B. Tech. (Computer Engineering / Computer Science and Engineering / Computer Technology and Allied) Syllabus In Aligned with the National Education Policy 2020 Effective from AY 2025 - 2026 (All Years)

(Affiliated Colleges)

Note: Refer this Syllabus for Second Year in Computer Engineering / Computer Science and Engineering / Computer Technology / Computer Science and Engineering (Cyber Security) with branch codes 11242, 11245, 11251, 11260.

Department of Computer Engineering

Dr. Babasaheb Ambedkar Technological University, Lonere - 402103

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B.Tech in Computer Engineering and Allied Programs
Course Curriculum Aligned with National Education Policy 2020
(Effective from Academic Year 2026 - 2027)
Fifth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	26AF1245PC501	Machine Learning	3	-	20	20	60	3
PCC2	26AF1245PC502	Theory of Computations	3	-	20	20	60	3
PCC3	26AF1245PC503	Operating Systems	3	-	20	20	60	3
PCC4	26AF1245PC504	Database Management Systems	3	-	20	20	60	3
PEC	26AF1XXXOEM05X	**Open Elective Bucket**	2	-	20	20	60	2
MDM	26AF1245MD506	**MDM Bucket***	-	-	20	20	60	-
OE-3	26AF1245PE507	**Program Elective** A. Computer Graphics B. Introduction to Quantum Technologies	3	-	20	20	60	3
PCC Lab	26AF1245PCL508	Machine Learning Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL509	Operating System Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL510	Database Management System Laboratory	-	2	60	-	40	1
AEC	26AF1245AE511	Seminar	-	2	60	-	40	1
		Total	**17**	**8**	**380**	**140**	**580**	**21**

*****A student must select a course or courses from the minor degree program s/he wishes to pursue.*
A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

B.Tech in Computer Engineering and Allied Programs
Course Curriculum Aligned with National Education Policy 2020
(Effective from Academic Year 2026 - 2027)
Sixth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC	26AF1245PC601	Compiler Design	3	-	20	20	60	3
PCC	26AF1245PC602	Data Communication & Computer Networks	3	-	20	20	60	3
PCC	26AF1245PC603	Software Engineering (DevOps)	3	-	20	20	60	3
PEC	26AF1245PE604	**Program Elective:** A. Internet of Things B. Big Data Analytics C. Optimization Techniques	3	-	20	20	60	3
PEC	26AF1245PE605	**Program Elective:** A. Human Computer Interaction B. Deep Learning C. Information Security and Privacy	3	-	20	20	60	3
MDM	26AF1245MD606	**MDM Bucket**	-	-	20	20	60	-
PCC Lab	26AF1245PCL607	Computer Network Laboratory	-	2	60	-	40	1
PCC Lab	26AF1245PCL608	Full Stack Development	1	2	60	-	40	2
PCC Lab	26AF1245PCL609	Prompt Engineering	1	2	60	-	40	2
AEC	26AF1245AE610	Mini Project	-	2	60	-	40	1
		Total	**17**	**6**	**300**	**120**	**480**	**21**

**A student must select a course or courses from the minor degree program s/he wishes to pursue.*
A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

List of Open Electives (OE)

In the vertical of Multidisciplinary courses, students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V are included in the basic minimum of 160-max.176 Credits. It is offered in the Second and/or Third year. Refer to the wise credit distribution table given below. Faculty-wise baskets of OE are prepared by the university. They are chosen from faculty other than that of the Major Faculty, i.e., in this case, the Major Faculty is the Faculty of Engineering. Other Faculties considered are as follows:

1. Faculty of Management and Commerce
2. Faculty of Law
3. Faculty of Humanities and Arts
4. Faculty of Architecture and Planning
5. Faculty of Health Sciences
6. Faculty of Science

Students must take up three courses of 08 credits over semesters III to V.

List of Open Electives for Faculty of Management and Commerce

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource Person	Link
1	Advanced Algorithmic Trading and Portfolio Management	4 Hrs / Week	8	2	IIT, Kanpur	Prof. Abhinava Tripathi	https://nptel.ac.in/courses/110104169
2	Business Analytics & Text Mining Modeling using Python	4 Hrs / Week	8	2	IIT, Roorkee	Prof. Gaurav Dixit	https://nptel.ac.in/courses/110107129
3	Commodity Derivative & Risk Management	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Prabina Rajib	https://nptel.ac.in/courses/110105168
4	E-Business	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Mamata Jenamani	https://nptel.ac.in/courses/110105083
5	Econometric Modelling	4 Hrs / Week	8	2	IIT, Roorkee	Prof. Sujata Kar	https://nptel.ac.in/courses/110107153
6	Introduction to Marketing Essentials	4 Hrs / Week	12	3	IIT, Roorkee	Prof. Zillur Rahman	https://nptel.ac.in/courses/110107147
7	Security Analysis & Portfolio Management	4 Hrs / Week	12	3	IIT, Roorkee	Prof. J. P. Singh	https://nptel.ac.in/courses/110107154
8	Equity Stock Market		6	3	Indian Institute of Management, Bangalore (IIB)	P. C. Narayan	https://onlinecourses.swayam2.ac.in/imb23_mg59/preview

List of Open Electives for Faculty of Law

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource Person	Link
1	Introduction to Law on Electricity	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Uday Shankar	https://nptel.ac.in/courses/129105004
2	New Labour Codes of India	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. K. D. Raju	https://nptel.ac.in/courses/129105006
3	Right to Information and Good Governance	4 Hrs / Week	12	3	National Law School of India University	Prof. Sairam Bhat	https://nptel.ac.in/courses/129106001
4	Conflict Management through Mediation	4 Hrs / Week	8	2	Vice-Chancellor, National University of Study and Research in Law, Ranchi (NUSRL)	Prof. (Dr.) Ashok R. Patil	https://nptel.ac.in/courses/129106008
5	Biodiversity Protection, Farmers and Breeders Rights	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Padmavati Manchikanti Prof. Narendran Thiruthy	https://nptel.ac.in/courses/129105008

List of Open Electives for Faculty of Humanities and Arts

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource person	Link
1	Developing Soft Skills and Personality	4 Hrs / Week	8	2	IIT, Kanpur	Prof. T. Ravichandran	https://nptel.ac.in/courses/109104107
2	Folk and Minor Art in India	4 Hrs / Week	8	2	IIT, Kanpur	Prof. Shatarupa Thakurta Roy	https://nptel.ac.in/courses/109104106
3	Sustainable Happiness	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105493
4	Soft Skill Development	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar	https://nptel.ac.in/courses/109105110
5	Introduction to Market Structures	4 Hrs / Week	12	3	IIT, Guwahati	Prof. Amarjyoti Mahanta	https://nptel.ac.in/courses/109103187
6	Human Resource Development	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. KBL Srivastava	https://nptel.ac.in/courses/109105121
7	Educational Leadership	4 Hrs / Week	12	3	IIT, Kharagpur	Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105122

List of Open Electives for Faculty of Architecture and Planning

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource person	Link
1	Architectural Approaches to Decarbonization of Buildings	4 Hrs / Week	12	3	School of Planning and Architecture, Vijayawada, An Institute of National Importance under the Ministry of Education Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106454
2	Building Materials and Composites	4 Hrs / Week	8	2	IIT, Kharagpur	Prof. Sumana Gupta	https://nptel.ac.in/courses/124105013
3	Building Materials as a Cornerstone to Sustainability	4 Hrs / Week	12	3	School of Planning and Architecture, Vijayawada, An Institute of National Importance under the Ministry of Education Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106455
4	Modern Indian Architecture	4 Hrs / Week	8	2	IIT, Roorkee	Prof. P. S. Chani	https://nptel.ac.in/courses/124107161

List of Open Electives for Faculty of Science

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor / Resource Person	Link
1	Quantum Computing	4 Hrs / Week	12	3	IIT, Kanpur	Prof. Debabrata Goswami	https://onlinecourses.nptel.ac.in/noc19_cy31/preview#:~:text=Building%20up%20on%20the%20digital,the%20laws%20of%20quantum%20mechanics.
2	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	4 Hrs / Week	4	1	IIT Madras, IBM Research, IBM Systems	Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan	https://onlinecourses.nptel.ac.in/noc24_cs67/preview
3	Quantum Information and Computing	4 Hrs / Week	8	2	IIT, Bombay	Prof. Dipan Ghosh Department of Physics	https://archive.nptel.ac.in/courses/115/101/115101092/
4	Dynamics of Classical and Quantum Fields	4 Hrs / Week	12	3	IIT, Guwahati	Prof. Girish S. Setlur	https://onlinecourses.nptel.ac.in/noc22_ph29/preview

Semester - V

Teaching Scheme		Semester V Machine Learning	Examination Scheme	
TH	3	**Course Objectives:** 1. Understand core concepts and types of machine learning. 2. Apply supervised learning algorithms and handle overfitting. 3. Implement neural networks and basic deep learning models. 4. Explore probabilistic models and learning theory. 5. Use clustering and recommendation techniques for data analysis.	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation.	06 Hrs
2	Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.	06 Hrs
3	Perceptron, multilayer network, back propagation, introduction to deep neural network.	06 Hrs
4	Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.	06 Hrs
5	Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model.	06 Hrs

Text / Reference Books:

1. Tom Mitchell, Machine Learning, First Edition, McGraw Hill, 1997.
2. Ethem Alpaydin, Introduction to Machine Learning, Prentice Hall India Learning Private Limited; 2nd edition, 2010.

Teaching Scheme		Semester V Theory of Computations	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Learn the fundamentals of finite automata and their applications.	MSE	20
CR	3	2. Understand regular expressions and grammars with their relation to automata.	ESE	60
		3. Analyze context-free grammars and their simplification techniques.		
		4. Study pushdown automata and context-free language recognition.		
		5. Explore Turing machines, undecidability, and the Chomsky hierarchy.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Finite Automata (FA):** Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.	08 Hrs
2	**Regular Expressions (RE):** Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA‟s to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. **Regular Grammars:** Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.	06 Hrs
3	**Context Free Grammar (CFG):** Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG‟s, Minimization of CFG‟s, CNF, GNF, Pumping Lemma for CFL‟s, Enumeration of Properties of CFL (Proof‟s omitted).	06 Hrs
4	**Pushdown Automata:** Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. **Turing Machines (TM):** Formal definition and behaviour, Languages of a TM, TM as accepters and TM as a computer of integer functions, Types of TMs	08 Hrs
5	**Recursive And Recursively Enumerable Languages (REL):** Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.	06 Hrs

Text / Reference Books:

1. Hopcroft, Ullman, Motwani, Introduction to Automata Theory, Languages, and Computation, Addison Wesley Publication, 2nd Edition, 2001.
2. Daniel I. A. Cohen, Introduction to Computer Theory, Wiley Publication, 1st Edition, 1986.
3. John C. Martin, Introduction to Languages and Theory of Computation, McGraw-Hill Publication, 4th Edition, 2010.
4. Krithivasan Kamala, Introduction to Formal Languages, Automata Theory and Computation, Pearson Education, 1st Edition, 2009.
5. Papadimitriou, Lewis, Elements of the Theory of Computations, PHI Publication, 2nd Edition, 1997.
6. E. V. Krishnamurthy, Introductory Theory of Computer Science, Springer-Velang New York Inc., 1st Edition, 1985.

Teaching Scheme		Semester V Operating Systems	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the structure, types, and components of operating systems, including system calls and virtual machines.	MSE	20
CR	3	2. Learn process management, CPU scheduling algorithms, and multithreading models.	ESE	60
		3. Analyze process synchronization, classical problems, and deadlock handling techniques.		
		4. Explore memory and virtual memory management, including paging and page replacement algorithms.		
		5. Study file systems, disk management, and mass-storage structures for efficient data handling.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction and Operating system structures:** Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.	06 Hrs
2	**Processes and CPU Scheduling:** Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.	06 Hrs
3	**Process Synchronization:** The critical-section problem, Critical regions, Peterson,,s Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.	08 Hrs
4	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging; Segmentation. **Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	08 Hrs
5	**File Management:** File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table),	06 Hrs

efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text / Reference Books:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.
2. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
3. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
4. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
5. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
6. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Teaching Scheme		Semester V Database Management Systems	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management. **Database Architecture Data modeling using the Entity Relationship Model:** ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, Reduction of an ER diagrams to tables.	08 Hrs
2	**Relational Data Model:** Structure of Relational Databases, Database Schema, Keys. **Relational algebra:** Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations.	06 Hrs
3	**Calculus:** Tuple relational calculus, Domain relational Calculus, calculus vs. algebra, computational capabilities. **SQL:** Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database.	08 Hrs
4	**Intermediate SQL:** Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization. **Advanced SQL:** Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,.	06 Hrs
5	**Normalization:** Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.	06 Hrs

Text / Reference Books:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Publication, 3rd Edition, 2003.
3. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
4. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.

5. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
6. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2nd Edition, 2011.
7. Serge Abiteboul, Richard Hull, Victor Vianu, Foundations of Databases, Reprint by Addison-Wesley.

Teaching Scheme		Semester V Computer Graphics	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Basic Concepts:** Introduction to computer graphics, lines, line segments, pixels and frame buffers, anti-aliasing techniques and character generation methods. Graphics Display devices (monochrome, color) interactive devices, Scanners and digitizers, touch panels, tablets, mouse, joysticks, trackball, light pen.	04 Hrs
2	**2D Transformation:** Line and circle plotting using Breshemham's and other algorithms, transformation matrices, scaling, rotation, translation, picture transformation, mirror image.	06 Hrs
3	**Window and Clipping:** Introduction, viewing transforms, 2-D clipping, Sutherland Cohen approach, Cyrus Beck Method, Midpoint subdivision algorithm, Liang-Barsky line clipping algorithm, polygon clipping, text clipping, generalized clipping.	06 Hrs
4	**3D Graphics:** Introduction, 3-D geometry, Coordination system, 3D transformation, rotation about an arbitrary axis, orthogonal projections, multiple views, isometric projection, perspective projections, 3-D clipping. **Hidden Surfaces and Lines:** Introduction, Back face removal algorithm, Z-buffers, Scan line and Painter's algorithm hidden surface removal, curved surface generation, generation of solids, sweep method, interpolation.	08 Hrs
5	**Graphical User Interface:** X-Windows, use of graphics tools like OPENGL, DirectX, Windows and Motif, Graphic Standards. **Animation:** Introduction, devices for producing animation, computer assisted animation, real time animation, method for controlling animation (fully explicit control, procedural). **Text / Reference Books:** 1. Peter Shirley, Michael Ashikhmin, Steve Marschner, Fundamental of Computer Graphics, 4th Edition, CRC Press. 2. Newman, Sprouall, Interactive Computer Graphics, McGraw-Hill Publication. 3. Hearn, Baker, Computer Graphics, PHI Publication. 4. Krishnamurthy, Introduction to Computer Graphics, McGraw-Hill Publication. 5. ISRD Group, Computer Graphics, McGraw-Hill Publication.	06 Hrs

Teaching Scheme		Semester V Introduction to Quantum Technologies	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Foundations of Quantum Technologies:** Introduction, Evolution from Classical to Quantum Technologies, Classical Physics versus Quantum Physics, Fundamental Concepts of Quantum Mechanics, Wave–Particle Duality, Quantum States, Superposition Concept, Quantum Measurement, Quantum Coherence and Decoherence, Overview of the First and Second Quantum Revolution, Applications of Quantum Technologies.	05 Hrs
2	**Quantum Materials and Quantum Hardware:** Introduction, Semiconductor Materials for Quantum Devices, Superconducting Materials, Quantum Dots, Color Centers in Diamond, Trapped Ion Systems, Neutral Atom Platforms, Photonic Systems, Cryogenic Systems for Quantum Devices, Fabrication of Quantum Hardware, Challenges in Building Quantum Systems.	05 Hrs
3	**Quantum Communication and Quantum Networks:** Introduction, Classical versus Quantum Communication, Quantum Entanglement Concepts, Quantum Key Distribution (QKD), Quantum Random Number Generation, Quantum Repeaters, Quantum Internet Fundamentals, Quantum Communication Protocols, Secure Communication Applications, Challenges in Quantum Networking.	05 Hrs
4	**Quantum Sensing:** Introduction, Principles of Quantum Sensing, Atomic Clocks, Magnetometers, Gravimeters, Quantum Imaging, Quantum Metrology, Applications in Healthcare, Navigation, Aerospace, Defence, Environmental Monitoring, Industrial Measurement Systems, Emerging Trends in Quantum Sensing.	05 Hrs
5	**Quantum Technology Ecosystem:** Global Quantum Technology Landscape, National Quantum Mission of India, Quantum Research Infrastructure, Quantum Standards and Ethics, Commercial Quantum Technologies, Quantum Startups and Industrial Adoption, Workforce Development in Quantum Technologies, Challenges in Quantum Technology Deployment, Future Trends in Quantum Engineering, Case Studies of Real-World Quantum Applications.	05 Hrs

Text / Reference Books:

1. Bernhardt, C. (2019). Quantum computing for everyone. MIT Press.
2. Auffèves, A. (2022). Quantum technologies: Concepts and applications. ISTE Press–Elsevier.
3. Fox, M. (2006). Quantum optics: An introduction. Oxford University Press.

4. Griffiths, D. J., & Schroeter, D. F. (2018). Introduction to quantum mechanics (3rd ed.). Cambridge University Press.
5. Pirandola, S., & Braunstein, S. L. (Eds.). (2020). Quantum communications and cryptography. CRC Press.
6. National Quantum Mission Secretariat. (2024). National Quantum Mission: Vision and implementation framework. Government of India.

Teaching Scheme		Semester V Machine Learning Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments: (Perform any TEN Experiments)

1. Implement a toy classification problem using decision boundaries (manual coding). Apply train/test split and k-fold cross-validation to a dataset (e.g., Iris). Compare accuracy, precision, recall, F1-score.
2. Implement simple and multiple linear regression using NumPy and using scikit-learn. Plot regression lines and residuals. Compute RMSE and R^2 values.
3. Train a decision tree classifier and visualize the tree. Analyze performance with/without pruning and depth control. Demonstrate overfitting using synthetic data.
4. Implement and visualize k-Nearest Neighbors classification. Tune k and compare accuracy. Demonstrate curse of dimensionality.
5. Apply PCA and t-SNE for dimensionality reduction. Visualize high-dimensional data in 2D. Measure accuracy before and after feature reduction.
6. Implement a simple user-based and item-based collaborative filter. Use cosine similarity or Pearson correlation. Recommend top-N items for a user.
7. Implement Gaussian Naive Bayes manually and using scikit-learn. Classify spam/ham email or sentiment analysis.
8. Train logistic regression for binary classification. Visualize the sigmoid function and decision boundary. Analyze ROC curve and AUC.
9. Train a linear and kernel (RBF, polynomial) SVM. Visualize margins and support vectors. Tune C and gamma hyperparameters.
10. Implement a single-layer perceptron from scratch. Train a multilayer perceptron using scikit-learn / Keras. Compare performance with different activation functions.
11. Visualize layers, activations, and loss using Keras. Build a 2–3 layer DNN for digit classification.
12. Simulate sample complexity: How performance improves with increasing training size. Discuss PAC model using toy examples. Conceptual lab: VC Dimension estimation for linear classifiers.
13. Compare Bagging (Random Forest) vs Boosting (AdaBoost/XGBoost). Visualize feature importance.
14. Apply K-Means and visualize clusters. Use silhouette score and elbow method to tune K.
15. Fit a Gaussian Mixture Model (GMM) and visualize decision boundaries. Perform Agglomerative Clustering and plot dendrograms.

Teaching Scheme		Semester V Operating System Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers and systems administration of different operating systems.
15. Writing utilities and OS performance tuning.

Teaching Scheme		Semester V Database Management System Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Assignment on Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Assignment on Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Creating web-page interfaces for database applications using servlet.

Teaching Scheme		Semester V Seminar	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Computer Science Engineering, Artificial Intelligence, Data Science, or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment: The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the Head of concern department of the institution.

Semester - VI

Teaching Scheme		Semester VI Compiler Design	Examination Scheme	
TH	3	**Course Objectives:** 1. Understand the phases of a compiler and tools used in compiler construction. 2. Learn lexical analysis techniques and design of lexical analyzers. 3. Explore syntax analysis methods including top-down, bottom-up, and LR parsing. 4. Apply syntax-directed translation for generating intermediate code and handling expressions. 5. Study code generation techniques, optimization, and runtime storage management.	CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Compiling:** Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler.	06 Hrs
2	**Lexical Analysis:** The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.	06 Hrs
3	**Syntax Analysis:** The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.	06 Hrs
4	**Syntax-Directed Translation:** Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes, Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.	06 Hrs
5	**Code Generation:** Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators. **Text / Reference Books:** 1. Aho, Sethi, Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2013. 2. Hopcroft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publication, 2nd Edition, 2001.	06 Hrs

3. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, Modern Compiler Design, Springer, 2nd Edition, 2012.

Teaching Scheme		Semester VI Data Communication and Computer Networks	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the fundamentals of computer networks, reference models, and performance metrics.	MSE	20
CR	3	2. Learn various LAN and wireless technologies including Ethernet, Wi-Fi, Bluetooth, and Wi-MAX.	ESE	60
		3. Explore data link layer design, error detection/correction, and flow control mechanisms.		
		4. Study network layer protocols, routing algorithms, congestion control, and QoS techniques.		
		5. Gain knowledge of application layer protocols and basic network security principles.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Physical Layer:** Data and Signals: Analog and digital data, Analog and digital signals, Periodic and non-periodic signals, Sine wave, Parameters of sine wave, Time and frequency domain, Composite signals, Bandwidth, Digital signal-bit rate, Baseband and broadband transmission, Transmission impairments, Nyquist bit rate, Shannon capacity, Performance: Throughput, Latency, Bandwidth-delay product, Jitter.	06 Hrs
2	**Error Detection and Correction:** Types of errors, Redundancy, Detection versus correction, Forward error correction and retransmission, Modular arithmetic, Block Coding: error detection, error correction, Hamming distance, Minimum hamming distance, Linear block codes, Cyclic Codes: Cyclic Redundancy check, Hardware implementation, Polynomials, Cyclic code analysis, Checksum: Concept, One's component, Internet checksum.	06 Hrs
3	**LAN Technologies:** X5, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.	06 Hrs
4	**Data Link Layer:** Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes. **Network Layer and Congestion Control:** IPv4/IPv6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets, General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.	08 Hrs
5	**Application Layer Protocols:** DNS, SMTP, POP, FTP, HTTP. Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls	06 Hrs

Text / Reference Books:

1. A. Tanenbaum, Computer Networks, PHI Publication, 5th Edition, 2011.
2. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
3. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman Publication, 5th Edition, 2012.
4. D. Comer, Computer Networks and Internet, Pearson Education, 6th Edition, 2014.
5. M. Gallo, W. Hancock, Computer Communications and Networking Technologies, Brooks/Cole Publisher, 2001.
6. Natalia Olifer, Victor Olifer, Computer Networks: Principles, Technologies and Protocols for Network Design, Wiley Publication, 2005.

Teaching Scheme		Semester VI Software Engineering (DevOps)	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**DevOps and Agile Software Engineering:** Software Engineering Evolution, Limitations of Traditional Software Development, Agile Development Principles, DevOps Philosophy, DevOps Lifecycle, Continuous Integration, Continuous Delivery, Continuous Deployment, Collaboration between Development and Operations Teams, DevOps Culture, DevOps Toolchain, Introduction to Version Control Systems, Git Fundamentals, Branching Strategies, DevOps Best Practices.	05 Hrs
2	**Source Code Management and Continuous Integration:** Git Repository Management, Distributed Version Control, GitHub and GitLab Platforms, Branching and Merging, Pull Requests, Code Reviews, Build Automation, Continuous Integration Concepts, CI Pipeline Design, Automated Build Process, Unit Testing in CI Pipelines, GitHub Actions, Jenkins Fundamentals, Build Failure Analysis.	06 Hrs
3	**Containerization and Infrastructure Automation:** Introduction to Virtualization and Containers, Docker Architecture, Docker Images, Containers and Volumes, Dockerfile, Docker Compose, Container Networking, Infrastructure as Code (IaC), Configuration Management Concepts, Ansible Fundamentals, Terraform Overview, Cloud-Native Applications, Container Security Best Practices.	06 Hrs
4	**Continuous Delivery and Cloud Deployment:** Continuous Delivery Workflow, Continuous Deployment Strategies, Deployment Automation, Blue-Green Deployment, Canary Deployment, Rolling Updates, Kubernetes Fundamentals, Pods, Services, Deployments, Helm Basics, Cloud Deployment Concepts, Application Scaling, High Availability, Release Management.	05 Hrs
5	**Monitoring, DevSecOps and Modern DevOps Practices:** Application Monitoring Concepts, Logging and Log Management, Performance Monitoring, Prometheus Fundamentals, Grafana Dashboards, Incident Management, DevSecOps Concepts, Secure Software Delivery Pipeline, Vulnerability Assessment, Secrets Management, Software Quality Metrics, Site Reliability Engineering (SRE) Overview, Emerging Trends in DevOps, AI-assisted DevOps (AIOps).	06 Hrs

Text / Reference Books:

1. Kim, G., Humble, J., Debois, P., & Willis, J. (2021). The DevOps handbook: How to create world-class agility, reliability, & security in technology organizations (2nd ed.). IT Revolution.
2. Forsgren, N., Humble, J., & Kim, G. (2018). Accelerate: The science of lean software and DevOps. IT Revolution.
3. Humble, J., & Farley, D. (2010). Continuous delivery: Reliable software releases through build, test, and deployment automation. Addison-Wesley Professional.
4. Burns, B., Beda, J., Hightower, K., & Evenson, L. (2022). Kubernetes: Up and running (3rd ed.). O'Reilly Media.
5. Turnbull, J. (2014). The Docker book: Containerization is the new virtualization. James Turnbull.
6. Morris, K. (2020). Infrastructure as code: Dynamic systems for the cloud age (2nd ed.). O'Reilly Media.

Teaching Scheme		Semester VI Internet of Things	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the evolution, architecture, and challenges of IoT and its impact on digitization.	MSE	20
CR	3	2. Learn about smart objects, sensors, actuators, and IoT access technologies.	ESE	60
		3. Explore IP networking, transport layers, and application protocols optimized for IoT.		
		4. Apply data analytics, machine learning, and security principles in IoT environments.		
		5. Gain hands-on experience with IoT devices like Arduino and Raspberry Pi and study smart city applications.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**IoT Introduction:** Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	06 Hrs
2	**Smart Objects:** The ―Things‖ in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.	06 Hrs
3	**IP Layer:** IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	06 Hrs
4	**Data and Analytics for IoT:** An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.	08 Hrs
5	**IoT Physical Devices and Endpoints:** Building iot with Arduino: Arduino–Interfaces-Arduino IDE–Programming, RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.	06 Hrs

Text / Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things‖, 1st Edition, Pearson Education.
2. Srinivasa K G, ―Internet of Things‖, CENGAGE Leaning India, 2017.
3. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
4. Raj Kamal, ―Internet of Things: Architecture and Design Principles, 1st Edition, McGraw Hill Education, 2017.

Teaching Scheme		Semester VI Big Data Analytics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	1. Understand the fundamentals, challenges, and applications of Big Data and its enabling technologies.	MSE	20
CR	3	2. Learn Big Data platforms like Apache Spark, HDFS, MapReduce, and distributed consistency models.	ESE	60
		3. Explore real-time data processing using streaming platforms such as Spark Streaming and Kafka.		
		4. Apply Big Data machine learning techniques with tools like Mahout and Spark MLlib.		
		5. Gain hands-on knowledge of modern NoSQL databases with MongoDB and query design.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Big Data:** Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.	06 Hrs
2	**Big Data Platforms:** Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.	06 Hrs
3	**Big Data Streaming Platforms:** Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.	06 Hrs
4	**Big Data Applications:** Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, Spark MLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.	06 Hrs
5	**Database for the Modern Web:** Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript,, sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.	06 Hrs

Text / Reference Books:

1. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications‖, Wiley and SAS Business Series.
2. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, Big Data Principals and Paradiagram, Elsevier.
3. Kyle Banker, Peter Bakkum and Shaun Verch, ―MongoDB in Action, 2nd Edition Dream tech Press, ISBN: 978-9351199359.

4. Anand Rajaraman, Jeffrey D. Ullman, Mining of Massive Datasets, 3rd edition,Cambridge University Press.
5. Sima Acharya, Subhashini Chhellappan, BIG Data and Analytics, Willey publication, ISBN: 978-8126554782.

Teaching Scheme		Semester VI Optimization Techniques	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Preliminaries:** Proofs, Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry, Elements of Calculus.	06 Hrs
2	**Unconstrained Optimization:** Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b	06 Hrs
3	**Linear Programming:** Introduction to Linear Programming, Simplex Method, Duality	06 Hrs
4	**Nonlinear Constrained Optimization:** Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems,	06 Hrs
5	**Algorithms for Constrained Optimization:** Projections, Project gradient methods, Penalty methods.	06 Hrs

Text / Reference Books:

1. An Introduction to Optimization, Edwin K.P. Chong, Stanislaw H. Zak, Wiley, 2017.
2. Convex Optimization, Stephen Boyd, LievenVandenberghe, 2004.
3. Modern Optimization with R (Use R), Paulo Cortez, Springer, 2014.

Teaching Scheme		Semester VI Human Computer Interaction	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.	06 Hrs
2	**Design Processes:** Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Soft- ware Process, Design Rules.	06 Hrs
3	**Implementation and Evaluation:** Implementation Support, Evaluation Techniques, Universal Design, Use Sup- port.	06 Hrs
4	**Models:** Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models. Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.	06 Hrs
5	**Modern Systems:** Group ware, Ubiquitous Computing and Augmented Realities, Hypertext, Multimedia and World Wide Web.	06 Hrs

Text / Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale; Human Computer Interaction‖, Pearson Education, 3rd Edition, 2003.
2. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
3. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
4. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.
5. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O‘Reilly Media, 2nd Edition, 2010.

Teaching Scheme		Semester VI Deep Learning	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Traditional Machine Learning Basics: Linear Regression, Logistic, Regression, k Nearest Neighbors, Classifier with Probability Theory, Decision Trees, Random Forest, Support Vector Machine, Artificial Neural Network: Artificial Neuron, Perceptron, Stochastic Gradien Descent, and Back Propagation Neural Network, Neural Network Architecture, NN with One Hidden Layer, NN with One Hidden Layer and Multiple Outputs, Neura Network Hyper-parameters	06 Hrs
2	Deep Architecture: need, applications, Hyper-parameters in Deep Neural Networks (Encoding, Layers, Loss function, Learning Rate, Momentum and Optimization Regularization and dropout, Batch Norms) , vanishing gradient problem, and way to mitigate it. Convolution Neural Network: from Dense Layers to Convolutions, pooling layers CNN Architectures (AlexNet, VGG, NiN, GoogLeNet, ResNet, DensNet), Application in Image segmentation, Automated Object Detection models.	06 Hrs
3	Deep Sequence Models: Sequence Modeling Problems, Motivation and Applications, Traditional Models: Recurrent Neural Networks, Back-propagation through time; Modern Recurrent Neural Networks: Gated Recurrent Units, Lon Short Term Memory (LSTM), Deep Recurrent Neural Networks, automatic imag captioning, video to text with LSTM models.	06 Hrs
4	Deep Unsupervised Learning: Latent variable models, Autoencoders, Deep Generative Modeling: Variational Autoencoders, Generative Adversarial Networks (GANs), Recent Advance, Image generation with Generative adversarial networks, Advance Topic in Deep Learning: Transfer Learning: Need and motivation, Transfer Learning Process, Data Augmentation, Applications	06 Hrs
5	Responsible AI, MLOps and Industrial Applications: Explainable AI (XAI), Fairness and Bias in AI Systems, Responsible and Ethical AI, Model Evaluation Metrics, Model Deployment Strategies, MLOps Fundamentals, Cloud-Based AI Deployment, Monitoring and Maintenance of AI Systems, AI Agents and Tool Usage, Case Studies in Healthcare, Finance, Manufacturing, Smart Cities, and Autonomous Systems.	06 Hrs

Text / Reference Books:

1. Deep Learning, Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

2. Machine Learning: An Algorithmic Perspective, Second Edition, Stephen Marsland, Chapman and Hall/CRC.
3. Dive into Deep Learning, Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2023). *Dive into deep learning*. Cambridge University Press.
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow Géron, A. (2022). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.). O'Reilly Media.
5. Pattern Recognition and Machine Learning, Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
6. Machine Learning, Mitchell, T. M. (1997). *Machine learning*. McGraw-Hill.
7. Neural Networks and Deep Learning, Aggarwal, C. C. (2018). *Neural networks and deep learning: A textbook*. Springer.
8. Deep Learning with Python, Chollet, F. (2021). *Deep learning with Python* (2nd ed.). Manning Publications.

Teaching Scheme		Semester VI Information Security and Privacy	Examination Scheme	
TH	3		CA	20
PR	-		MSE	20
CR	3		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	Information Security Introduction -- Defining and Understanding security through security models, Confidentiality, Integrity and Availability, formal description of security, Attacks and Defences, Threats, Vulnerabilities and Risk, Assurance, Prevention, Detection, Security Controls, Identification and Authentication. Authorization and Access Control, Access Control Models & Mechanisms and Multilevel Security, Auditing and Accountability.	06 Hrs
2	Computational Number Theory & Cryptography - Fermat's theorem, Euler's theorem, Euclid's algorithm, manually and computationally encrypt/decrypt, sign/verify signatures for small messages using RSA, Deffie-Hellman and DSA algorithms. Applied cryptography viz. Symmetric key Cryptography, asymmetric Cryptography and Digital Signatures, message authentication codes, hash functions and modes of cryptographic operations, Physical Security.	06 Hrs
3	Network Security – Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks, intrusion detection. Different Network Security Protocols.	06 Hrs
4	Operating System Security & Trusted OS-- Memory, time, file, object protection requirements and techniques, Protection in contemporary operating systems, ACLs, DAC, MAC, RBAC, Identification and authentication, Identification goals, Authentication requirements, Human authentication, Machine authentication, OS Forensics. Assurance & Trust, Design principles, Evaluation criteria, Evaluation process.	06 Hrs
5	Application & Program Security– Flaws, Malicious code: viruses, Trojan horses, worms, Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation o Defenses, Software development controls, Testing techniques, Secure Coding, Distributed Systems Security.	06 Hrs

Text/Reference Books:

1. The Basics of Information Security by Jason Andress, Syngress Publication.
2. Security in Computing (3rd Edition) 3rd Edition by Charles P. Pfleeger (Author), Shari Lawrence Pfleeger (Author), PHI.
3. B. Tjaden Fundamentals of Secure Computer Systems Franklin Beedle & Associates 2003.

4. D. Russell & G.T. Gangemi, Sr, Computer Security Basics.
5. W. Stallings, Network Security Essentials. Prentice Hall, 2003.

Teaching Scheme		Semester VI Computer Network Laboratory	Examination Scheme	
TH	-		CA	60
PR	2		MSE	-
CR	1		ESE	40

List of Experiments:

1. Study of Analog and Digital Signals: Generate and analyze analog and digital signals.
2. Verification of Nyquist Bit Rate and Shannon Capacity.
3. Implementation of Hamming Code
4. Implementation of Cyclic Redundancy Check (CRC)
5. Implementation of Internet Checksum: Compute and verify Internet checksum using one's complement arithmetic. Analyze its role in error detection during data transmission.
6. Study of Framing and Flow Control Techniques: Implement byte stuffing and bit stuffing methods along with Stop-and-Wait ARQ. Analyze the efficiency of framing and flow control mechanisms.
7. Study of Ethernet and CSMA/CD: Capture and analyze Ethernet frames using a packet analyzer. Observe medium access control and collision handling in Ethernet networks.
8. Performance Analysis of Network Topologie
9. Wireless LAN Performance Analysis: Study how throughput and signal quality vary with distance between wireless nodes and the access point in an IEEE 802.11 network.
10. IPv4 and IPv6 Address Configuration
11. Simulation of IP Forwarding Across Routers: Configure routers and analyze packet forwarding between different networks. Observe routing table entries and packet paths.
12. Study of RIP and OSPF Routing Protocols: Configure RIP and OSPF and compare routing table formation, route convergence, and path selection mechanisms.
13. Implementation of Link State Routing Algorithm
14. Study of TCP Connection Establishment: Capture packets to observe TCP three-way handshake and connection termination. Analyze sequence numbers and acknowledgments.
15. TCP/UDP Socket Programming
16. File Transfer Using TCP/IP Sockets
17. Analysis of DNS and HTTP Protocols: Capture and analyze DNS queries and HTTP request-response messages using a network protocol analyzer.
18. Study of FTP, SMTP and POP Protocols
19. Implementation of Public Key Cryptography and Digital Signature
20. Firewall Configuration and Packet Filtering: Configure firewall rules to allow or block network traffic and analyze their impact on network security and accessibility.

Teaching Scheme		Semester VI Full Stack Development	Examination Scheme	
TH	1		CA	60
PR	2		MSE	-
CR	2		ESE	40

COURSE CONTENT

Unit No.	Topic	Hours
1	**Bootstrap:** Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS.	02 Hrs
2	**Javascripts:** Introduction to JavaScript, JavaScript Language Basics, JavaScript Events, JavaScript Strings, JavaScript Type Conversion, JavaScript RegExp, JavaScript Error, JavaScript Hoisting.	02 Hrs
3	**jQuery:** jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX & Misc.	02 Hrs
4	**PHP & Mysql:** Embedding PHP in HTML, Adding Dynamic Content, Accessing Form Variables, Storing and retrieving data, Using Arrays perform different operations, String Manipulation and Regular Expressions.	02 Hrs
5	**MVC with Laravel:** Laravel Installation, Working with Forms, Working with Controller, Laravel Blade Template with Bootstrap, Responses with Html, Laravel Migration, Laravel Requests, Models; Laravel Eloquent ORM, Build a Complete App in Laravel.	02 Hrs

Text / Reference Books:

1. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon.
2. Full-Stack JavaScript Development by Eric Bush.
3. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas.
4. Laravel: Up and Running by Matt Stauffer.
5. Title: Head First jQuery by Ryan Benedetti, Ronan Cranley, September 2011, O'Reilly Media, Inc.

List of Practicals:

1. Design a Responsive Web Page using Bootstrap: Create a responsive webpage using Bootstrap containers, typography, tables, buttons, forms, and navigation components.
2. Develop a Multi-Column Layout using Bootstrap Grid System: Design a responsive web page using Bootstrap grid classes and demonstrate layout adaptation across different screen sizes.

3. Customize Web Pages using Bootstrap Themes and Components: Implement cards, alerts, modals, accordions, carousels, and Bootstrap themes to enhance user interface design.
4. JavaScript Basics and Type Conversion: Develop scripts demonstrating variables, operators, control statements, functions, and explicit/implicit type conversions.
5. JavaScript String Manipulation and Regular Expressions
6. Event-Driven Programming using JavaScript
7. JavaScript Error Handling and Hoisting:
8. DOM Manipulation using JavaScript
9. Implement jQuery Events and Effects
10. HTML and CSS Manipulation using jQuery
11. jQuery Traversing Techniques: Demonstrate parent, child, sibling, ancestor, and descendant traversal methods on a structured HTML document.
12. Asynchronous Data Retrieval using jQuery AJAX: Fetch and display data from a server asynchronously using AJAX methods such as load(), get(), and post().
13. Embedding PHP in HTML: Create dynamic web pages using PHP scripts embedded within HTML and display runtime-generated content.
14. Form Handling using PHP: Develop a form processing application that accepts user input, validates data, and displays the submitted information.
15. PHP Arrays and String Operations: Implement programs demonstrating indexed arrays, associative arrays, multidimensional arrays, string functions, and regular expressions.
16. PHP-MySQL Database Connectivity: Establish a connection between PHP and MySQL, perform CRUD operations, and display database records on a webpage.
17. Student Management System using PHP and MySQL: Develop a web application to add, update, delete, and search student records stored in a MySQL database.
18. Laravel Installation and Project Setup: Install Laravel, create a new project, understand project structure, and configure environment settings.
19. Form Handling and Validation in Laravel
20. Working with Controllers and Routes in Laravel: Create controllers, define routes, and handle requests and responses using MVC architecture.
21. Laravel Blade Templates with Bootstrap: Design reusable layouts using Blade templates and integrate Bootstrap components for responsive interfaces.
22. Database Migration and Eloquent ORM: Create database tables using migrations and perform CRUD operations using Laravel Eloquent models.
23. Laravel CRUD Application
24. Authentication and Session Management in Laravel: Implement user registration, login, logout, and session management features using Laravel authentication mechanisms.
25. Mini Project – Full Stack Laravel Application: Develop a complete web application integrating Bootstrap, JavaScript, jQuery, PHP, MySQL, and Laravel following the MVC design pattern.

Teaching Scheme		Semester VI Prompt Engineering	Examination Scheme	
TH	1		CA	60
PR	2		MSE	-
CR	2		ESE	40

COURSE CONTENT

Unit No.	Topic	Hours
1	Evolution of Natural Language Processing (NLP) to Large Language Models (LLMs). Anatomy of LLMs including tokens, embeddings, and context windows. Importance of prompt engineering and its role in improving model outputs. Applications of prompt engineering in AI and Machine Learning systems. Introduction to popular LLMs such as GPT, Claude, PaLM, Mistral, and related models. Comparison between prompt engineering and fine-tuning approaches.	02 Hrs
2	Concepts of Zero-Shot, One-Shot, and Few-Shot prompting. Instructional prompting techniques for task-specific outputs. Delimiting strategies for structuring prompts. Role-based prompting and persona assignment. Socratic prompting for guided reasoning and learning. Evaluation of prompts based on accuracy, relevance, hallucination, and safety. Prompt debugging and optimization techniques.	02 Hrs
3	Chain-of-Thought prompting for complex reasoning tasks. Self-Ask prompting for problem decomposition and multi-step reasoning. ReAct (Reason + Act) prompting for combining reasoning with action execution. Multimodal prompting using text and image inputs. Design of reusable prompt templates. Introduction to prompt engineering using Python APIs. Development of prompt-driven applications using LangChain and OpenAI SDK.	02 Hrs
4	Prompt design for coding assistance, code generation, and debugging. Development of conversational agents and dialogue systems. Educational prompting for tutoring, assessment, and content generation. Medical and healthcare prompting for information retrieval and analysis. Legal prompting for document understanding and compliance support. Data wrangling, analysis, and report generation using prompts. Prompting techniques for low-resource and regional languages.	02 Hrs
5	Understanding bias, toxicity, and misinformation in Large Language Model outputs. Identification and mitigation of hallucinations. Adversarial prompting and jailbreak attacks on language models. Safety best practices in prompt design and deployment. Evaluation of generated outputs using BLEU, ROUGE, BERTScore, and human evaluation methods. Introduction to function calling and tool use with LLMs. Retrieval-Augmented Generation (RAG) concepts and applications. Emerging trends and future directions in prompt engineering and generative AI systems.	02 Hrs

Text / Reference Books:

1. "The Art of Prompt Engineering with OpenAI APIs" by Nathan Hunter.
2. "Prompt Engineering for Everyone" by Isa Fulford & Andrew Ng (DeepLearning.AI short course).
3. "Building AI Applications with OpenAI API" by Yash Sheth.

List of Practicals:

1. Exploration and comparison of responses generated by different LLMs.
2. Analysis of tokenization, embeddings, and context window limitations.
3. Design of Zero-Shot, One-Shot, and Few-Shot prompts.
4. Implementation of role-based and instructional prompting techniques.
5. Prompt evaluation and debugging exercises.
6. Application of Chain-of-Thought and Self-Ask prompting.
7. Development of ReAct-based reasoning workflows.
8. Multimodal prompting using text and image inputs.
9. Prompt template development using Python APIs.
10. Code generation and debugging using LLM prompts.
11. Conversational chatbot design using prompt engineering.
12. Data analysis and reporting using LLMs.
13. Evaluation of bias, toxicity, and hallucination in model outputs.
14. Adversarial prompting and jailbreak testing.
15. Development of a simple Retrieval-Augmented Generation (RAG) application.
16. Mini Project: Development of a domain-specific AI assistant using prompt engineering techniques.