYAM/NPTEL course from the respective Programme Elective basket.

1. **Enrollment in an approved SWAYAM/NPTEL course is mandatory for all students.** The selected course shall be from the respective **Programme Elective (PEC)** basket as notified by the Department.
2. Since **Massive Open Online Course-I & II** carries **04 credits**, the selected **SWAYAM/NPTEL course must be of a minimum duration of 12 weeks only**.
3. **Submission and successful completion of all SWAYAM/NPTEL assignments is mandatory** and shall be considered for the **Internal Semester Evaluation (ISE).**
4. **Students shall appear for the SWAYAM/NPTEL proctored examination and submit the Course Completion Certificate/Grade Card** issued by SWAYAM/NPTEL after successfully completing the course.
5. **Successful completion of the prescribed SWAYAM/NPTEL course is mandatory** for fulfilling the Massive Online Courses (Program Electives) requirement and earning the associated academic credits.
6. **The Institute reserves the right to approve the list of eligible SWAYAM/NPTEL courses** and issue detailed guidelines regarding **enrollment, assessment, and credit transfer** from time to time.

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M.Tech. in Computer Science & Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Semester-IV

Sr No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Research	26203DP401	Dissertation Phase-II ***			40		20	120	-	80	200
			Total	**-**	**-**	**40**		**20**	**120**	-	**80**	**200**

- **Total Contact Hours/Week: 40** - **CumulativeCredits:80**
- **ISE: In Semester Evaluation** - **ESE: End Semester Examination**

***Research Publication / Intellectual Property Requirement

As a part of the **M.Tech. (Computer Science and Engineering)** programme, every student shall **mandatorily fulfill any one of Clauses 1 to 3**, based on the research work carried out under the guidance of the Research Guide.

Fulfill any one of the following:

1) **Publish One research papers** in blind peer-reviewed journals approved by the Research Guide.

OR

2) **Publish One research paper** in reputed conference proceedings or publications of **IEEE / Springer / CRC Press / Science Direct (Elsevier) / ASCE / ASME.**

OR

3) **Publish and Grant one patent** based on the research work carried out during the programme.

Note: Award of the M.Tech. degree shall be subject to the successful fulfillment of any one of the mandatory publication requirements specified in **Clauses 1 to 3.**


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An Autonomous Institute
Department of
Computer Science & Engineering
Semester: I

Course:M.Tech	Semester: I	L	T	P	Credits
Course Code: 26203PCC101	Course Name: Probability, Statistics and Queuing Theory	3	1	-	04

Course Outcomes: The Probability, Statistics and Queuing Theory course aims to:

1	Students will be able to demonstrate basic principles of probability and explain a random variable that describes randomness or an uncertainty in certain realistic situations. It can be of either discrete or continuous type.
2	Students will be able to comprehend concepts of discrete, continuous probability distributions
3	Students will be able to solve problems of probability using Binomial, Poisson, Uniform Distribution, Exponential Distribution, Normal distributions.
4	Students will be able to compute simple correlation between the variables and fit straight line, parabola by the principle of least squares.
5	Students will be able to Analyze the statistical data and apply various small or large sample tests for testing the hypothesis.
6	Students will be able to Understand about different Queuing models and its applications.

Prerequisites: Engineering Mathematics, Discrete Mathematics

Unit No.	Description	Hrs.
1	**Unit 01: Fundamentals of Probability** Definition of Random Experiment – Events and sample space – Definition of probability – Addition and multiplication theorems – Conditional probability – Baye's theorem – Simple problems on Baye's theorem. Introduction to Random variable: Discrete and continuous random variables – Distribution function of random variable – Properties – Probability mass function – Probability density function – Mathematical expectation – Properties of mathematical expectation – Moments, moment generating function – Mean and variance.	07
2	**Unit 02: Discrete Distributions** Discrete distributions: Binomial distribution – Poisson distribution – Mean, Variance, Moment generating function and problems.	05
3	**Unit 03:Continuous probability distributions** Continuous probability distributions: Uniform distribution – Exponential distribution – Memoryless property – Normal distribution – Properties of	07

	normal distribution – Importance of normal distribution – Area properties of normal curve - MGF, Mean ,Variance and simple problems.	
4	**Unit04:Curve Fitting, Correlation and Regression** Curve Fitting : Principle of least squares – Method of least squares – Fitting of straight lines – Fitting of second degree curves and exponential curves. Correlation : Definition – Karl Pearson's coefficient of correlation – Measures of correlation – Rank correlation coefficients. Regression : Simple linear regression – Regression lines and properties.	08
5	**Unit 05: Testing of Hypothesis** Introduction – Null hypothesis – Alternative hypothesis – Type –I, II errors – Level of significance – Critical Region – Confidence interval – One sided test – Two sided test, Small Sample Tests : Students t - distribution , its properties – Test of significance difference between sample mean and population mean – Difference between means of two small samples – F- Distribution – Test of equality of two population variances – Chi-square test of goodness of fit . Large sample Tests : Test of Significance of Large Samples – Tests of significance difference between sample proportion and population proportion & difference between two sample proportions – Tests of significance difference between sample mean and population mean & difference between two sample means.	12
6	**Unit 06: Queuing Theory** Structure of a queuing system – Operating characteristics of queuing system – Transient and steady states – Terminology of queuing systems – Arrival and service processes – Pure Birth-Death process Deterministic queuing models – M/M/1 Model of infinite queue – M/M/1 model of finite queue.	08

Text Books/Reference Books:

1. T. .Veerarajan , "Probability, Statistics and Random Processes" , Tata McGraw Hill Publications.
2. Kishor S. Trivedi , "Probability & Statistics with Reliability, Queuing and Computer Applications" , Prentice Hall of India .
3. Dr. B.S Grewal, "Higher Engineering Mathematics", Khanna Publishers.
4. Sheldon M.Ross, "Probability and Statistics for Engineers and Scientists", Academic Press.
5. S C Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics".

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	-	-	1	1	1
CO6	3	2	-	-	-	-	-	-	-	-	1	1	1

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING * SATARA *

Course:M.Tech	Semester: I	L	T	P	Credits
Course Code: 26203PCC102	Course Name: Advanced Computer Architecture	3	-	-	03

Course Objectives: The Advanced Computer Architecture course aims to:

1	To understand the concepts and evolution of advanced computer architectures and parallel processing systems.
2	To study instruction-level, data-level, and thread-level parallelism techniques.
3	To analyze pipelined, superscalar, vector, and multithreaded processor architectures.
4	To understand memory hierarchy design, cache optimization, and advanced storage architectures.
5	To study multiprocessor, cluster, and distributed computing architectures.
6	To evaluate modern high-performance computing architectures including multicore and GPU-based systems.

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamentals of parallel processing and advanced architectural development trends.
CO2	Analyze pipelined, vector, superscalar, and VLIW processor architectures.
CO3	Evaluate multithreaded, SIMD, and dataflow computing architectures.
CO4	Analyze memory hierarchy, cache performance, virtual memory, and storage systems.
CO5	Apply concepts of multiprocessor, cluster, and distributed computing architectures to solve performance-related problems.
CO6	Evaluate modern multicore, GPU, and high-performance computing architectures for specific applications.

Prerequisites: Computer Organization

Unit No.	Description	Hrs.
1	**Computer Architecture and Quantitative Design:** Concept of Computer Architecture , Fundamentals of Quantitative Design and Analysis ,Parallel Processing Mechanisms ,Parallel Computer Structures:Pipeline Computers , Array Processors ,Multiprocessor Systems ,Architectural Classification Schemes: Multiplicity of Instruction-Data Streams ,rends in Power and Energy in Integrated Circuits ,Trends in Cost ,Dependability	10

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2	**Principles of Pipeline:** Principles of Linear Pipeline , Classification of Pipelined Processors , Interleaved Memory Organization , Hazard Detection and Resolution ,Basic Compiler Techniques for Exposing Instruction-Level Parallelism (ILP)	6
3	**Data-Level Parallelism in Vector, SIMD, and GPU Architectures:** Introduction to Data-Level Parallelism , Vector Processing Requirements ,Characteristics of Vector Processing ,Vector Architecture , Multiple Vector Task Dispatching , Pipelined Vector Processing Methods	6
4	**Associative Array Processing and Advanced Parallel Architectures:** Associative Array Processing , Associative Memory Organization , Associative Processors: PEPE , STARAN , Data-Level Parallelism in Vector Processing , SIMD Architecture , GPU Architecture	7
5	**Data Level Parallelism in SIMD and GPU Architecture:** SIMD ARRAY PROCESSORS: SIMD Computer organization,Masking and Data Routing Mechanism, SIMD Instruction set extension for Multimedia, Graphics Processing Units : Programming the GPU, NVIDA GPU Computational structures, NVIDA GPU Instruction set Architecture, Conditional Branching in GPU, NVIDA GPU Memory Structure	8
6	**Multiprocessor Architecture :** Introduction, Multiprocessor Architecture: Issus and Approach, Challenges of parallel processing, Centralized shared memory Architecture: Multiprocessors, Cache coherence, Basic schemes for enforcing coherence, Snooping Coherence Protocols, Distributed shared memory and directory based coherence, Directory Based cache coherence protocol	8
	Self Study Topics: Superscalar Processors , Out-of-Order Execution, GPU Architecture, Quantum Computer Architecture	

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Text Books:

1. Computer architecture and Parallel Processing, Kai Hwang and Faye A Briggs, Tata McGrawHill
2. Computer Architecture: A Quantitative Approach, John L. Hennessy and Davd A. Patterson, Morgan Kaufmann

Reference Books:

1. Advanced computer Architecture , DezsoSima, Terence Fountain & Peter Kacsuk, Pearson Education
2. Parallel Programming Techniques & Applications using Networked Workstations &Parallel Computers, Barry Wilkinson & Michael Allen, Pearson Education
3. Advanced Computer Architecture, Kai Hwang & NareshJotwani, McGraw Hill Publications

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	1	-	3	1	3
CO2	1	-	3	1	3
CO3	3	-	3	1	3
CO4	2	1	3	1	3
CO5	2	1	3	1	3
CO6	2	1	3	1	3

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Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute

Department of Computer Science & Engineering

Course: M-Tech	Semester: I	L	T	P	Credits
Course Code: 26203PCC103	Course Name: Advance Computer Networks	3	1	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Explain advanced networking architectures, Internet technologies, and performance metrics.
CO2	Analyze routing and switching mechanisms used in modern communication networks.
CO3	Evaluate transport-layer protocols and essential network services for reliable communication.
CO4	Examine wireless, mobile, and ad hoc networking technologies for contemporary communication systems.
CO5	Analyze cloud networking, virtualization, and software-defined networking concepts.
CO6	Evaluate network security mechanisms and emerging networking technologies for secure and scalable network infrastructures.

Prerequisites: Computer Networks , Operating System, Database System

Unit No.	Description	Hrs.
1	**Fundamentals of Advanced Computer Networks :** Evolution of Computer Networks and Internet , Network Architecture: OSI and TCP/IP Models ,Internet Structure and Network Components , IPv4 and IPv6 Addressing, Network Performance Metrics: Throughput, Delay, Jitter, Packet Loss ,Quality of Service (QoS) Concepts	7
2	**Routing Technologies and Algorithms :** Routing Principles and Algorithms; Static and Dynamic Routing; Distance Vector and Link State Routing; Routing Tables and Routing Metrics; OSPF Overview; BGP Overview.	7
3	**Switching Technologies and Network Design** :Switching Concepts; Layer 2 and Layer 3 Switching; VLANs and VLAN Configuration Concepts; Inter-VLAN Routing; Spanning Tree Protocol (STP); Redundancy and Loop Prevention in Switched Networks.	7
4	**Wireless and Mobile Networks :** Wireless LAN Architecture; IEEE 802.11 Standards; Mobile IP Concepts; Cellular Networks: 4G and 5G Overview; Wireless Sensor Networks (WSNs); Mobile Ad Hoc Networks (MANETs); Applications of Wireless Networks.	8

5	**Cloud Networking and Software-Defined Networking :** Introduction to Cloud Networking; Data Center Networking Concepts; Virtualization in Networking; Network Virtualization Concepts; Software-Defined Networking (SDN) Fundamentals; SDN Architecture and Controllers; Applications of SDN in Modern Networks.	8
6	**Network Security and Emerging Trends :** Network Security Requirements; Firewalls and Intrusion Detection Systems (IDS); Virtual Private Networks (VPNs); Secure Communication Protocols; Internet of Things (IoT) Networking Overview; AI-Enabled Network Management; Emerging and Future Trends in Advanced Computer Networks.	8

Text Books

1. **James F. Kurose and Keith W. Ross**, *Computer Networking: A Top-Down Approach*, 8th Edition, Pearson.
2. **Andrew S. Tanenbaum and David J. Wetherall**, *Computer Networks*, 6th Edition, Pearson.

Reference Books

1. **Behrouz A. Forouzan**, *Data Communications and Networking*, 5th Edition, McGraw Hill.
2. **Larry L. Peterson and Bruce S. Davie**, *Computer Networks: A Systems Approach*, 6th Edition, Morgan Kaufmann.
3. **Nader F. Mir**, *Computer and Communication Networks*, 2nd Edition, Pearson.
4. **William Stallings**, *Wireless Communications and Networks*, 3rd Edition, Pearson.
5. **Paul Goransson and Chuck Black**, *Software Defined Networks: A Comprehensive Approach*, Morgan Kaufmann.

CO-PO Mapping Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	1	3	1	1
CO2	3	3	2	1	2	-	-	-	-	-	1	3	1	1
CO3	2	3	2	1	3	-	-	-	-	-	1	3	1	1
CO4	2	3	2	2	2	-	-	-	-	-	1	3	2	2
CO5	2	3	3	2	3	-	-	-	-	-	2	3	2	2
CO6	2	3	2	3	3	1	1	2	-	-	2	2	3	3

Correlation Levels: 3- High 2- Moderate 1-Low

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING * SATARA *

Course:PG	Semester: I	L	T	P	Credits
Course Code:	Course Name: Advanced Algorithms	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	**CO1**: Analyze the complexity and correctness of advanced algorithms using mathematical techniques.
CO2	**CO2**: Apply advanced algorithmic paradigms such as dynamic programming, greedy methods, approximation, and randomized algorithms to solve computational problems.
CO3	**CO3**: Design efficient algorithms for large-scale, parallel, graph-based, and optimization problems arising in modern computing applications.
CO4	**CO4**: Develop approximation and randomized algorithms with performance guarantees for computationally hard problems.
CO5	**CO5**: Analyze and design parallel and distributed algorithms for scalable computation in modern computing environments.
CO6	**CO6**: Evaluate advanced algorithmic approaches for big data analytics, machine learning, computational geometry, streaming data, and emerging computing paradigms.

Prerequisites:

1. Design and Analysis of Algorithms
2. Data Structures
3. Discrete Mathematics
4. Probability and Statistics
5. Programming in C/C++/Java/Python

Unit No.	Description	Hrs.
1	**Advanced Analysis of Algorithms** Asymptotic Analysis Review, Recurrence Relations, Amortized Analysis, Probabilistic Analysis, Lower Bounds, Complexity Classes (P, NP, NP-Complete, NP-Hard), Polynomial-Time Reductions, Computational Complexity Theory.	8

2	**Advanced Algorithm Design Techniques** Dynamic Programming Strategies, Memoization Techniques, Advanced Greedy Algorithms, Branch and Bound, Backtracking, Divide-and-Conquer Optimization, Algorithmic Paradigms and Design Patterns.	8
3	**Graph Algorithms** Shortest Path Algorithms, All-Pairs Shortest Paths, Network Flow Algorithms, Maximum Flow and Minimum Cut, Matching Algorithms, Graph Coloring, Planar Graphs, Applications of Graph Algorithms. .	8
4	**Approximation and Randomized Algorithms** Approximation Algorithms, Performance Guarantees, Set Cover Problem, Vertex Cover Approximation, Randomized Algorithms, Randomized Quick Sort, Monte Carlo and Las Vegas Algorithms, Probabilistic Analysis.	7
5	**Parallel and Distributed Algorithms** Introduction to Parallel Computing, PRAM Models, Parallel Sorting Algorithms, Parallel Graph Algorithms, Distributed Computing Concepts, MapReduce Framework, Scalability and Performance Analysis.	7
6	**Advanced Applications and Emerging Trends** Algorithms for Big Data Analytics, Streaming Algorithms, Machine Learning Algorithms and Optimization, Computational Geometry, String Matching Algorithms, Research Trends in Algorithms, Quantum Computing Concepts and Quantum Algorithms Overview.	7

Reference Books

1. Introduction to Algorithms – Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press.
2. Algorithm Design – Jon Kleinberg and Éva Tardos, Pearson Education.
3. The Design and Analysis of Computer Algorithms – Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman.
4. Randomized Algorithms – Rajeev Motwani and Prabhakar Raghavan.
5. Approximation Algorithms – Vijay V. Vazirani, Springer.

6. Parallel Computing: Theory and Practice – Michael J. Quinn.
7. Algorithms – Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani.

NPTEL References

1. Design and Analysis of Algorithms – Prof. Naveen Garg, IIT Delhi.
2. Advanced Algorithms – Prof. Kamala Krithivasan, IIT Madras.
3. Data Structures and Algorithms – Prof. Madhavan Mukund, IIT Madras.
4. Graph Theory and Algorithms – Prof. Sandeep Sen, IIT Delhi.
5. Parallel Algorithms – Prof. P. Sadayappan.
6. Computational Complexity – Prof. Venkatesh Raman, IMSc Chennai.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1		3	2	1
CO2		1	3	3		
CO3		2	3			
CO4	3		3	3	3	3
CO5	3		3			
CO6	3		3			



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Department of Computer Science & Engineering

Course: MTech CSE	Semester: I	L	T	P	Credits
Course Code: 26203PCC105	Course Name: Modern Database Systems	3			3

Course Outcomes: At the end of the course student will be able to

CO No.	Course Outcome
CO1	Explain modern database architectures, data models, and database management concepts.
CO2	Design and implement relational and NoSQL database solutions for modern applications.
CO3	Analyze distributed and cloud database systems for scalable data management.
CO4	Apply big data technologies and data warehousing concepts for analytical applications.
CO5	Evaluate database security, performance optimization, and recovery techniques.
CO6	Assess emerging database technologies and recommend suitable solutions for real-world applications.

Unit No.	Description	Hrs.
1	**Database Fundamentals:** Database architecture, Data models, Relational database concepts, SQL review, Database design, Normalization, Transactions, ACID properties, Query processing, Database security basics.	8
2	**NoSQL Databases:** Introduction to NoSQL, Key-value databases, Document databases, Column-family databases, Graph databases, CAP theorem, Data modeling in NoSQL, Comparison with relational databases.	8
3	**Distributed and Cloud Databases:** Distributed database concepts, Data partitioning, Replication, Distributed transactions, Cloud databases, Database-as-a-Service (DBaaS), Data consistency, Fault tolerance, Scalability.	8
4	**Big Data and Data Warehousing:** Introduction to Big Data, Data warehouse concepts, ETL process, Data lakes, OLTP and OLAP, Data analytics, Hadoop ecosystem overview, Apache Spark basics.	7
5	**Database Security and Performance:** Database security, Authentication, Authorization, Encryption, Backup and recovery, Query optimization, Indexing techniques, Performance tuning, Database monitoring.	7
6	**Emerging Trends in Database Systems:** NewSQL databases, In-memory databases, Time-series databases, Blockchain databases, AI-enabled databases, Multi-model databases, Edge databases, Future trends in data management.	7

Text Books

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, **Database System Concepts**, 7th Edition, McGraw-Hill, 2019.
2. Carlos Coronel and Steven Morris, **Database Systems: Design, Implementation and Management**, 14th Edition, Cengage Learning, 2023.
3. Pramod J. Sadalage and Martin Fowler, **NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence**, Addison-Wesley, 2013.

Reference Books

1. Martin Kleppmann, **Designing Data-Intensive Applications**, O'Reilly Media, 2017.
2. Eric Redmond and Jim R. Wilson, **Seven Databases in Seven Weeks**, 2nd Edition, Pragmatic Bookshelf, 2018.
3. Raghu Ramakrishnan and Johannes Gehrke, **Database Management Systems**, 3rd Edition, McGraw-Hill.
4. Thomas Connolly and Carolyn Begg, **Database Systems: A Practical Approach to Design, Implementation and Management**, 6th Edition, Pearson.
5. Tom White, **Hadoop: The Definitive Guide**, 4th Edition, O'Reilly Media, 2015.
6. Bill Karwin, **SQL Antipatterns**, Pragmatic Bookshelf, 2010.

CO-PO-PSO Matrix

Course Outcome	Programme Outcome (PO) & Programme Specific Outcome (PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	-	3	2	1	-
CO2	2	1	3	3	2	1
CO3	3	2	3	3	3	2
CO4	3	2	3	3	3	2
CO5	3	2	3	3	3	2
CO6	3	3	3	3	3	3

Correlation Levels: 3 = High, 2 = Moderate, 1 = Low, '-' = No Correlation

Course: M.Tech.	Semester: I	L	T	P	Credits
Course Code:	Course Name: Research Methodology	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Identify and formulate research problems, objectives, research questions, and hypotheses in a selected domain.
CO2	Conduct literature surveys using digital research databases and manage references using appropriate citation tools.
CO3	Design research methodologies, sampling plans, questionnaires, and data collection instruments using ICT tools.
CO4	Apply statistical techniques and software tools for data pre-processing, analysis, interpretation, and visualization.
CO5	Utilize modern ICT tools for collaborative research, scientific writing, bibliometric analysis, and research dissemination.
CO6	Prepare ethical, plagiarism-free research reports and demonstrate awareness of intellectual property rights, research integrity, and lifelong learning practices.

Unit No.	Description	Hrs.
1	**Introduction to Research :** The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature	7
2	**Types of Research :** Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. Research Design : Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and Features of good Research design. Experiments, surveys and case study Research design	8

3	**Sampling, Data Collection and analysis** : Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties. Statistical Methods for Data Analysis : Applications of Statistics in Research, measures of central tendency and dispersion	8
4	**Research Report** Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations . components of thesis and dissertations. Referencing styles and bibliography.	8
5	**Ethics in Research** Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher. Plagiarism detection tools and research integrity. Intellectual Property Rights (IPR), copyrights, patents, and ethical issues in digital research.	7
6	**ICT Tools for Research** Role of Information and Communication Technology (ICT) in research. Digital libraries and online databases. Academic search engines and indexing services. Reference management tools such as Mendeley, Zotero, and EndNote. Online survey and data collection tools. Statistical and data analysis tools such as SPSS, R, Python, and Microsoft Excel. Data visualization tools. Collaborative research platforms and cloud-based research environments.	7

Text Books/Reference books:

1. Kothari, C. R., and Garg, G., *Research Methodology: Methods and Techniques*, 4th Edition, New Age International Publishers.

2. Kumar, Ranjit, *Research Methodology: A Step-by-Step Guide for Beginners*, Sage Publications.
3. Creswell, John W., and Creswell, J. David, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications.
4. Trochim, William M. K., Donnelly, James P., and Arora, Kanika, *Research Methods: The Essential Knowledge Base*, Cengage Learning.
5. VanderPlas, Jake, *Python Data Science Handbook*, O'Reilly Media.
6. Field, Andy, *Discovering Statistics Using IBM SPSS Statistics*, Sage Publications.
7. Mendeley and Zotero Official User Guides and Documentation.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2		
CO2	2	2	2		
CO3	3	1	3		
CO4	3	1	3		
CO5	2	3	2		
CO6	1	3	2		

Course:PG	Semester: II	L	T	P	Credits
Course Code: 26203PCC107L	**Course Name:** Modern Database Systems Laboratory	-	-	2	1

Course Outcomes: At the end of the course student will be able to

CO1	Explain modern database architectures, relational models, transaction management, and database design principles.
CO2	Design and implement relational and NoSQL database solutions for different application domains.
CO3	Analyze distributed and cloud database architectures to ensure scalability, consistency, and fault tolerance.
CO4	Analyze distributed and cloud database architectures to ensure scalability, consistency, and fault tolerance.
CO5	Evaluate database security mechanisms, query optimization techniques, indexing methods, and recovery strategies for high-performance databases.
CO6	Assess emerging database technologies and recommend suitable database solutions for real-world enterprise applications.

Software/Tools Required

- MySQL / PostgreSQL
- MongoDB Community Edition
- Neo4j
- Cassandra (Optional)
- MongoDB Atlas
- Firebase
- Apache Hadoop
- Apache Spark
- Pentaho Data Integration (Kettle)
- Talend Open Studio
- Docker (Optional)
- pgAdmin / MySQL Workbench
- Visual Studio Code / IntelliJ IDEA

Sr No.	Lab List
1	Design and implement a normalized relational database for a real-world application (Hospital/Library/University) and perform SQL operations including joins, views, stored procedures, and transactions.
2	Implement ACID properties and transaction management using COMMIT, ROLLBACK, SAVEPOINT, and concurrency control mechanisms.
3	Install and perform CRUD operations using a NoSQL Document Database (MongoDB). Compare schema design with relational databases.
4	Implement different NoSQL data models (Key-Value, Document, Graph, and Column-Family databases) and compare their performance for different datasets.
5	Configure a Distributed Database environment using PostgreSQL replication/MySQL replication or Cassandra. Demonstrate replication and fault tolerance.
6	Deploy a Cloud Database (Firebase, MongoDB Atlas, AWS RDS, Azure SQL, or Google Cloud SQL) and perform remote database operations.
7	Design a Data Warehouse schema (Star/Snowflake Schema), perform ETL using Pentaho/Talend/OpenRefine, and execute OLAP queries.
8	Perform Big Data analytics using Hadoop HDFS and Apache Spark for processing structured or semi-structured datasets.
9	Analyze query execution plans, implement indexing techniques (B-Tree, Hash Index), and compare query performance before and after optimization.
10	Study emerging database systems (NewSQL, In-Memory, Time-Series, Graph, Blockchain Database, AI-enabled Databases). Develop a comparative report with a suitable use case recommendation.

Reference Books

1. Silberschatz, Korth & Sudarshan – Database System Concepts, 7th Ed. (Ch. 1–8)
2. Coronel & Morris – Database Systems, 14th Ed. (Ch. 3–10)
3. Ramakrishnan & Gehrke – *Database Management Systems*
4. Pramod Sadalage & Martin Fowler – *NoSQL Distilled*
5. Martin Kleppmann – *Designing Data-Intensive Applications*
6. Tom White – *Hadoop: The Definitive Guide*

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	-
CO2	3	2	3	3	3	1
CO3	3	2	3	3	3	2
CO4	3	2	3	3	3	2
CO5	3	3	3	3	2	3
CO6	3	3	3	3	3	3


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DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
Semester: II

Course:PG	Semester: II	L	T	P	Credits
Course Code:	**Course Name:** Big Data Analytics & Data Science	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	**CO1**: Explain the concepts, characteristics, applications, and processing frameworks of Big Data and Data Science.
CO2	**CO2**: Perform data acquisition, preprocessing, visualization, and analytics using Big Data tools and machine learning techniques.
CO3	**CO3**: Analyze real-world datasets and develop data-driven solutions using Hadoop, Spark, MongoDB, Python, and advanced analytical methods.
CO4	**CO4**: Perform data acquisition, preprocessing, transformation, integration, and feature engineering for effective data analysis.
CO5	**CO5**: Develop and evaluate machine learning models using classification, regression, clustering, and performance evaluation techniques for data-driven decision making.
CO6	**CO6**: Analyze real-world datasets and design advanced data science solutions using visualization, predictive analytics, business intelligence, IoT analytics, AI techniques, and ethical data practices.

Prerequisites:

1. Basic knowledge of programming using C, C++, Java, or Python.
2. Understanding of Database Management Systems (DBMS) and SQL.
3. Familiarity with Data Structures and Algorithms.
4. Basic knowledge of Computer Networks and Operating Systems.
5. Understanding of Probability and Statistics.
6. Basic knowledge of software development and problem-solving techniques.

Unit No.	Description	Hrs.
1	**Fundamentals of Big Data (6 Hours)** Introduction to Big Data, Evolution of Big Data, Characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value), Challenges in Big Data Management, Big Data Storage and Processing Requirements, Applications of Big Data in Various Domains, Big Data Ecosystem and Technologies.	7

2	**Hadoop and Distributed Computing Frameworks (6 Hours)** Introduction to Hadoop, Hadoop Architecture, Hadoop Distributed File System (HDFS), HDFS Components and Data Replication, MapReduce Programming Model, YARN Architecture, Hadoop Ecosystem Components: Hive, Pig, HBase, Sqoop, Flume, Introduction to Apache Spark and Distributed Computing Concepts.	8
3	**Big Data Analytics Tools and Technologies (6 Hours)** Apache Spark Architecture, Resilient Distributed Datasets (RDDs), Spark SQL, Spark Streaming, Real-Time Data Processing, NoSQL Databases, MongoDB Fundamentals, Cassandra Fundamentals, Data Warehousing Concepts, ETL Process, OLTP and OLAP Systems.	8
4	**Introduction to Data Science and Data Preparation (6 Hours)** Introduction to Data Science, Data Science Lifecycle, Types of Data Analytics (Descriptive, Diagnostic, Predictive, and Prescriptive Analytics), Data Sources and Data Collection Methods, Structured, Semi-Structured, and Unstructured Data, Data Cleaning, Data Integration, Data Transformation, Handling Missing Values, Feature Selection Techniques.	7
5	**Machine Learning for Data Science (6 Hours)** Introduction to Machine Learning, Types of Machine Learning, Training and Testing Datasets, Classification Techniques, Regression Techniques, Decision Trees, K-Nearest Neighbors (KNN), Clustering Concepts, K-Means Clustering Algorithm, Model Evaluation Metrics and Performance Analysis.	8
6	**Advanced Data Science Applications (5 Hours)** Data Visualization Techniques, Exploratory Data Analysis (EDA), Predictive Analytics, Recommendation Systems, Sentiment Analysis, Social Media Analytics, Business Intelligence, IoT Data Analytics, Artificial Intelligence and Data Science, Deep Learning Overview, Data Privacy, Ethical Issues, and Future Trends in Data Science.	7

Reference Books

1. Big Data: A Revolution That Will Transform How We Live, Work and Think – Viktor Mayer-Schönberger and Kenneth Cukier.

2. Business Intelligence, Analytics and Data Science – Efraim Turban et al.
3. Hadoop in Practice – Alex Holmes, Manning Publications.
4. Data Science from Scratch – Joel Grus, O'Reilly Publications.
5. Doing Data Science – Cathy O'Neil and Rachel Schutt, O'Reilly Publications.
6. Data Mining and Machine Learning – Mohammed J. Zaki and Wagner Meira Jr., Cambridge University Press.

NPTEL References

1. Big Data Computing – Prof. D. Janakiram, IIT Madras.
2. Data Analytics with Python – Prof. Raghunathan Rengasamy, IIT Madras.
3. Introduction to Machine Learning – Prof. Balaraman Ravindran, IIT Madras.
4. Data Science for Engineers – Prof. Raghunathan Rengasamy, IIT Madras.
5. Database Management Systems – Prof. P. P. Chakrabarti, IIT Kharagpur.
6. Programming, Data Structures and Algorithms Using Python – Prof. Madhavan Mukund, IIT Madras.

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	1
CO2	2		3		2	1
CO3						
CO4						
CO5			3			
CO6	3	3	3		3	3

1. Low 2. Medium 3.High

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Department of Computer Science & Engineering

Course: MTech CSE	Semester: II	L	T	P	Credits
Course Code: 26203PCC202	Course Name: Parallel Programming	2			2

Course Outcomes: At the end of the course student will be able to

CO No.	Course Outcome
CO1	Explain parallel computing architectures, programming models, and performance metrics.
CO2	Develop parallel applications using shared memory programming with OpenMP.
CO3	Design distributed memory applications using MPI for scalable computing.
CO4	Implement GPU-based applications using CUDA and heterogeneous programming techniques.
CO5	Analyze and optimize the performance of parallel algorithms for scientific and engineering applications.
CO6	Evaluate modern parallel computing technologies and apply them to AI, cloud, and high-performance computing applications.

Unit No.	Description	Hrs.
1	**Introduction to Parallel Computing:** Parallel computing concepts, Need for parallel computing, Flynn's taxonomy, Parallel architectures, Shared and distributed memory systems, Multicore processors, Parallel programming models, Performance metrics, Speedup, Efficiency, Scalability.	5
2	**Shared Memory Programming:** OpenMP programming model, Parallel regions, Work sharing constructs, Loop scheduling, Synchronization, Critical sections, Reduction operations, Tasks, Performance optimization.	5
3	**Distributed Memory Programming:** MPI architecture, MPI programming model, Point-to-point communication, Collective communication, Process synchronization, Non-blocking communication, Parallel debugging, Performance evaluation.	5
4	**GPU and Heterogeneous Programming:** GPU architecture overview, CUDA programming model, CUDA kernels, Memory hierarchy, OpenCL fundamentals, Heterogeneous computing, CPU-GPU programming.	5
5	**Parallel Algorithms and Performance:** Parallel searching, Parallel sorting, Matrix operations, Graph algorithms, Load balancing, Performance analysis, Scalability, Profiling tools.	5
6	**Applications and Emerging Trends:** Parallel computing for AI, Machine learning, Big data processing, Cloud computing, Scientific computing, Energy-efficient computing, Recent trends in parallel programming.	5

Text Books

1. Peter S. Pacheco, **An Introduction to Parallel Programming**, Morgan Kaufmann, 2011.
2. Michael J. Quinn, **Parallel Programming in C with MPI and OpenMP**, McGraw-Hill Education, 2003.

3. Georg Hager and Gerhard Wellein, **Introduction to High Performance Computing for Scientists and Engineers**, CRC Press, 2011.

Reference Books

1. David B. Kirk and Wen-mei W. Hwu, **Programming Massively Parallel Processors: A Hands-on Approach**, 4th Edition, Morgan Kaufmann, 2022.
2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, **Using OpenMP: Portable Shared Memory Parallel Programming**, MIT Press, 2008.
3. William Gropp, Ewing Lusk, Anthony Skjellum, **Using MPI: Portable Parallel Programming with the Message Passing Interface**, 3rd Edition, MIT Press, 2014.

CO-PO-PSO Matrix

Course Outcome	Programme Outcome (PO) & Programme Specific Outcome (PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	-	3	2	1	-
CO2	2	1	3	3	2	1
CO3	3	2	3	3	3	2
CO4	3	2	3	3	3	2
CO5	3	2	3	3	3	2
CO6	3	3	3	2	3	3

Correlation Levels: 3 = High, 2 = Moderate, 1 = Low, '-' = No Correlation


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Department of
Computer Science & Engineering
Semester -II Programme
Elective
Course (PEC) 26203PEC203
Programme
Elective-I

Course:M.Tech	Semester: Semester-II	L	T	P	Credits
Course Code:	Course Name: Information Security	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Analyze information security principles, threats, vulnerabilities, risks, and security management frameworks.
CO2	Apply cryptographic techniques and secure communication mechanisms to protect information and ensure secure data transmission.
CO3	Design and evaluate secure network and system security solutions using authentication, access control, and security mechanisms.
CO4	Apply information security governance, auditing, compliance, and incident management practices in organizational environments.
CO5	Evaluate emerging technologies and research trends in information security for secure computing environments.

Prerequisites: Computer Networks,Operating Systems,Basic Cryptography Concepts

Unit No.	Description	Hrs
1	**Fundamentals of Information Security:** Introduction to Information Security, Information Assets and Security Goals (CIA Triad) , Security Services and Security Mechanisms , Threats, Vulnerabilities and Common Security Attacks , Risk Assessment and Risk Management , Information Security Policies and Standards, Information Security Management System (ISMS) , Overview of ISO/IEC 27001 and NIST Cybersecurity Framework	6
2	**Cryptography and Data Protection:** Introduction to Cryptography and Security Goals , Classical Cryptography Techniques , Symmetric-Key Cryptography (DES and AES) , Public-Key Cryptography (RSA and Diffie-Hellman), Hash Functions and Message Authentication , Digital Signatures and Public Key Infrastructure (PKI), Key Management and Digital Certificates , Data Confidentiality, Integrity and Authentication.	6
3	**Network and Communication Security:** Network Security Fundamentals and TCP/IP Security, Firewalls and Intrusion Detection/Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs) , Secure Communication Protocols (SSL/TLS, HTTPS and SSH) , Wireless Network Security , Web and Email Security , Network Monitoring and Security Best Practices	8
4	**System Security and Access Control:** Authentication and Multi-Factor Authentication , Authorization and Access Control Models (DAC, MAC and RBAC), Identity and Access Management (IAM) , Operating System Security , Malware	

	Ransomware and Common Cyber Threats , Endpoint Security and System Hardening, Security Monitoring and Logging , Secure Software Development Principles	
5	**Information Security Management and Governance:** Information Security Governance and Organizational Security , Security Policies, Standards and Guidelines, Security Auditing and Compliance , Vulnerability Assessment and Basic Penetration Testing Concepts , Incident Response and Security Incident Handling , Business Continuity Planning (BCP) and Disaster Recovery (DR) , Cyber Laws, Data Privacy and Professional Ethics	8
6	**Emerging Trends in Information Security:** Cloud Security and Cloud Access Security Broker (CASB) , Internet of Things (IoT) Security , Mobile and Enterprise Security , Blockchain and Distributed Ledger Security , Artificial Intelligence and Machine Learning for Information Security , Privacy-Preserving Technologies (Homomorphic Encryption, Differential Privacy, Secure Multi-Party Computation) , Zero Trust Security Architecture , Quantum Computing and Information Security Challenges	10

Text Books:

- Computer Security: Principles and Practice ,**William Stallings and Lawrie Brown**, Pearson, 2024..
- Cryptography and Network Security: Principles and Practice ,**William Stallings**, Pearson, 2023..
- Computer Security Fundamentals ,**Chuck Easttom**, Pearson, 2022.
- Information Security: Principles and Practice ,**Mark Stamp**, Wiley, 2022.

Reference Books:

- Security Engineering: A Guide to Building Dependable Distributed Systems **Ross J. Anderson**, Wiley, 2020.
- Computer and Information Security Handbook **,John R. Vacca (Ed.)**, Morgan Kaufmann/Elsevier, 2021.
- Cloud Security and Privacy,**Tim Mather, Subra Kumaraswamy, and Shahed Latif**, O'Reilly Media, 2009.

Course Outcomes	Programme Outcome (PO)/ Programme Specific Outcome(PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	3	2	1	1
CO2	3	1	3	3	2	1
CO3	3	2	3	3	2	2
CO4	2	2	3	3	3	2
CO5	3	2	3	3	3	3

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Department of Computer Science & Engineering

Course: M. Tech CSE	Semester: III	L	T	P	Credits
Course Code: 26203PEC203B	Course Name: Advanced Graph Theory	3	-	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamental concepts, terminology, and structural properties of graphs used in advanced graph theory.
CO2	Analyze graph connectivity, trees, spanning trees, planarity, graph coloring, and graph traversal techniques.
CO3	Apply graph algorithms for shortest paths, network flows, matchings, and optimization problems.
CO4	Evaluate advanced graph theoretic concepts such as graph decomposition, spectral graph theory, random graphs, and graph embeddings.
CO5	Analyze computational complexity of graph algorithms and formulate graph-based solutions for real-world problems.
CO6	Design efficient graph-based models and algorithms for applications in social networks, communication networks, distributed systems, artificial intelligence, and data science.

Unit No.	Description	Hrs.
1	**Fundamentals of Graph Theory:** Graphs and Digraphs, Types of Graphs, Graph Representations, Degree Sequences, Graph Isomorphism, Subgraphs, Graph Operations, Eulerian and Hamiltonian Graphs.	8
2	**Trees and Connectivity:** Trees, Rooted Trees, Spanning Trees, Minimum Spanning Trees, Graph Connectivity, Edge and Vertex Connectivity, Cut Vertices, Bridges, Depth First Search (DFS), Breadth First Search (BFS).	8
3	**Graph Coloring and Planarity:** Vertex Coloring, Edge Coloring, Chromatic Number, Chromatic Polynomial, Planar Graphs, Euler's Formula, Kuratowski's Theorem, Map Coloring Problems.	8
4	**Graph Algorithms and Optimization:** Shortest Path Algorithms (Dijkstra, Bellman-Ford, Floyd-Warshall), Maximum Flow (Ford-Fulkerson), Matching in Bipartite Graphs, Network Optimization Problems.	7
5	**Advanced Topics in Graph Theory:** Spectral Graph Theory, Graph Matrices, Random Graphs, Graph Partitioning, Graph Embedding, Graph Mining, Computational Complexity of Graph Problems.	7
6	**Applications of Graph Theory:** Social Network Analysis, Web Graphs, Communication Networks, Wireless Sensor Networks, Bioinformatics, Knowledge Graphs, Machine Learning on Graphs, Graph Neural Networks (GNNs), Future Trends.espionage, Privacy vs safety.	7

Text Book:

1. Douglas B. West, Introduction to Graph Theory, 2nd Edition, Pearson.
2. Reinhard Diestel, Graph Theory, 5th Edition, Springer.
3. Bondy, J. A. and Murty, U. S. R., Graph Theory, Springer.

Reference Books:

1. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Gary Chartrand and Ping Zhang, A First Course in Graph Theory, Dover Publications.
3. Alan Gibbons, Algorithmic Graph Theory, Cambridge University Press.
4. Thomas H. Cormen et al., Introduction to Algorithms, MIT Press (Graph Algorithms Chapters).
5. Fan Chung, Spectral Graph Theory, American Mathematical Society.

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	-	3	1	1	-
CO2	2	1	3	2	2	1
CO3	3	2	3	2		
CO4	3	1	3	3		
CO5	2	2	3	2		
CO6	3	3	3	2	3	3

1. Low 2. Medium 3.High

Course:M.Tech	Semester: II	L	T	P	Credits
Course Code: 26203PEC206C	Course Name: Natural Language Processing with DL	3	1	-	04

Course Outcomes: At the end of the course student will be able to

CO1	Explain the evolution of neural networks and NLP, apply the mathematical and linguistic foundations of NLP, and differentiate between classical machine learning and deep learning approaches for language processing.
CO2	Apply word embedding techniques (Word2Vec, GloVe, FastText) and sequence-to-sequence architectures to solve fundamental NLP tasks such as POS tagging, chunking, and machine translation.
CO3	Analyze the architecture and functioning of Transformer-based models and evaluate modern language models (BERT, XLM, GPT, Llama, Mistral) for diverse NLP applications.
CO4	Develop NLP solutions using transfer learning, pretraining, fine-tuning, Retrieval-Augmented Generation (RAG), and encoder-decoder architectures for machine translation and deep parsing tasks.
CO5	Design deep learning models for semantic analysis, text classification, question answering, and multimodal NLP applications including sarcasm, metaphor, humor, and fake news detection.
CO6	Evaluate large language models and generative AI systems for natural language generation tasks, while assessing ethical challenges such as bias, hallucination, misinformation, and responsible AI practices.

Prerequisites: Programming Skill, Statistics, Probability, linear algebra and machine learning

Unit No.	Description	Hrs.
1	History of Neural Nets; History of NLP; Basic Mathematical Machinery - Linear Algebra, Probability, Information Theory, etc.; Basic Linguistic Machinery - Phonology, morphology, syntax, semantics. **Introducing Neural Computation:** Perceptrons, Feedforward Neural Network and Backpropagation, Recurrent Neural Nets. **Difference between Classical Machine Learning and Deep Learning:** Representation - Symbolic Representation, Distributed Representation, Compositionality; Parametric and non-parametric learning.	7
2	**Word Embeddings:** Word2Vec (CBOW and Skip Gram), Glove, FastText. **Application of Word Embedding to Shallow Parsing:** Morphological Processing, Part of Speech Tagging and Chunking.	7

	Sequence to Sequence (seq2seq) Transformation using Deep Learning: LSTMs and Variants, Attention, Transformers.	
3	**Transformer:** Architecture and Functioning, Attention, Positional Encoding, Layer Normalization, Applications in Sentiment Analysis, Image Labelling etc. **Deep Neural Net based Language Modeling:** XLM, BERT, GPT2-3 etc.; Subword Modeling; Transfer Learning and Multilingual Modeling. **Small LM, Medium LM and Large LM:** Language Modelling, Statistical Language Modelling; Curse of Dimensionality, Neural Language Modelling, Various LMs like BERT, XLM, etc., Open LLMs like Llama, Mistral, Mixtral.	7
4	**Pretraining and Finetuning:** RAG, Generative Pretraining and GPT series; Transfer Learning and 0-shot Learning, Finetuning and few-shot learning; domain and language adaptation, Knowledge Graph Embedding; Knowledge Infusion; Retrieval Augmented Generation Natural Language Generation. **Application of seq2seq in Machine Translation:** Supervised, Semi-supervised, and Unsupervised MT; Encoder-Decoder and Attention in MT; Memory Networks in MT. **Deep Learning and Deep Parsing:** Recursive Neural Nets; Neural Constituency Parsing; Neural Dependency Parsing.	6
5	**Deep Learning and Deep Semantics:** Word Embeddings and Word Sense Disambiguation; Semantic Role Labeling with Neural Nets. **Neural Text Classification:** Sentiment and Emotion labeling with Deep Neural Nets (DNN); DNN-based Question Answering. **The indispensability of DNN in Multimodal NLP:** Advanced Problems like Sarcasm, Metaphor, Humor, and Fake News Detection using multimodality and DNN.	6
6	**Natural Language Generation:** Extractive and Abstractive Summarization with Neural Nets. **Large Language Models and Generative AI:** Llama3 like systems, ChatGPT, Gemini, Copilot, Comet etc. **Good and Bad LLMs:** Bias, Hallucination, FakeNews detection and mitigation.	6

Text Books/Reference Books:

1. Pushpak Bhattacharyya and Aditya Madhav Joshi, Natural Language Processing, Print ISBN: 978-93-5746-283-9 eISBN: 978-93-5746-239-6, Wiley, 2023.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
3. Dan Jurafsky and James Martin, Speech and Language Processing, 3rd Edition, October 16, 2019.
4. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, e-book, 2020.
5. Christopher Manning and Heinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
6. Daniel Graupe, Deep Learning Neural Networks: Design and Case Studies, World Scientific Publishing Co., Inc., 2016.
7. Pushpak Bhattacharyya, Machine Translation, CRC Press, 2017.

Journals: Computational Linguistics, Natural Language Engineering, Journal of Machine Learning Research (JMLR), Neural Computation, IEEE Transactions on Neural Networks and Learning Systems.

Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Neural Information Processing (NeuiPS), Int'l Conf on Machine Learning (ICML), Empirical Methods in NLP (EMNLP).

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	3
CO2	2	3	2	2	3	-	-	-	-	-	-	3	3
CO3	2	3	3	2	3	-	-	-	-	-	-	3	3
CO4	2	3	3	3	3	-	1	-	-	-	-	3	3
CO5	2	3	3	3	3	2	2	-	1	1	-	3	3
CO6	2	3	2	2	3	3	3	-	-	2	-	3	3

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING SATARA

Course:MTech CSE	Semester: II	L	T	P	Credits
Course Code: 26203PEC204D	**Course Name:** Programme Elective-I (Edge Computing)	3			4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamentals, architecture, and evolution of Edge Computing and distinguish it from Cloud and Fog Computing.
CO2	Analyze IoT-edge integration models, communication protocols, and data processing frameworks.
CO3	Apply virtualization, containerization, and resource management techniques in edge environments.
CO4	Evaluate security, privacy, trust, and reliability challenges in Edge Computing infrastructures.
CO5	Analyze AI/ML-based intelligent edge systems and real-time analytics frameworks.
CO6	Design edge-based solutions for emerging applications such as Industry 4.0, Smart Cities, Healthcare, and Autonomous Systems.

Prerequisites: Computer Networks, Cloud Computing, Internet of Things (IoT) , Distributed Systems, Operating Systems Fundamentals

Unit No.	Description	Hrs. (26Hrs)
1	**Introduction to Edge Computing:** Evolution of Distributed Computing, Limitations of Cloud Computing, Need for Edge Computing, Characteristics of Edge Computing, Edge vs Cloud Computing, Edge vs Fog Computing, Edge Computing Architecture and Components	7
2	**Edge Computing and IoT Integration:** IoT Architecture, Edge-enabled IoT Systems, Sensors and Smart Devices, Data Acquisition and Processing at Edge, MQTT, CoAP and AMQP Protocols, Real-Time Edge Analytics.	7
3	**Virtualization and Resource Management at Edge:** Virtualization Fundamentals, Containerization, Docker Concepts, Kubernetes Basics, Resource Scheduling, Service Placement, Load Balancing and Edge Orchestration.	8
4	**Security and Privacy in Edge Computing:** Security Challenges, Authentication and Authorization, Access Control, Data Privacy, Trust	

	Management, Blockchain-enabled Security, Reliability and Fault Tolerance.	
5	**Edge Intelligence and AI:** Edge AI Fundamentals, TinyML, Federated Learning, Edge Analytics, Machine Learning at Edge, Model Optimization and Real-Time Decision Making.	7
6	**Applications and Future Trends:** Smart Cities, Industry 4.0, Healthcare Systems, Autonomous Vehicles, 5G-enabled Edge Computing, Digital Twins, AR/VR Applications and Future Research Directions.	9

Text Books:

1. Rajkumar Buyya and Satish Narayana Srirama, **Fog and Edge Computing: Principles and Paradigms**, Wiley, 2019.
2. Rajkumar Buyya and Satish Narayana Srirama, **Edge Computing: A Primer**, Wiley, 2024.

Reference Books:

1. Theo Lynn, John G. Mooney, Pierangelo Rosati and Grace Fox, **Cloud, Edge and IoT Computing**, CRC Press, 2020.
2. Amir Vahid Dastjerdi and Rajkumar Buyya, **Internet of Things: Principles and Paradigms**, Morgan Kaufmann, 2016.
3. Brendan Burns, **Designing Distributed Systems**, O'Reilly Media, 2018.
4. Qiang Yang et al., **Federated Learning**, Springer, 2020.
5. Weisong Shi and Schahram Dustdar, **The Promise of Edge Computing**, IEEE Computer Magazine.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	2	-	-	-	-	-	-	-	3	2
CO4	2	3	2	3	-	-	-	-	-	-	-	2	2
CO5	2	3	3	2	3	-	-	-	-	-	-	3	3

Correlation Levels: 3 = High, 2 = Moderate, 1 = Low, '-' = No Correlation

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING SATARA



KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING SATARA

Course: M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26203PEC204A	**Course Name:** Cryptography & Network Security	3	1	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the principles of modern cryptography, security services, attacks, and cryptographic algorithms.
CO2	Analyze symmetric and asymmetric encryption techniques, key management, and digital signatures.
CO3	Evaluate authentication protocols, hash functions, message authentication codes (MAC), and Public Key Infrastructure (PKI).
CO4	Analyze network security mechanisms including firewalls, IDS/IPS, VPNs, SSL/TLS, IPsec, and secure communication protocols.
CO5	Design secure systems by applying cryptographic techniques to wireless, cloud, IoT, and distributed computing environments.
CO6	Evaluate emerging trends in cybersecurity, blockchain security, quantum-safe cryptography, and zero-trust security architectures.

Unit No.	Description	Hrs.
1	**Introduction to Cryptography and Security:** Security Goals, Threats, Attacks, Security Services, Classical Cryptography, Caesar Cipher, Playfair Cipher, Hill Cipher, Vigenère Cipher, Cryptanalysis, One-Time Pad.	7
2	**Symmetric and Asymmetric Cryptography:** DES, Triple DES, AES, Block Cipher Modes, Stream Ciphers, RSA, ElGamal, Diffie–Hellman Key Exchange, ECC, Key Management	8
3	**Authentication and Message Integrity:** Hash Functions, SHA Family, MD5, Message Authentication Codes (MAC), HMAC, Digital Signatures, Digital Certificates, Public Key Infrastructure (PKI), Kerberos Authentication.	8
4	**Network Security Protocols:** SSL/TLS, HTTPS, IPsec, VPN, Secure Shell (SSH), Email Security (PGP, S/MIME), Wireless Security (WPA2/WPA3), Secure DNS.	8

5	**Network Defense Mechanisms:** Firewalls, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS), Malware, Ransomware, DDoS Attacks, Network Monitoring, Security Policies, Incident Response.	7
6	**Emerging Trends in Cyber Security:** Cloud Security, IoT Security, Blockchain Security, Zero Trust Architecture, Quantum Cryptography, Post-Quantum Cryptography, AI in Cybersecurity, Future Trends.	7

Text Books:

1. William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson.
2. Behrouz A. Forouzan, Cryptography and Network Security, McGraw-Hill.
3. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in a Public World, Pearson.

Reference Books:

1. Wenbo Mao, Modern Cryptography: Theory and Practice, Pearson.
2. Bruce Schneier, Applied Cryptography, Wiley.
3. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.
4. NIST Cryptographic Standards and Guidelines.
5. William Stallings, Network Security Essentials, Pearson.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2		
CO2	2	2	2	2	
CO3	3	1	3	2	3
CO4	3	1	3	2	
CO5	2	3	2		3
CO6	1	3	2		

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING SATARA

Course: M.Tech.	Semester: I	L	T	P	Credits
Course Code:	Course Name: Advanced AI	3	1	-	4

	Course Objective
1	To provide a strong foundation in intelligent agents, agent architectures, and autonomous AI systems.
2	To impart knowledge of reasoning, planning, learning, and decision-making mechanisms in intelligent agents.
3	To enable students to design and implement autonomous and adaptive agents using modern AI technologies.
4	To introduce multi-agent systems and their applications in distributed intelligence and collaborative environments.
5	To familiarize students with LLM-powered agents, agent orchestration frameworks, and AI tool integration.
6	To develop awareness of ethical, security, and societal challenges in agent-based AI applications.

Course Outcomes: At the end of the course student will be able to

CO1	Understand the concepts, architectures, and types of intelligent agents and agent-based systems.
CO2	Analyze agent reasoning, planning, decision-making, and learning mechanisms.
CO3	Design and develop autonomous agents using modern AI frameworks and tools.
CO4	Implement multi-agent systems for collaborative problem solving and distributed intelligence.
CO5	Apply LLM-based agent architectures, orchestration frameworks, and AI tool integration.
CO6	Evaluate ethical, security, and societal aspects of agent-based AI systems.

Prerequisites

Students should have basic knowledge of Artificial Intelligence, Machine Learning, Python programming, Data Structures, Object-Oriented Programming, and Software Engineering concepts.

Unit No.	Description	Hrs.
1	**Introduction** Introduction to Artificial Intelligence Agents. Evolution from traditional AI systems to autonomous agents. Characteristics of intelligent agents. Agent environment and agent architecture. Types of agents: Simple Reflex Agents, Model-Based Agents, Goal-Based Agents, Utility-Based Agents, Learning Agents. Agent life cycle and applications.	7
2	**Agent Reasoning, Planning and Decision Making** Knowledge representation in agents. Rule-based reasoning. Goal formulation and utility functions. Planning techniques. Search strategies for intelligent agents. Decision-making under uncertainty. Reinforcement learning concepts for autonomous agents. Agent memory and context management.	8
3	**Large Language Model (LLM) Agents** Introduction to Generative AI and LLMs. Prompt engineering for agents. Agent workflows and task decomposition. Retrieval-Augmented Generation (RAG). Tool-using agents. Function calling and API integration. Memory architectures in LLM agents. Agent evaluation metrics and performance analysis.	8
4	**Multi-Agent Systems** Introduction to Multi-Agent Systems (MAS). Agent communication protocols. Cooperation, coordination, and negotiation. Distributed problem solving. Swarm intelligence concepts. Consensus mechanisms. Agent societies and organizational structures. Applications of multi-agent systems in smart cities, healthcare, and cybersecurity.	8
5	**Agent Development Frameworks and Platforms** Agent development life cycle. Agent frameworks and platforms. LangChain agents. LangGraph. CrewAI. AutoGen. OpenAI Agents SDK. Agent deployment architectures. Monitoring and debugging agent systems. Cloud-based agent deployment and scalability considerations.	7

6	**Security, Ethics and Emerging Trends** Trustworthy AI agents. Ethical challenges in autonomous decision making. Bias and fairness in agent systems. Security risks in AI agents. Privacy preservation. Human-AI collaboration. Agentic AI ecosystems. Autonomous digital workers. Future trends in agent-based AI systems.	7

Text Books/Reference books:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, Pearson.
2. Michael Wooldridge, *An Introduction to MultiAgent Systems*, Wiley.
3. Stuart J. Russell, *Human Compatible: Artificial Intelligence and the Problem of Control*, Viking.
4. Chip Huyen, *AI Engineering: Building Applications with Foundation Models*, O'Reilly.
5. James Briggs and Francisco Ingham, *Building LLM Powered Applications*, O'Reilly.
6. LangChain Documentation.
7. CrewAI Documentation.
8. Microsoft AutoGen Documentation.
9. OpenAI Agents SDK Documentation.
10. Gerhard Weiss, *Multiagent Systems*, MIT Press.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	1	-	3		
CO2	2	1	3		
CO3	3	1	3		
CO4	3	1	3		
CO5	2	1	3		
CO6	1	2	2		

Course:M.Tech	Semester: II	L	T	P	Credits
Course Code: 26203PEC208A	Course Name: Computer Vision	3	-	-	3

Course Objectives: The Computer Vision course aims to:

1	To understand the principles of image formation, visual perception, and image representation in computer vision systems.
2	To analyze feature extraction, pattern recognition, and image understanding techniques for intelligent visual applications.
3	To apply geometric computer vision concepts for camera calibration, stereo vision, and three-dimensional scene reconstruction.
4	To investigate motion analysis and video intelligence techniques for dynamic scene understanding.
5	To design intelligent vision systems using deep learning, transformers, and foundation models for real-world applications.

Course Outcomes: At the end of the course student will be able to

CO1	Analyze image formation models, visual features, and image representation techniques for computer vision applications.
CO2	Apply pattern recognition, feature extraction, segmentation, and classification methods for image understanding and object recognition.
CO3	Evaluate geometric computer vision techniques including camera calibration, stereo vision, multi-view geometry, and 3D scene reconstruction.
CO4	Analyze motion estimation, object tracking, and video analytics techniques for dynamic scene understanding.
CO5	Design intelligent computer vision solutions using deep learning architectures, vision transformers, and foundation models for real-world applications.

Prerequisites: Digital Image Processing ,Linear Algebra and Matrix Computations Probability and Statistics ,Machine Learning Fundamentals ,Python Programming

Unit No.	Description	Hrs.
1	**Unit I: Foundations of Computer Vision** Introduction to Computer Vision, Human Visual Perception, Image Formation Process, Geometric and Photometric Image Models, Image Representation, Image Sampling and Quantization, Image Filtering, Edge Detection, Corner Detection, Blob Detection, Scale Space Representation, Visual Features and Descriptors.	8

2	**Unit II: Pattern Recognition and Image Understanding** Bayesian Decision Theory, Supervised and Unsupervised Learning, Parametric and Non-Parametric Classification, Clustering Techniques, Feature Extraction, Texture Analysis and Classification, Image Segmentation, Region-Based Analysis, Object Representation, Optical Character Recognition, Content-Based Image Retrieval.	7
3	**Unit III: Geometric Vision and 3D Perception** Projective Geometry, Camera Models, Camera Calibration, Homography Estimation, Pose Estimation, Epipolar Geometry, Stereo Vision, Depth Estimation, Multi-view Geometry, Structure from Motion, Surface Reconstruction, 3D Object Representation and Recognition.	7
4	**Unit IV: Motion Analysis and Video Intelligence** Optical Flow Computation, Motion Estimation, Motion Tracking, Trajectory Analysis, Multi-Object Tracking, Video Segmentation, Activity Recognition, Event Detection, Visual Surveillance Systems, Video Analytics Applications.	8
5	**Unit V: Deep Learning for Computer Vision** Neural Networks Review, Convolutional Neural Networks (CNNs), Transfer Learning, AlexNet, VGG, ResNet, DenseNet, Object Detection using R-CNN Family and YOLO, Semantic Segmentation using FCN, U-Net and Mask R-CNN, Visual Feature Learning.	7
6	**Unit VI: Advanced Topics and Research Trends** Vision Transformers (ViT), Self-Supervised Learning, Contrastive Learning, CLIP, Segment Anything Model (SAM), Vision-Language Models, Diffusion Models for Vision, Explainable Computer Vision, Edge AI Vision Systems, Autonomous Vehicles, Medical Vision Systems, Industrial Inspection, Recent Research Trends and Case Studies.	8

Text Books:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, 2nd Edition, Springer, 2022
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, 2nd Edition, Pearson.
3. Richard Hartley and Andrew Zisserman, *Multiple View Geometry in Computer Vision*, 2nd Edition, Cambridge University Press.

Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, 4th Edition, Pearson.
2. Mark Nixon and Alberto Aguado, *Feature Extraction and Image Processing for Computer Vision*, 4th Edition, Academic Press.
3. Richard O. Duda, Peter E. Hart and David G. Stork, *Pattern Classification*, Wiley.
4. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press.
5. Simon J. D. Prince, *Computer Vision: Models, Learning and Inference*, Cambridge University Press.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)					
	PO1	PO2	PO3	PO11	PSO1	PSO2
CO1	3	1	2	3	1	-
CO2	3	1	2	3	2	-
CO3	3	2	3	3	2	2
CO4	3	2	3	3	2	2
CO5	3	3	3	3	3	3

KARMAVEER BHAURAO PATIL COLLEGE OF ENGINEERING * SATARA *

Course: M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26203PEC205D	Course Name: Quantum Computing	3	1	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamental principles of quantum computing, including qubits, quantum states, superposition, and measurement.
CO2	Construct and analyze quantum circuits using single-qubit, two-qubit, and universal quantum logic gates.
CO3	Explain quantum entanglement, Bell's theorem, and implement foundational quantum algorithms such as Deutsch, Deutsch–Jozsa, Bernstein–Vazirani, and Simon's algorithms.
CO4	Analyze advanced quantum algorithms including Grover's search, Quantum Fourier Transform, Shor's algorithm, VQE, HHL, and QAOA for solving computational problems.
CO5	Explain quantum error correction techniques, fault-tolerant quantum computing concepts, and evaluate the capabilities and limitations of NISQ-era quantum processors.
CO6	Evaluate quantum advantage claims and explore current and emerging applications of quantum computing across cryptography, optimization, artificial intelligence, healthcare, and scientific research.

Unit No.	Description	Hrs.
1	**Fundamentals of Quantum Computing** Introduction to Quantum Computing, evolution of quantum computing, applications of quantum computing, comparison of classical and quantum computing, qubits and quantum states, superposition and measurement, Bloch sphere representation, and basic mathematical concepts for quantum computing.	7
2	**Quantum Gates and Quantum Circuits** Quantum computing basics, single-qubit gates (Pauli gates, Hadamard gate, phase gates), two-qubit gates (CNOT, controlled gates, SWAP gate), universal	8

	quantum logic gates, quantum circuits, Solovay–Kitaev theorem, and quantum parallelism.	
3	**Quantum Correlations and Basic Quantum Algorithms** Quantum entanglement, Bell's theorem and Bell inequalities, quantum correlations, Deutsch algorithm, Deutsch–Jozsa algorithm, Bernstein–Vazirani algorithm, and Simon's algorithm.	8
4	**Advanced Quantum Algorithms** Grover's search algorithm, Quantum Fourier Transform (QFT), Shor's prime factorization algorithm, Variational Quantum Eigensolver (VQE), HHL algorithm, and Quantum Approximate Optimization Algorithm (QAOA).	8
5	**Quantum Error Correction and NISQ Computing** Quantum noise and decoherence, quantum error correction, simple error-correcting codes, fault-tolerant quantum computing, NISQ-era processors, current status of quantum hardware, and challenges in practical quantum computing.	7
6	**Quantum Computing Applications and Future Directions** Quantum advantage and quantum supremacy claims, applications of quantum computing in cryptography, optimization, artificial intelligence and machine learning, healthcare, drug discovery, and finance, current research trends, and future scope of quantum computing.	7

List of Theoretical Tutorials:

1. Fundamentals of Quantum Computing: Classical vs. Quantum Computing and Applications.
2. Representation of Qubits, Superposition, Measurement, and Bloch Sphere.
3. Analysis of Single-Qubit and Two-Qubit Quantum Gates.
4. Design and Analysis of Universal Quantum Logic Gates and Quantum Circuits.
5. Study of Quantum Entanglement, Bell's Theorem, and Quantum Parallelism.
6. Problem Solving on Deutsch, Deutsch–Jozsa, Bernstein–Vazirani, and Simon's Algorithms.

7. Comparative Study of Grover's Search Algorithm and Classical Search Techniques.
8. Analysis of Quantum Fourier Transform, Shor's Algorithm, VQE, HHL, and QAOA.
9. Study of Quantum Error Correction, Fault Tolerance, and NISQ-Era Quantum Processors.
10. Case Studies on Quantum Computing Applications, Quantum Advantage Claims, and Recent Advances in Quantum Computing.

Text Books:

1. M. A. Nielsen and I. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press (2010).
2. Arthur O. Pittenger, An Introduction to Quantum Computing Algorithms", Birkhäuser, 1st Edition, 2000.
3. Qiskit Textbook: https://qiskit.org/textbook/preface.html

Reference Books:

1. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2010. 2. Chris Bernhardt, "Quantum Computing for Everyone", MIT Press, 2019.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2		
CO2	2	2	2		
CO3	3	1	3		
CO4	3	1	3		
CO5	2	3	2		
CO6	1	3	2		


Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil
College of Engineering, Satara
An Autonomous Institute
Department of
Computer Science & Engineering
Semester: II
Programme Elective-III
COURSE (PEC) 26203PEC205

Course: M. Tech CSE	Semester: III	L	T	P	Credits
Course Code: 26203PEC208A	Course Name: Cyber Security & Network Audit	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamental concepts of cyber security, including confidentiality, integrity, availability, and key security principles.
CO2	Apply security governance, risk, compliance frameworks, and contingency planning techniques to manage organizational cyber security requirements.
CO3	Analyze cyber security policies, risk management processes, and control mechanisms for securing information assets.
CO4	Evaluate cyber security technologies, defense mechanisms, access control models, encryption techniques, and industry security practices.
CO5	Analyze privacy principles, privacy regulations, and data breach implications in the context of information security and digital systems.
CO6	Evaluate global and Indian data protection frameworks, including GDPR and DPDP Act, and assess the economic, strategic, and societal implications of privacy.

NPTEL 12 Weeks course Link-

https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_cs127

Unit No.	Description	Hrs.
1	Introduction - Introduction to cyber security, Confidentiality, integrity, and availability. Foundations - Fundamental concepts, CIA, CIA triangle, data breach at target.	8
2	Security management, Governance, risk, and compliance (GRC)- GRC framework, security standards. Contingency planning - Incidence response, Disaster Recovery, BCP.	8
3	Cyber security policy - ESSP, ISSP, SYSSP. Risk Management - Cyber Risk Identification, Assessment, and Control.	8
4	Cyber security: Industry perspective - Defense Technologies, Attack, Exploits. Cyber security technologies - Access control, Encryption, Standards.	7

5	Foundations of privacy - Information privacy, Measurement, Theories. Privacy regulation - Privacy, Anonymity, Regulation, Data Breach.	7
6	Privacy regulation in Europe, Privacy: The Indian Way - Data Protection, GDPR, DPDP, Aadhar. Information privacy: Economics and strategy, Economic value of privacy, privacy valuation, WTA and WTC, Business strategy and privacy, espionage, Privacy vs safety.	7

Text Book:

1. Michael E. Whitman, Herbert J. Mattord, (2018). Principles of Information Security, 6th edition, Cenage Learning, N. Delhi.
2. Darktrace, "Technology" https://www.darktrace.com/en/technology/#machine-learning, accessed November 2018.2. Joseph, G. and Jeganathan, C. (2018), Fundamentals of Remote Sensing, Third Edition, Universities Press
3. Van Kessel, P. Is cyber security about more than protection? EY Global Information Security Survey 2018-2019.

Reference Books:

1. Johnston, A.C. and Warkentin, M. Fear appeals and information security behaviors: An empirical study. MIS Quarterly, 2010.
2. Arce I. et al. Avoiding the top 10 software security design flaws. IEEE Computer Society Center for Secure Design (CSD), 2014.
3. Smith, H. J., Dinev, T., & Xu, H. Information privacy research: an interdisciplinary review. MIS Quarterly, 2011.
4. Subramanian R. Security, privacy and politics in India: a historical review. Journal of Information Systems Security (JISSec), 2010.
5. Acquisti, A., John, L. K., & Loewenstein, G. What is privacy worth? The Journal of Legal Studies, 2013

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	-	3	1	1	-
CO2	2	1	3	2	2	1
CO3	3	2	3	2	3	2
CO4	3	1	3	3	3	2
CO5	2	2	3	2	2	2
CO6	3	3	3	2	3	3

1. Low 2. Medium 3.High

Course: M-Tech	Semester: I	L	T	P	Credits
Course Code: 26203PCC103	Course Name: Advance Computer Networks	3	1	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Explain advanced networking architectures, Internet technologies, and performance metrics.
CO2	Analyze routing and switching mechanisms used in modern communication networks.
CO3	Evaluate transport-layer protocols and essential network services for reliable communication.
CO4	Examine wireless, mobile, and ad hoc networking technologies for contemporary communication systems.
CO5	Analyze cloud networking, virtualization, and software-defined networking concepts.
CO6	Evaluate network security mechanisms and emerging networking technologies for secure and scalable network infrastructures.

Prerequisites: Computer Networks , Operating System, Database System

Unit No.	Description	Hrs.
1	**Fundamentals of Advanced Computer Networks :** Evolution of Computer Networks and Internet , Network Architecture: OSI and TCP/IP Models ,Internet Structure and Network Components , IPv4 and IPv6 Addressing, Network Performance Metrics: Throughput, Delay, Jitter, Packet Loss ,Quality of Service (QoS) Concepts	7
2	**Routing and Switching Technologies :** Routing Principles and Algorithms , Static and Dynamic Routing ,Distance Vector and Link State Routing ,OSPF and BGP Overview ,Switching Concepts, VLANs and Inter-VLAN Routing, Spanning Tree Protocol (STP)	7
3	**Routing and Switching Technologies** : Routing Principles and Algorithms, Static and Dynamic Routing , Distance Vector and Link State Routing, OSPF and BGP Overview ,Switching Concepts, VLANs and Inter-VLAN Routing ,Spanning Tree Protocol (STP)	7
4	**Wireless and Mobile Networks :** Wireless LAN Architecture, IEEE 802.11 Standards , Mobile IP Concepts , Cellular Networks (4G and 5G Overview)	8

	,Wireless Sensor Networks , Mobile Ad Hoc Networks (MANETs), Applications of Wireless Networks	
5	**Cloud and Software Defined Networking :** Introduction to Cloud Networking, Data Center Networking Concepts ,Virtualization in Networking , Software Defined Networking (SDN) Fundamentals ,Network Virtualization Concepts , Applications of SDN in Modern Networks	8
6	**Network Security and Emerging Trends :** Network Security Requirements , Firewalls and Intrusion Detection Systems ,Virtual Private Networks (VPNs) ,Secure Communication Protocols ,Internet of Things (IoT) Networking Overview, AI-enabled Network Management ,Future Trends in Networking	8

Text Books

1. **James F. Kurose and Keith W. Ross**, *Computer Networking: A Top-Down Approach*, 8th Edition, Pearson.
2. **Andrew S. Tanenbaum and David J. Wetherall**, *Computer Networks*, 6th Edition, Pearson.

Reference Books

1. **Behrouz A. Forouzan**, *Data Communications and Networking*, 5th Edition, McGraw Hill.
2. **Larry L. Peterson and Bruce S. Davie**, *Computer Networks: A Systems Approach*, 6th Edition, Morgan Kaufmann.
3. **Nader F. Mir**, *Computer and Communication Networks*, 2nd Edition, Pearson.
4. **William Stallings**, *Wireless Communications and Networks*, 3rd Edition, Pearson.
5. **Paul Goransson and Chuck Black**, *Software Defined Networks: A Comprehensive Approach*, Morgan Kaufmann.

CO-PO Mapping Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	1	3	1	1
CO2	3	3	2	1	2	-	-	-	-	-	1	3	1	1
CO3	2	3	2	1	3	-	-	-	-	-	1	3	1	1
CO4	2	3	2	2	2	-	-	-	-	-	1	3	2	2
CO5	2	3	3	2	3	-	-	-	-	-	2	3	2	2
CO6	2	3	2	3	3	1	1	2	-	-	2	2	3	3
Correlation Levels: 3- High 2- Moderate 1-Low														

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Course: MTech CSE	Semester: II	L	T	P	Credits
Course Code: 26203PEC208C	Course Name: Programme Elective-III (GPU Architecture and Programming)	3			3

Course Outcomes: At the end of the course student will be able to

CO No.	Course Outcome
CO1	Explain GPU architecture, parallel computing concepts, and memory organization.
CO2	Develop parallel applications using CUDA programming techniques.
CO3	Analyze and optimize GPU application performance using appropriate techniques.
CO4	Implement heterogeneous computing solutions using OpenCL and GPU platforms.
CO5	Apply GPU computing techniques to solve AI, machine learning, and data-intensive problems.
CO6	Evaluate advanced GPU technologies and emerging research trends in high-performance computing.

Unit No.	Description	Hrs.
1	**Introduction to GPU Computing:** Evolution of GPU computing, CPU vs GPU architecture, Parallel computing concepts, Data and task parallelism, SIMD and SIMT execution models, GPU architecture overview, Threads, Warps, Thread blocks, GPU memory hierarchy.	8
2	**CUDA Programming Fundamentals:** Introduction to CUDA, CUDA programming model, Kernel execution, Thread hierarchy, Memory management, Global memory, Shared memory, Constant memory, CUDA Runtime API, Basic CUDA programming examples.	8
3	**GPU Performance Optimization:** Memory access optimization, Memory coalescing, Shared memory utilization, Synchronization techniques, CUDA streams, Concurrent execution, Performance analysis and profiling, Optimization strategies.	8
4	**OpenCL and Heterogeneous Computing:** Introduction to OpenCL, OpenCL architecture, Execution model, Memory model, Kernel programming, Host-device interaction, Heterogeneous computing using CPU and GPU.	7
5	**Parallel Algorithms and Applications:** Parallel reduction, Matrix operations, Sorting algorithms, Graph processing, Image processing applications, Machine learning and deep learning acceleration using GPUs.	7
6	**Advanced GPU Computing:** Multi-GPU computing, Cloud GPU platforms, GPU applications in AI and High-Performance Computing (HPC), Emerging trends in GPU computing, Research challenges and future directions.	7

Text Books

1. **David B. Kirk and Wen-mei W. Hwu**, *Programming Massively Parallel Processors: A Hands-on Approach*, 4th Edition, Morgan Kaufmann Publishers, 2022.
2. **Shane Cook**, *CUDA Programming: A Developer's Guide to Parallel Computing with GPUs*, Morgan Kaufmann Publishers, 2013.

3. **John Cheng, Max Grossman, Ty McKercher**, *Professional CUDA C Programming*, Wrox Publications, 2014.

Reference Books

1. **Benedict Gaster, Lee Howes, David Kaeli, Perhaad Mistry, Dana Schaa**, *Heterogeneous Computing with OpenCL*, 2nd Edition, Morgan Kaufmann Publishers, 2013.
2. **John L. Hennessy and David A. Patterson**, *Computer Architecture: A Quantitative Approach*, 6th Edition, Morgan Kaufmann Publishers, 2017.
3. **Wen-mei W. Hwu (Ed.)**, *GPU Computing Gems Emerald Edition*, Morgan Kaufmann Publishers, 2011.
4. **Duane Storti and Mete Yurtoglu**, *CUDA for Engineers: An Introduction to High-Performance Parallel Computing*, Addison-Wesley Professional, 2015.
5. **Jason Sanders and Edward Kandrot**, *CUDA by Example: An Introduction to General-Purpose GPU Programming*, Addison-Wesley Professional, 2010.
6. **NVIDIA Corporation**, *CUDA C++ Programming Guide*, Latest Edition, NVIDIA Developer Documentation.

Online Resources

1. NVIDIA CUDA Toolkit Documentation
2. NVIDIA Developer Portal
3. Khronos OpenCL Documentation
4. AMD ROCm Documentation

CO-PO-PSO Matrix

Course Outcome	Programme Outcome (PO) & Programme Specific Outcome (PSO)					
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	-	3	2	1	-
CO2	2	1	3	3	2	1
CO3	3	2	3	3	3	2
CO4	3	2	3	3	3	2
CO5	3	1	3	3	3	2
CO6	3	3	3	2	3	3

Correlation Levels: 3 = High, 2 = Moderate, 1 = Low, '-' = No Correlation

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Department of Computer Science & Engineering

Course:M.Tech CSE	Semester: II	L	T	P	Credits
Course Code: 26203PEC208D	Course Name: Geographic Information Systems (GIS)	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamental concepts of Geographic Information Systems (GIS) and represent real-world features in a digital environment
CO2	Apply various GIS data types, data models, and advanced data generation and collection techniques, including field surveys.
CO3	Analyze GIS data quality parameters and utilize Global Positioning System (GPS) technology for accurate spatial data acquisition.
CO4	Demonstrate the concepts of Database Management Systems (DBMS), perform database queries, and conduct spatial analysis using GIS tools.
CO5	Perform basic and advanced spatial analysis, integrate and digitize spatial data, and develop maps using Quantum GIS (QGIS).
CO6	Generate, process, and analyze geospatial data from multiple sources while implementing data standards, interoperability concepts, and WebGIS applications using GeoServer.

Unit No.	Description	Hrs.
1	Introduction to GIS, Representing a real world in digitalscape	8
2	Data types and data models, Advanced data models in GIS and Data Generation/Collection/Surveys	8
3	GIS data quality, Global Positioning system	8
4	Database and Database Management System– Introduction, Database query and Spatial analysis	7
5	Basic and Advanced Spatial analysis of data, Quantum GIS introduction, Hands on working with maps, data integration, collection, digitization and extraction	7
6	Hands on data generation and analysis using various sources, Data standards and Interoperability WEBGIS through GEOSERVER hands-on tutorials	7

Text Book:

1. Fundamentals of Geographic Information Systems by Michael N. Demers
2. Introduction to Geographic Information Systems - Kang-tsung Chang

Reference Books:

1. Principles of Geographical Information Systems by Peter A. Burrough
2. Concepts and Techniques of Geographic Information Systems by Chor Pang Lo

NPTEL Reference-:
https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_de24

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	1
CO2	2	1	3	3	2	1
CO3	3	1	3	3	2	2
CO4	2	2	3	3	2	2
CO5	3	2	3	3	3	2
CO6	3	3	3	3	3	3

1. Low 2. Medium 3.High

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An Autonomous Institute

Department of Computer Science & Engineering

Course: PG	Semester: PG Sem II	L	T	P	Credits
Course Code:	Course Name: Elective- Blockchain Technology	3	-	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain blockchain fundamentals, cryptographic primitives, distributed ledger concepts, and blockchain architectures.
CO2	Analyze Bitcoin architecture, cryptocurrency transactions, mining processes, and security challenges in cryptocurrency systems.
CO3	Compare and evaluate various consensus mechanisms used in blockchain networks and their suitability for different applications
CO4	Explain the architecture, design principles, and consensus protocols of permissioned blockchain systems.
CO5	Analyze blockchain-based solutions for enterprise applications including finance, supply chain management, trade, and digital identity.
CO6	Demonstrate understanding of blockchain platforms, smart contract development tools, cybersecurity applications, and emerging research directions in blockchain technology.

Prerequisites: Basic understanding of data security and distributed systems

Unit No.	Description	Hrs.
1	**Introduction to Blockchain and Cryptography** Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Cryptocurrency and Blockchain, Permissioned Model of Blockchain, Security Aspects of Blockchain. Basic Cryptographic Primitives: Cryptographic Hash Functions, Properties of Hash Functions, Hash Pointer and Merkle Tree, Digital Signatures, Public Key Cryptography, Basic Cryptocurrency.	7
2	**Bitcoin and Cryptocurrency** Creation of Coins, Payments and Double Spending, Bitcoin Scripts, Bitcoin Peer-to-Peer (P2P) Network, Transactions in Bitcoin Network, Block Mining, Block Propagation and Block Relay, Mining Difficulty, Mining Pool, Life Cycle of a Bitcoin Miner.	7
3	**Consensus Mechanisms in Blockchain** Distributed Consensus in Open Environments, Consensus in Bitcoin Network, Proof of Work (PoW), Bitcoin PoW, Attacks on PoW and Monopoly Problem, Proof of Stake (PoS), Proof of Burn (PoB), Proof of Elapsed Time (PoET), Comparative Analysis of Consensus Mechanisms.	7

4	**Permissioned Blockchain** Permissioned Blockchain Model and Use Cases, Design Issues in Permissioned Blockchains, Smart Contract Execution, State Machine Replication, Distributed Consensus in Closed Environments, Paxos Consensus Algorithm, RAFT Consensus Algorithm, Byzantine Generals Problem, Byzantine Fault Tolerance (BFT), Lamport-Shostak-Pease BFT Algorithm, BFT in Asynchronous Systems.	8
5	**Enterprise Applications of Blockchain** Cross-Border Payments, Know Your Customer (KYC), Food Security and Traceability, Mortgage and Real Estate Applications, Blockchain-enabled Trade, We.Trade – Trade Finance Network, Supply Chain Financing, Identity Management on Blockchain.	8
6	**Blockchain Platforms, Cybersecurity and Emerging Applications** Overview of Ethereum Ecosystem, Development Environment using MetaMask, Ganache and Remix IDE, Overview of Hyperledger Fabric, Ripple and Corda, Security Challenges in Distributed Systems, Blockchain for Cybersecurity, Blockchain-based Identity Management, Blockchain for Secure IoT Networks, Blockchain-based Intrusion Detection Systems, Emerging Blockchain Applications.	8

Text Books:

1. Melanie Swan, —Blockchain: Blueprint for a New Economy‖, O'Reilly, 2015

Reference Books:

1. Josh Thompsons, —Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming‖.

2. Daniel Drescher, —Blockchain Basics‖, Apress; 1st Edition, 2017.

3. Anshul Kaushik, —Blockchain and Crypto Currencies‖, Khanna Publishing House, Delhi.

4. Imran Bashir, —Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained‖, Packt Publishing.

5. Ritesh Modi, —Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain‖, Packt Publishing.

6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, —Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer‖, Import, 2018.

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	2	3	2	1	
CO2	1				3	3
CO3	3				2	2
CO4	2	2			2	1
CO5	3	3				
CO6			3	2	2	

1. Low 2. Medium 3.High

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Department of Computer Science & Engineering

Course: M-Tech	Semester: III	L	T	P	Credits
Course Code: 26203PEC301B	**Course Name:** Introduction to Industry 4.0 and Industrial Internet of Things	3		-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the concepts, principles, architecture, and enabling technologies of Industry 4.0 and the Industrial Internet of Things (IIoT).
CO2	Analyze IIoT architectures, communication protocols, sensors, actuators, and industrial networking technologies.
CO3	Design IoT-enabled industrial systems using cloud, edge, and fog computing technologies for smart manufacturing..
CO4	Evaluate Industrial IoT data analytics, artificial intelligence, and machine learning techniques for predictive maintenance and process optimization..
CO5	Analyze cybersecurity, privacy, interoperability, and standardization issues in Industry 4.0 environments.
CO6	Develop Industry 4.0 solutions for smart factories, digital twins, cyber-physical systems, and intelligent industrial automation.

Prerequisites: • Computer Networks Embedded Systems Internet of Things Operating Systems Database Management Systems

Unit No.	Description	Hrs.
1	**Introduction to Industry 4.0:** Industrial Revolutions, Evolution of Manufacturing, Industry 4.0 Principles, Smart Manufacturing, Cyber-Physical Systems (CPS), Industrial Automation, Reference Architectures (RAMI 4.0, IIRA).	7
2	**Industrial Internet of Things (IIoT):** IIoT Architecture, Industrial Sensors and Actuators, RFID, PLC, SCADA, Industrial Gateways, Communication Technologies, Industrial Networking, OPC-UA, MQTT, CoAP.	7
3	**Cloud, Edge and Industrial Data Analytics:** Cloud Computing for IIoT, Edge Computing, Fog Computing, Industrial Data Acquisition, Big Data Analytics, Data Visualization, Industrial AI, Predictive Analytics.	7
4	**Artificial Intelligence and Digital Manufacturing:** Machine Learning in Manufacturing, Predictive Maintenance, Quality Inspection, Digital Twin, Robotics, Autonomous Manufacturing, Additive Manufacturing (3D Printing).	8

5	**Security and Standards in Industry 4.0:** IIoT Security Challenges, Authentication, Access Control, Industrial Cybersecurity, Blockchain for IIoT, IEC Standards, Interoperability, Functional Safety.	8
6	**Applications and Future Trends:** Smart Factory, Smart Grid, Smart Healthcare, Smart Agriculture, Supply Chain Management, Autonomous Systems, 5G-enabled IIoT, Green Manufacturing, Future Research Directions.	8

Text Books

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress.
2. Sabina Jeschke, Christian Brecher, Houbing Song and Danda Rawat, Industrial Internet of Things, Springer.
3. Rajkumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann.

Reference Books

1. Ovidiu Vermesan and Peter Friess, Internet of Things – Converging Technologies for Smart Environments, River Publishers.
2. Perry Lea, Internet of Things for Architects, Packt.
3. Dieter Uckelmann, Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Springer.
4. Houbing Song, Danda Rawat, Sabina Jeschke and Christian Brecher, Industrial Internet of Things, Springer.
5. Klaus Schwab, The Fourth Industrial Revolution, Crown Business.

CO-PO Mapping Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-		-	-	-	-	-	1	3	1	1
CO2	3	3	2	1		-	-	-	-	-	1	3	1	1
CO3	2	3	2	1		-	-	-	-	-	1	3	1	1
CO4	2	3	2	2		-	-	-	-	-	1	3	2	2
CO5	2	3	3	2		-	-	-	-	-	2	3	2	2
CO6	2	3	2	3	3	1	1	2	-	-	2	2	3	3
Correlation Levels: 3- High 2- Moderate 1-Low														

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Course: M-Tech	Semester: III	L	T	P	Credits
Course Code: 26203PEC301C	Course Name: Advanced Distributed Systems	3		-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the principles, architectures, and design models of advanced distributed systems.
CO2	Analyze communication mechanisms, synchronization techniques, and distributed coordination algorithms.
CO3	Design distributed applications using distributed file systems, distributed databases, and middleware technologies...
CO4	Evaluate fault tolerance, consistency models, replication techniques, and distributed transaction management...
CO5	Analyze cloud-native distributed systems, microservices, container orchestration, and distributed computing frameworks.
CO6	Develop scalable, secure, and reliable distributed applications by integrating emerging technologies such as edge computing, blockchain, and distributed AI.

Prerequisites: Operating Systems Computer Networks Database Management Systems Data Structures and Algorithms Cloud Computing (Preferred)

Unit No.	Description	Hrs.
1	**Introduction to Distributed Systems:** Evolution, Characteristics, Distributed Computing Models, Client–Server, Peer-to-Peer Systems, Distributed System Architectures, Transparency, Scalability, Distributed System Challenges.	7
2	**Communication and Coordination**: Inter-process Communication (IPC), Remote Procedure Call (RPC), Remote Method Invocation (RMI), Message-Oriented Middleware, Distributed Naming Services, Logical Clocks, Vector Clocks, Distributed Mutual Exclusion, Leader Election Algorithms.	7
3	**Distributed Data Management:** Distributed File Systems, Distributed Databases, Replication Strategies, Data Partitioning, Distributed Transactions, Two-Phase Commit (2PC), Three-Phase Commit (3PC), Consistency Models, CAP Theorem.	7
4	**Fault Tolerance and Reliability:** Failure Models, Checkpointing, Recovery Mechanisms, Consensus Algorithms (Paxos and Raft), Byzantine Fault Tolerance, Load Balancing, Distributed Scheduling, High Availability Systems.	8

5	**Cloud-native Distributed Systems:** Virtualization, Containers, Docker, Kubernetes, Microservices Architecture, Service Discovery, API Gateway, Distributed Caching, Event-driven Architecture, Apache Kafka.	8
6	**Emerging Trends in Distributed Systems:** Edge Computing, Fog Computing, Blockchain-based Distributed Systems, Distributed Artificial Intelligence, Serverless Computing, Internet of Things Integration, Future Trends and Case Studies..	8

Text Books

1. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, **Distributed Systems: Concepts and Design**, 6th Edition, Pearson.
2. Maarten van Steen and Andrew S. Tanenbaum, **Distributed Systems**, 4th Edition, CreateSpace/Open Distributed Systems.
3. Andrew S. Tanenbaum and Maarten van Steen, **Distributed Systems: Principles and Paradigms**, Pearson.

Reference Books

- Kai Hwang, Geoffrey Fox and Jack Dongarra, **Distributed and Cloud Computing**, Morgan Kaufmann.
- Martin Kleppmann, **Designing Data-Intensive Applications**, O'Reilly.
- Brendan Burns, **Designing Distributed Systems**, O'Reilly.
- Nancy Lynch, **Distributed Algorithms**, Morgan Kaufmann.
- Kenneth Birman, **Guide to Reliable Distributed Systems**, Springer.

CO-PO Mapping Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-		-	-	-	-	-	1	3	1	1
CO2	3	3	2	1		-	-	-	-	-	1	3	1	1
CO3	2	3	2	1		-	-	-	-	-	1	3	1	1
CO4	2	3	2	2		-	-	-	-	-	1	3	2	2
CO5	2	3	3	2		-	-	-	-	-	2	3	2	2
CO6	2	3	2	3			1	2	-	-	2	2	3	3
Correlation Levels: 3- High 2- Moderate 1-Low														

Course: M. Tech CSE	Semester: III	L	T	P	Credits
Course Code: 26203PEC301D	Course Name: Remote Sensing: Principles and Applications (Online)	3	-	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Explain the fundamentals of Remote Sensing, electromagnetic radiation principles, radiometry, and the interaction of EMR with terrain features.
CO2	Apply the concepts of visible and infrared remote sensing, image acquisition, atmospheric and topographic corrections, and evaluate different sensor types and resolution characteristics.
CO3	Analyze spectral resolution concepts, spectral reflectance curves, and derive spectral indices for feature identification and classification.
CO4	Demonstrate the principles and applications of thermal infrared remote sensing and passive microwave radiometry for Earth observation
CO5	Evaluate active microwave remote sensing techniques, imaging radar systems, and various platforms used for remote sensing data acquisition.
CO6	Apply LiDAR technology and utilize common remote sensing datasets and data portals for land use/land cover monitoring and water resources management applications.

NPTEL 12Weeks course

hhttps://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ce115

Unit No.	Description	Hrs.
1	Introduction, electromagnetic radiation, basic laws, Radiometry, Interaction of EMR with terrain features	7
2	RS in visible and IR domain: Radiance to reflectance, atmospheric and topographic correction, RS image acquisition, Different types of sensors, resolution concepts	7
3	Resolution concepts, Spectral reflectance curves, Spectral reflectance curves, Spectral indices	7
4	Thermal infrared remote sensing, Passive microwave radiometry	8
5	Active microwave remote sensing: Imaging radar, Platforms used for RS data acquisition and characteristics	8
6	LIDAR, Common remote sensing datasets and data portals, Applications of RS for land use and land cover monitoring, water resources management	8

Text Book:

1. Rees, W. G. (2012), Physical Principles of Remote Sensing, Third Edition, Cambridge University Press

2. Joseph, G. and Jeganathan, C. (2018), Fundamentals of Remote Sensing, Third Edition, Universities Press
3 Jensen, J. R. (2007), Remote sensing of the environment: An earth resource perspective, Second edition, Pearson

Reference Books:

1. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008), Remote sensing and image interpretation, Sixth or Seventh edition, Wiley

CO-PO Mapping Matrix

Course Outcome	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	1
CO2	2	1	3	3	2	1
CO3	3	1	3	3	2	2
CO4	2	2	3	3	2	2
CO5	3	2	3	3	3	2
CO6	3	3	3	3	3	3

1. Low 2. Medium 3.High

Course: M.Tech.	Semester: III	L	T	P	Credits
Course Code: 26203PEC301	Course Name: Massive Open Online Course	3	-	-	4

Course Outcomes: At the end of the course student will be able to

CO1	Acquire new knowledge and practical skills
CO2	Benefit from a flexible and self-paced learning environment,
CO3	Find reputed journals and conference in relevant filed.

The students in consultation with the faculty advisor, opt for a single course of 12 weeks offered by the NPTEL in the current semester. The students need to register for the examination conducted by the NPTEL. For the students who secured a passing score in the NPTEL examination, the marks obtained for assignments (in 25 marks) will be upscaled to out of 50 marks of CIE and the marks obtained from the certificate examination (in 75 marks) will be downscaled 50 marks of ESE assessments.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	2	1
CO2	2	3	2	1	1
CO3	1	3	2	1	2

Course: M.Tech.	Semester: III	L	T	P	Credits
Course Code: 26203RS302	Course Name: Research Seminar	-	-	4	2

Course Outcomes: At the end of the course student will be able to

CO1	Explore research areas and problems.
CO2	Present the finding of literature survey / review.
CO3	Find reputed journals and conference in relevant filed.

Prerequisites

Familiarity with basic subjects of computer science and engineering.

It is a course requirement under the guidance of faculty called as Supervisor. It is expected by the student to carry out exhaustive literature survey with consultation of his/her supervisor for not less than 15 reputed national / international journal and conference papers. Student should present the survey report to DPGC (Department Post Graduate Committee) and justify about the innovativeness, applicability, relevance and significance of the work. Student shall submit seminar report as per the prescribed format in 02 copies to department

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	1	2	1
CO2	2	3	3	2	1
CO3	1	3	2	1	-

Evaluation will be done in two steps: Internal Continuous Assessment (In-Semester Evaluation - ISE) and End-Semester Evaluation (ESE).

- **Internal Evaluation (In-Semester Evaluation - ISE):** The internal guide will evaluate his/her student for **60 marks** distributed across six continuous progressive phases throughout the semester:
  - **Phase-I (Problem Definition & Objectives):** 10 Marks
  - **Phase-II (Literature Review & Gap Analysis):** 15 Marks
  - **Phase-III (Methodology Design):** 10 Marks
  - **Phase-IV (System Architecture / Algorithm Design):** 10 Marks
  - **Phase-V (Initial Prototype Development):** 10 Marks
  - **Phase-VI (Progress Seminar):** 5 Marks
- **End-Semester Evaluation (ESE):** A panel of External Examiner(s) and two senior faculty of the department will evaluate the work for **40 marks** based on the following definitive deliverables of Phase-I:
  - **Dissertation Phase-I Report:** 15 Marks
  - **Presentation:** 10 Marks
  - **Technical Contribution:** 10 Marks
  - **Viva Voce:** 5 Marks

The marks obtained in these two assessments will be combined to get a final evaluation out of **100 marks**. The course grading, like other courses, will be relative in nature. The evaluation takes place based on foundational research criteria including literature survey, well-defined problem statement, proposed high-level system design, initial prototyping, and presentation quality. The evaluation panel will provide a report containing structured suggestions/changes to be strictly incorporated by the student during Phase-II.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	1	2	1
CO2	2	3	1	3	2
CO3	3	3	-	2	3
CO4	2	1	2	1	3
CO5	2	2	3	2	2
CO6	1	1	3	-	1

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An Autonomous Institute
Department of Computer Science & Engineering

Course: M.Tech.	Semester: III	L	T	P	Credits
Course Code: 26203DP303	Course Name: Dissertation Phase-I	-	-	22	11

Course Outcomes: At the end of the course student will be able to

CO1	Demonstrate how to search the existing literature to gather information about a specific problem or domain.
CO2	Identify the state-of-the-art technologies and research in the chosen domain, and highlight open problems that are relevant to societal or industrial needs.
CO3	Evaluate various solution techniques to determine the most feasible solution within given constraints for the chosen dissertation problem.
CO4	Apply software engineering principles related to requirements gathering and design to produce relevant documentation.
CO5	Write a dissertation report that details the research problem, objectives, literature review, and solution architecture.
CO6	Deliver effective oral presentations to communicate the findings and outcomes of the research work.

Guidelines

The dissertation is a year-long project, conducted and evaluated in two phases. It can be carried out either in-house or within an industry as assigned by the department. The project topic and internal advisor (a faculty member from the department) are determined at the beginning of Phase I. Student is expected to complete the following activities in Phase-I: 1. Literature survey 2. Problem Definition 3. Motivation for study and Objectives 4. Preliminary design / feasibility / modular approaches

Deliverables

A report having following details: Abstract, Problem statement, Requirements specification, Literature survey, Proposed solution, High level design description, Plan for implementation 42 and testing in Phase-II 2. A presentation that covers the major points covered in the report. 3. A proof of concept (preferable but not mandatory)

Course: M.Tech.	Semester: III	L	T	P	Credits
Course Code: 26203OJT304	Course Name: Internship/OJT	-	-		3

Course Outcomes: At the end of the course student will be able to

CO1	Apply theoretical knowledge to solve real-world engineering and research problems in an industrial or research environment.
CO2	Develop professional, technical, communication, teamwork, and project management skills through practical exposure.
CO3	Prepare technical reports and present the internship work effectively while adhering to professional ethics and organizational practices.

Prerequisites

Completion of core M.Tech. coursework relevant to the specialization.
Basic programming, analytical, and problem-solving skills.
Familiarity with engineering tools and technologies related to the chosen internship domain.

Internship Guidelines

The internship shall be carried out in an **industry, research organization, academic institution, government organization, or startup** approved by the Department. The internship should provide practical exposure to real-world engineering or research problems relevant to the student's specialization.

The duration of the internship shall normally be **8 to 16 weeks (or as prescribed by the University)**. The student shall work under the joint supervision of an **Industry Mentor** and a **Faculty Supervisor**.

The student shall maintain a **daily/weekly work diary**, submit periodic progress reports, and strictly follow the rules, ethics, confidentiality, and safety policies of the host organization.

At the end of the internship, the student shall submit an **Internship Report** in the prescribed format along with the **Internship Completion Certificate** issued by the host organization. The student shall deliver a seminar presentation and appear for **viva-voce** before the **Department Post Graduate Committee (DPGC)**, demonstrating the objectives, work carried out, technical contributions, outcomes, learning experiences, and future scope.

The evaluation shall be based on the student's performance during the internship, quality of work completed, report writing, presentation, viva-voce, feedback from the Industry Mentor, and recommendations of the Faculty Supervisor.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	3	2
CO2	2	3	3	2	2
CO3	1	3	2	1	2


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Department of
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Semester: IV

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Karmaveer Bhaurao Patil College of Engineering, Satara
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Department of Computer Science & Engineering

Course: M.Tech.	Semester: IV	L	T	P	Credits
Course Code: 26203DP401	Course Name: Dissertation Phase-II	-	-	40	20

Course Outcomes: At the end of the course student will be able to

CO1	Achieve proficiency in the languages, tools, libraries, and technologies used in the dissertation work.
CO2	Apply project planning principles and techniques to ensure effective and efficient project execution.
CO3	Demonstrate an understanding of the entire lifecycle of a software product or solution.
CO4	Produce artifacts such as source code, test plans, and test results based on the dissertation work.
CO5	Write research paper(s) and a thesis in accordance with publication ethics.
CO6	Exhibit the presentation skills needed to effectively present the work at various platforms.

Guidelines

Student is expected to complete the following activities in Phase-II:

1. Implementation of the proposed approach in the first stage
2. Testing and verification of the implemented solution
3. Writing of a report and presentation
4. Publish the work done at suitable conference/in a journal

Deliverables

1. Source code (if the project is in-house)
2. Dissertation report that gives overview of the problem statement, literature survey, design, implementation details, testing strategy and results of testing
3. All the artifacts created throughout the duration of dissertation such as requirements specification, design, project plan, test cases etc
4. Presentation based on the dissertation report
5. Research Paper(s) based on the dissertation work

Evaluation

Evaluation will be done in two steps: Internal Continuous Assessment (In-Semester Evaluation - ISE) and End-Semester Evaluation (ESE).

- **Internal Evaluation (In-Semester Evaluation - ISE):** The internal assessment is structured across three comprehensive reviews conducted by the department, totaling **120 marks**:
  - **Review-I (40 Marks):** Assesses the initial phase of execution. The evaluation criteria include Implementation Progress (15 Marks), Research Methodology Execution (10 Marks), Work Diary & Documentation (5 Marks), and the Review Presentation (10 Marks).
  - **Review-II (40 Marks):** Focuses on core development and analytics. The assessment is based on Experimental Results (15 Marks), Performance Analysis (10 Marks), Publication Progress (5 Marks), and Technical Discussion (10 Marks).
  - **Review-III / Pre-submission (40 Marks):** Checks the final readiness of the student. The evaluation evaluates overall Completion Status (10 Marks), Research Contribution (10 Marks), Publication/Patent Status (10 Marks), and the Pre-submission Seminar performance (10 Marks).
- **End-Semester Evaluation (ESE):** The final evaluation is conducted for **80 marks** to assess the definitive outcomes of the year-long research project. The evaluation criteria and weightages are distributed as follows:
  - **Dissertation Thesis:** 25 Marks
  - **Final Presentation:** 20 Marks
  - **Technical Contribution & Innovation:** 15 Marks
  - **Viva Voce:** 15 Marks
  - **Plagiarism Compliance & Documentation:** 5 Marks

The total assessment of the Dissertation Phase-II work is for **200 marks** (120 Marks for Internal Evaluation and 80 Marks for End-Semester Evaluation), and the grading, like other courses, will be relative in nature.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	3	2
CO2	1	2	2	1	3
CO3	2	2	1	2	3
CO4	2	1	1	2	3
CO5	2	3	3	2	1
CO6	-	1	3	-	1

Curriculum Evaluation Framework & Assessment Rubrics

Program: Master of Technology (M.Tech.)

Department: Computer Science & Engineering

Academic Regulation: Outcome-Based Education (OBE) Framework

Compliance Standards: AICTE, NEP-2020, NBA, and NAAC Guidelines

1. Course-Specific Assessment Rubrics

1.1 Rubrics for Course Code: 26203RS302 — Research Seminar

The Research Seminar is structured to evaluate a student's capacity to survey contemporary literature, identify research gaps, and communicate technical concepts effectively.

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Literature Survey	Comprehensive review of recent high-impact papers (IEEE, ACM, Scopus/WoS).	Good coverage of relevant literature with clear categorization.	Limited coverage; relies mostly on textbooks or older references.	Inadequate review; critical foundational papers are missing.
Research Gap Identification	Clearly identified and articulated a novel, well-substantiated research gap.	Gap clearly identified and framed within the context of current trends.	Partial identification; gap is vague or lacks convincing evidence.	No clear research gap identified or addressed.

Technical Knowledge	Demonstrates deep, authoritative understanding of domain concepts and tools.	Demonstrates good, structurally sound understanding of the core subject matter.	Demonstrates basic understanding; struggles with advanced technical details.	Weak or incorrect technical understanding of the chosen domain.
Presentation Skills	Highly professional delivery, excellent time management, and seamless narrative.	Effective, clear articulation with well-designed visual slides.	Average presentation quality; over-reliant on reading text from slides.	Poor communication, unstructured slides, and bad time management.
Response to Questions	Accurate, confident, and highly insightful responses to panel queries.	Mostly correct, logical, and structured answers to technical questions.	Partially correct answers; unable to fully justify technical choices.	Unable to answer core questions or handles feedback defensively.
Report Quality	Publication-quality formatting, rigorous technical language, and perfect citations.	Well-organized, structurally sound report with minor formatting errors.	Acceptable layout but contains grammatical gaps or weak synthesis.	Poorly structured, unformatted, and lacks proper technical depth.

1.2 Rubrics for Course Code: 26203DP303 — Dissertation Phase-I

Dissertation Phase-I evaluates the foundational formulation of the year-long project, checking the validity of the problem definition and preliminary high-level design.

Weightage Distribution

- **Problem Formulation:** 15%
- **Literature Survey Quality:** 20%
- **Research Gap Identification:** 15%
- **Methodology & Design:** 20%
- **Innovation & Novelty:** 10%
- **Prototype Development:** 10%
- **Report Writing & Presentation:** 10%

Detailed Assessment Scale

Level	Score Range	Description
Excellent	90–100%	Exceptionally formulated problem statement, extensive up-to-date literature review, robust architectural design, and functional initial prototype.
Very Good	80–89%	Clear and logical objectives, strong literature backing, well-defined methodology, and steady modular prototype progress
Good	70–79%	Standard engineering problem statement, adequate literature survey, feasible design, and basic initial setup.
Satisfactory	60–69%	Problem definition lacks rigorous focus, basic system design is present but lacks deep feasibility analysis
Unsatisfactory	Below 60%	Poorly defined problem, shallow literature base, unfeasible methodology, or zero prototype development.

1.3 Rubrics for Course Code: 26203DP401 — Dissertation Phase-II

Dissertation Phase-II marks the completion of the master's research, focusing on implementation, experimental validation, and scholarly output.

Weightage Distribution

- **Novelty and Innovation:** 15%
- **Technical Depth:** 15%
- **Methodology Implementation:** 15%
- **Experimental Validation:** 15%
- **Results Analysis:** 10%
- **Publication / Patent Outcome:** 10%
- **Thesis Quality:** 10%
- **Presentation & Viva:** 10%

2. Institutional Research Standardizations

2.1 Publication & Patent Rubric (Recommended for M.Tech.)

To foster high-quality research and protect intellectual property, students are evaluated on their scholarly outcomes according to the following matrix:

Research Achievement	Allocated Marks
Patent Filed	10
Scopus / Web of Science (WoS) Journal Paper Published / Accepted	10
IEEE / Springer / Tier-1 International Conference Paper Published / Accepted	8
Peer-reviewed Journal Manuscript Under Review / Submitted	5
Draft Manuscript Completed & Evaluated Ready for Submission	3

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2.2 Academic Integrity & Plagiarism Rubric

(Mandatory across Research Seminar, Dissertation Phase-I, and Dissertation Phase-II)

Every submission must be accompanied by an official plagiarism report generated through departmentally approved software (e.g., Turnitin/Ouriginal) and signed by the Research Guide.

Similarity Index	Status	Action Required
≤ 10%	Excellent	Approved for final evaluation.
>10% to 15%	Acceptable	Approved, minor citation fixes recommended
>15% to 20%	Revision Required	Sent back for re-writing and mandatory re-evaluation.
>20%	Not Eligible	Rejected. Flagged for academic dishonesty; ineligible for evaluation.

Mandatory Requirement: Every Seminar Report, Dissertation Phase-I Report, and Dissertation Thesis must be accompanied by a plagiarism report generated using approved plagiarism detection software and certified by the Research Guide.

3. Curriculum Organization & Research Domains

3.1 Modular Course Architecture

To align with research-oriented curriculum formats, these courses are organized as continuous, progressive milestones rather than standard academic units. Research Ethics, Plagiarism Controls, Technical Documentation, and Emerging Technologies are integrated directly into every stage of evaluation.

3.2 Approved Research Domains (Indicative)

Students are encouraged to select dissertation topics anchored in the following advanced, high-impact computing domains:

- **Advanced AI:** Generative AI, Large Language Models (LLMs), Agentic AI Systems, Explainable AI (XAI).
- **Data Science & Learning Systems:** Deep Learning, Federated Learning, Computer Vision, Natural Language Processing.

- **Infrastructure & Security:** Cloud & Edge Computing, Cyber Security, Digital Forensics, Blockchain & Web3 Technologies.
- **Smart Ecosystems:** Internet of Things (IoT), Industrial IoT, Digital Twin Technology, Smart Cities, Intelligent Transportation.
- **Next-Gen Computing:** Quantum Computing, High-Performance Computing (HPC), AR/VR & Metaverse Environments, Sustainable/Green Computing.