



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956



MK University, Patan
Faculty of Engineering Technology,
Department of Computer Science Engineering



SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	MTCSE101	ADVANCED MATHEMATICS FOR ENGINEERS	4	0	4	40	60	100
2	MAJOR	MTCSE102	ADVANCED ALGORITHMS & DATA STRUCTURES	4	2	6	90	60	150
3	MAJOR	MTCSE103	ADVANCED DATABASE SYSTEMS	4	2	6	90	60	150
4	MINOR	MTCSE104	RESEARCH METHODOLOGY & TECHNICAL COMMUNICATION	4	0	4	40	60	100
5	SEC	MTCSE105	ENTERPRENEURSHIP DEVELOPMENT	4	0	4	40	60	100
TOTAL				20	4	24	300	300	600

M. TECH (COMPUTER SCIENCE ENGINEERING) SEM-II									
SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	MTCSE201	ADVANCED COMPUTER NETWORKS	4	0	4	40	60	100
2	MAJOR	MTCSE202	CLOUD COMPUTING & VIRTUALIZATION	4	2	6	90	60	150
3	MAJOR	MTCSE203	BLOCK CHAIN	4	2	6	90	60	150
4	MINOR	MTCSE204	CYBER SECURITY	4	2	6	90	60	150
5	VAC	MTCSE205	BUSINESS COMMUNICATION-I	2	0	2	0	50	50
TOTAL				18	6	24	310	290	600



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

M. TECH (COMPUTER SCIENCE ENGINEERING) SEM-III									
SR NO .	COURSE TYPE	COURSE CODE	COURSE NAME	LECTU RE (HRS.)/ WEEK	PRACTI CAL (HRS.)/ WEEK	CREDIT S	EXAMINATION		TOTAL MARK S
							INTER NAL	EXTER NAL	
1	MAJOR	MTCSE301	BIG DATA ANALYTICS & CLOUD AI	4	2	6	90	60	150
2	MAJOR	MTCSE302	DEEP LEARNING & NEURAL NETWORKS	4	2	6	90	60	150
3	MINOR	MTCSE303	MOOC/SWAYAM COURSE	3	0	3	100	00	100
4	VAC	MTCSE304	DISSERTATION PHASE-I	0	8	8	100	100	200
TOTAL				11	12	23	380	220	600

M. TECH (COMPUTER SCIENCE ENGINEERING) SEM-IV									
SR NO .	COURSE TYPE	COURSE CODE	COURSE NAME	LECTU RE (HRS.)/ WEEK	PRACTI CAL (HRS.)/ WEEK	CREDIT S	EXAMINATION		TOTAL MARK S
							INTER NAL	EXTER NAL	
1	MAJOR	MTCSE401	INDUSTRY SEMINARS/WORKS HOPS/INTERNSHIP	0	2	2	50	00	50
2	MINOR	MTCSE402	COMPREHENSIVE VIVA VOCE	0	2	2	50	00	50
3	MAJOR	MTCSE403	DISSERTATION PHASE-II	0	16	16	200	200	400
4	VAC	MTCSE404	BUSINESS COMMUNICATION-II	2	0	2	00	50	50
TOTAL				2	20	22	300	250	550



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

SEMESTER-I

SUBJECT CODE: MTCSE101

SUBJECT NAME: ADVANCED MATHEMATICS FOR ENGINEERS

Course Objectives:

- To provide a rigorous mathematical foundation for advanced engineering modeling and analysis.
- To bridge theoretical mathematics with practical engineering applications.
- To develop problem-solving skills using analytical and computational tools.
- To prepare students for research and development in engineering domains requiring mathematical sophistication.

Course Outcomes: At the end of the course students shall be able to

CO1	Formulate and solve engineering problems using advanced techniques in linear algebra and tensor analysis.
CO2	Apply partial differential equations (PDEs) and transform methods to model dynamical systems and boundary value problems.
CO3	Use variational calculus and optimization methods for engineering design and control problems.
CO4	Analyze stochastic systems and uncertainty propagation using probability theory and statistical methods.

Unit	Content	Credit	Weightage
I	Advanced Linear Algebra & Tensors for Engineers <ul style="list-style-type: none">○ Review of vector spaces, eigenvalues, SVD, Jordan form○ Matrix decompositions (LU, QR, Cholesky, Schur)○ Tensor algebra: notation, operations, invariants○ Tensor applications: stress-strain, inertia, constitutive models○ Numerical linear algebra (conditioning, iterative solvers)• Applications: Structural analysis, continuum mechanics, control systems, data compression.	1	25%
II	Partial Differential Equations & Transform Methods <ul style="list-style-type: none">○ Classification of PDEs (elliptic, parabolic, hyperbolic)○ Separation of variables, eigenfunction expansions○ Green's functions for ODEs and PDEs○ Integral transforms (Fourier, Laplace, Hankel) for PDEs○ Introduction to finite element and finite volume concepts	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">• Applications: Heat transfer, wave propagation, fluid dynamics, signal processing.		
III	Calculus of Variations & Optimization <ul style="list-style-type: none">○ Functional derivatives, Euler–Lagrange equation○ Constraints (Lagrange multipliers, isoperimetric problems)○ Direct methods (Ritz, Galerkin)○ Optimal control theory (Pontryagin's principle, Hamiltonian formulation)○ Convex optimization basics (gradient descent, KKT conditions) <ul style="list-style-type: none">• Applications: Optimal design, trajectory optimization, energy minimization, control systems.	1	25%
IV	Stochastic Processes & Uncertainty Quantification <ul style="list-style-type: none">○ Probability spaces, random variables, distributions○ Stochastic processes (Brownian motion, Poisson process, Markov chains)○ Itô calculus basics (stochastic differential equations)○ Uncertainty quantification (Monte Carlo, polynomial chaos, sensitivity analysis)○ Statistical estimation and regression for engineering data <ul style="list-style-type: none">• Applications: Risk analysis, reliability engineering, random vibrations, financial engineering, signal noise modelling	1	25%

TEXT BOOKS:

- Kreyszig, E. – *Advanced Engineering Mathematics* (10th ed.) – Wiley.
- Strang, G. – *Linear Algebra and Its Applications* (5th ed.) – Cengage.
- Arfken, G.B., Weber, H.J., Harris, F.E. – *Mathematical Methods for Physicists* (7th ed.) – Academic Press.
- J.N. Reddy – *Applied Functional Analysis and Variational Methods in Engineering* – McGraw-Hill.
- Papoulis, A., & Pillai, S.U. – *Probability, Random Variables and Stochastic Processes* (4th ed.) – McGraw-Hill.

REFERENCE BOOKS:

- Riley, K.F., Hobson, M.P., Bence, S.J. – *Mathematical Methods for Physics and Engineering* (3rd ed.) – Cambridge.
- Gelfand, I.M., & Fomin, S.V. – *Calculus of Variations* – Dover.
- Oksendal, B. – *Stochastic Differential Equations: An Introduction with Applications* (6th ed.) – Springer.
- Holmes, M.H. – *Introduction to Numerical Methods in Differential Equations* – Springer.
- Gould, P. – *Introduction to Linear Elasticity* (for tensor applications) – Springer.

ONLINE RESOURCES:



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

- Coursera:
 - *Mathematics for Engineers Specialization* (The Hong Kong University of Science and Technology)
 - *Data Science Math Skills* (Duke University)

SUBJECT CODE: MTCSE102

SUBJECT NAME: ADVANCED ALGORITHMS AND DATA STRUCTURES

Course Objectives:

- To develop a deep understanding of advanced algorithmic paradigms and their applications in solving complex computational problems.
- To master advanced data structures for efficient storage, retrieval, and manipulation of large-scale data.
- To analyze algorithmic complexity in terms of time, space, and approximation guarantees.
- To design and implement efficient algorithms for real-world problems in distributed systems, AI, and computational geometry.

Course Outcomes: At the end of the course students shall be able to

CO1	Understanding of advanced algorithmic paradigms and their applications in solving complex computational problems.
CO2	Advanced data structures for efficient storage, retrieval, and manipulation of large-scale data.
CO3	Analyze algorithmic complexity in terms of time, space, and approximation guarantees.
CO4	Design and implement efficient algorithms for real-world problems in distributed systems, AI, and computational geometry.

Unit	Content	Credit	Weightage
I	ADVANCED ANALYSIS TECHNIQUES & DIVIDE-AND-CONQUER <ul style="list-style-type: none">• Divide-and-Conquer Paradigms:<ul style="list-style-type: none">○ Strassen's matrix multiplication○ Fast Fourier Transform (FFT) and polynomial multiplication○ Closest pair of points algorithm○ Median finding algorithms (deterministic and randomized)• Amortized Analysis:<ul style="list-style-type: none">○ Aggregate method, accounting method, potential method○ Dynamic table expansion analysis○ Fibonacci heaps (structure and amortized analysis)• Competitive Analysis:<ul style="list-style-type: none">○ Online vs offline algorithms○ Paging problem and competitive ratios	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<p>Applications:</p> <ul style="list-style-type: none">• Signal processing (FFT)• Computational geometry• Dynamic resource allocation		
II	<p>ADVANCED DATA STRUCTURES & PERSISTENCE</p> <ul style="list-style-type: none">• Augmented Data Structures:<ul style="list-style-type: none">◦ Order-statistic trees◦ Interval trees◦ Segment trees with lazy propagation• Persistent Data Structures:<ul style="list-style-type: none">◦ Fully persistent and partially persistent structures◦ Persistent segment trees◦ Persistent hash arrays• Spatial Data Structures:<ul style="list-style-type: none">◦ K-D trees◦ Quad trees and Octrees◦ R-trees and B+ trees for spatial indexing• Probabilistic Data Structures:<ul style="list-style-type: none">◦ Bloom filters◦ Count-min sketch◦ Hyper Log for cardinality estimation• Succinct Data Structures:<ul style="list-style-type: none">◦ Bit vectors with rank and select operations◦ Succinct trees <p>Applications:</p> <ul style="list-style-type: none">• Database indexing• Geographic information systems• Streaming data algorithms• Compressed data storage	1	25%
III	<p>ADVANCED GRAPH ALGORITHMS & NETWORK FLOWS</p> <ul style="list-style-type: none">• Advanced Graph Algorithms:<ul style="list-style-type: none">◦ Maximum flow algorithms:<ul style="list-style-type: none">▪ Edmonds-Karp algorithm▪ Dinic's algorithm▪ Push-relabel algorithm◦ Minimum cost maximum flow◦ Bipartite matching (Hopcroft-Karp algorithm)◦ Strongly connected components (Kosaraju, Tarjan)• Planar Graphs:<ul style="list-style-type: none">◦ Planarity testing◦ Planar separator theorem	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">• Approximation Algorithms:<ul style="list-style-type: none">◦ Vertex cover (2-approximation)◦ Traveling salesman problem (TSP) approximations◦ Set cover ($\log n$ approximation)• Randomized Graph Algorithms:<ul style="list-style-type: none">◦ Minimum cut (Karger's algorithm)◦ Randomized incremental construction• Dynamic Graph Algorithms:<ul style="list-style-type: none">◦ Connectivity queries in dynamic graphs◦ Fully dynamic reachability <p>Applications:</p> <ul style="list-style-type: none">• Network routing• Social network analysis• Resource allocation problems• VLSI design		
IV	<p>COMPUTATIONAL GEOMETRY & PARALLEL ALGORITHMS</p> <ul style="list-style-type: none">• Computational Geometry:<ul style="list-style-type: none">◦ Convex hull algorithms (Graham scan, Quickhull)◦ Line segment intersection (sweep line algorithm)◦ Voronoi diagrams and Delaunay triangulation◦ Range searching (range trees, kd-trees)• Parallel Algorithm Design:<ul style="list-style-type: none">◦ PRAM model (EREW, CREW, CRCW)◦ Parallel prefix sum◦ Parallel merge sort◦ Parallel matrix multiplication• Multithreaded Algorithms:<ul style="list-style-type: none">◦ Work-span model◦ Parallel dynamic programming◦ Parallel graph algorithms (BFS, connected components)• External Memory Algorithms:<ul style="list-style-type: none">◦ I/O model◦ External sorting and searching◦ B-trees for external memory• Approximation and Hardness:<ul style="list-style-type: none">◦ NP-completeness proofs◦ Polynomial-time approximation schemes (PTAS)◦ Fixed-parameter tractability	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	Applications: <ul style="list-style-type: none">Geographic mappingComputer graphicsBig data processingMulti-core and distributed computing		
--	--	--	--

TEXT BOOKS:

- Cormen, T.H., Leiserson, C.E., Rivest, R.L., & Stein, C. – *Introduction to Algorithms* (4th ed.) – MIT Press.
- Kleinberg, J., & Tardos, É. – *Algorithm Design* – Pearson.
- Sedgewick, R., & Wayne, K. – *Algorithms* (4th ed.) – Addison-Wesley.
- Skiena, S.S. – *The Algorithm Design Manual* (3rd ed.) – Springer.

REFERENCE BOOKS:

- Dasgupta, S., Papadimitriou, C., & Vazirani, U. – *Algorithms* – McGraw-Hill.
- Goodrich, M.T., & Tamassia, R. – *Algorithm Design and Applications* – Wiley.
- Mehlhorn, K., & Sanders, P. – *Algorithms and Data Structures: The Basic Toolbox* – Springer.
- de Berg, M., Cheong, O., van Kreveld, M., & Overmars, M. – *Computational Geometry: Algorithms and Applications* (3rd ed.) – Springer.
- Jájá, J. – *An Introduction to Parallel Algorithms* – Addison-Wesley.

ONLINE RESOURCES:

1. Coursera:
 - *Algorithms Specialization* (Stanford University)
 - *Data Structures and Algorithms* (UC San Diego)
2. edX:
 - *Algorithmic Design and Techniques* (UC San Diego)
 - *Advanced Algorithms and Complexity* (UC San Diego)

PRACTICAL LIST:

- FFT Implementation: Implement Fast Fourier Transform and inverse FFT for polynomial multiplication.
- Segment Tree with Lazy Propagation: Build a segment tree supporting range updates and queries.
- Bloom Filter: Implement a Bloom filter with configurable false positive rate.
- Dinic's Algorithm: Implement maximum flow using Dinic's algorithm.
- Hopcroft-Karp Algorithm: Solve bipartite matching for large graphs.
- Convex Hull: Implement Graham scan and compare with Quickhull.
- Parallel Merge Sort: Implement parallel merge sort using OpenMP or pthreads.
- Persistent Segment Tree: Build a persistent segment tree for range queries on historical data.
- K-D Tree: **Implement k-d tree for nearest neighbor search.**
- Karger's Algorithm: **Implement randomized minimum cut algorithm.**
- External Merge Sort: **Simulate external sorting for large datasets.**
- TSP Approximation: **Implement 2-approximation for Metric TSP.**



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

SUBJECT CODE: MTCSE104

SUBJECT NAME: RESEARCH METHODOLOGY AND TECHNICAL COMMUNICATION

Course Objectives:

- To equip engineering graduates with a structured approach to scientific inquiry and problem-solving.
- To develop proficiency in selecting and applying appropriate research methods for engineering investigations.
- To enhance technical communication skills for academia and industry.
- To foster an understanding of research ethics, scholarly publishing, and lifelong learning in research.

Course Outcomes: At the end of the course students shall be able to

CO1	Formulate a research problem, conduct systematic literature reviews, and develop a viable research proposal.
CO2	Design and execute appropriate research methodologies (experimental, numerical, analytical) with consideration for ethics and data integrity.
CO3	Apply statistical tools and software for data analysis, interpretation, and validation of research findings.
CO4	Produce high-quality technical documents (research papers, proposals, theses) and deliver effective technical presentations.

Unit	Content	Credit	Weightage
I	Foundations of Engineering Research & Problem Formulation <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Philosophy of research: inductive vs. deductive reasoning, scientific method in engineering.○ Types of engineering research: fundamental, applied, experimental, computational, empirical.○ Problem identification and formulation: research gap analysis.○ Literature review strategies: databases (Scopus, Web of Science, IEEE Xplore), citation management tools (Zotero, Mendeley), critical analysis of literature.○ Developing a research proposal: objectives, scope, significance, and work plan.• Applications: Thesis topic selection, grant proposal writing, project planning.	1	25%
II	Research Design, Methods & Ethics <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Research design: experimental, quasi-experimental, case study, modeling & simulation.○ Data collection methods: sensors, surveys,	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">instrumentation, simulation outputs.○ Design of Experiments (DoE): factorial design, Taguchi methods, response surface methodology.○ Research ethics: plagiarism, fabrication/falsification, authorship, informed consent.○ Ethical approval process and responsible conduct of research (RCR).• Applications: Planning a lab/field experiment, setting up a CFD/FEA study, survey design.		
III	<p>Data Analysis, Statistics & Software Tools</p> <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Data preprocessing: outlier detection, missing data, normalization.○ Descriptive and inferential statistics: hypothesis testing (t-test, ANOVA), confidence intervals.○ Regression analysis: linear, multiple, logistic.○ Introduction to multivariate analysis and machine learning for engineering data.○ Software tools: MATLAB/Python (NumPy, SciPy, pandas), R, MiniTab.○ Data visualization principles: effective graphs, charts, and plots.• Applications: Analyzing experimental results, validating computational models, interpreting sensor data.	1	25%
IV	<p>Technical Communication & Research Dissemination</p> <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Structure of technical documents: research papers, theses, technical reports.○ Writing strategies: clarity, conciseness, coherence, and argument development.○ Graphical abstracts, data presentation, and table/figure design.○ Oral presentations: conference talks, thesis defense, poster design.○ Publication process: journal selection, peer review, responding to reviewers.○ Intellectual Property Rights (IPR): patents, copyrights, licensing.○ Research dissemination: repositories, academic social networks (ResearchGate, LinkedIn), and impact metrics (h-index, citations).	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">• Applications: Paper writing, thesis compilation, conference presentation, patent filing.		
--	---	--	--

TEXT BOOKS:

- Kothari, C.R. – *Research Methodology: Methods and Techniques* (4th ed.) – New Age International.
- Day, R.A., and Gastel, B. – *How to Write and Publish a Scientific Paper* (9th ed.) – Greenwood.
- Montgomery, D.C. – *Design and Analysis of Experiments* (10th ed.) – Wiley.
- Alley, M. – *The Craft of Scientific Writing* (4th ed.) – Springer.

REFERENCE BOOKS:

- Bordens, K.S., and Abbott, B.B. – *Research Design and Methods: A Process Approach* (11th ed.) – McGraw-Hill.
- Wallwork, A. – *English for Writing Research Papers* (2nd ed.) – Springer.
- Box, G.E.P., Hunter, J.S., and Hunter, W.G. – *Statistics for Experimenters* (2nd ed.) – Wiley.
- IEEE Author Center Guides – *IEEE Publication Services and Products Board*.
- Laplante, P.A. – *Technical Writing: A Practical Guide for Engineers and Scientists* – CRC Press.

ONLINE RESOURCES:

- edX Courses:
 1. "Principles of Statistical Analysis" (Microsoft)
 2. "How to Write and Publish a Scientific Paper" (KU Leuven)

SUBJECT CODE: MTCSE105

SUBJECT NAME: ENTERPRENURSHIP DEVELOPMENT

Course Objectives:

- To cultivate an entrepreneurial mindset among engineering graduates.
- To provide practical tools for transforming technical ideas into viable business ventures.
- To develop skills in business modeling, financial planning, and venture funding.
- To prepare students for startup creation, intrapreneurship, or technology commercialization roles.

Course Outcomes: At the end of the course students shall be able to

CO1	Identify and evaluate entrepreneurial opportunities emerging from technological trends and market gaps.
CO2	Develop a comprehensive business model and validate it using lean startup methodologies and customer discovery.
CO3	Create financial projections, evaluate startup costs, and understand funding mechanisms for technology ventures.
CO4	Formulate a complete investor-ready business plan and deliver an effective pitch to potential stakeholders.

Unit	Content	Credit	Weightage
I	Entrepreneurial Mindset & Opportunity Identification <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ The Entrepreneurial Engineer: Mindset, traits, and role in economic development.	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Sources of Innovation: Technology push vs. market pull, disruptive vs. sustaining innovation.○ Opportunity Recognition: Identifying problems worth solving, trend analysis (STEEP), blue ocean strategy.○ Idea Validation: Lean canvas, hypothesis testing, conducting problem-solution interviews.○ Intellectual Property Strategy for Startups: Patents, trademarks, trade secrets, and licensing basics.• Applications: Spotting opportunities in cleantech, Industry 4.0, medtech, and digital transformation.		
II	Business Model Design & Customer Development <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Business Model Innovation: Business Model Canvas (Osterwalder), Value Proposition Canvas.○ Customer Discovery & Validation: The "Get Out of the Building" approach, creating MVP (Minimum Viable Product).○ Market Analysis: TAM, SAM, SOM, competitive analysis, positioning.○ Pricing Strategies for Tech Products: Cost-plus, value-based, subscription, freemium models.○ Go-to-Market Strategy: Sales channels, partnerships, digital marketing fundamentals.• Applications: Designing scalable models for SaaS, hardware-as-a-service, platform businesses.	1	25%
III	Startup Finance, Funding & Legal Foundations <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ Startup Financials: Building financial models, unit economics, burn rate, runway.○ Pro Forma Statements: Income statement, cash flow, balance sheet projections.○ Funding Sources: Bootstrapping, angels, venture capital, crowdfunding, government grants (SBIR, DST).○ Valuation Methods for Early-Stage Startups: Scorecard, Berkus, risk factor summation.	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Legal Structures & Compliance: Company registration (LLP, Pvt Ltd), shareholder agreements, ESOPs, compliance essentials.○ Term Sheet Fundamentals: Key clauses, negotiation basics.• Applications: Preparing for seed funding, managing cash flow, cap table management.		
IV	Business Planning, Pitching & Scaling Ventures <ul style="list-style-type: none">• Topics:<ul style="list-style-type: none">○ The Business Plan: Executive summary, company description, product/service, market analysis, marketing plan, management team, financial projections.○ The Art of Pitching: Investor pitch deck structure, storytelling, demo preparation.○ Building the Team: Co-founder selection, hiring early employees, advisory boards.○ Operational Planning: Supply chain, quality, scaling production.○ Growth Strategies: Scaling challenges, pivoting, exit strategies (acquisition, IPO).○ Social Entrepreneurship & Ethics: Creating social impact, ethical leadership.• Applications: Crafting investor pitches, developing operational roadmaps, planning for scale.	1	25%

TEXT BOOKS:

- Osterwalder, A., and Pigneur, Y. – *Business Model Generation* – Wiley.
- Ries, E. – *The Lean Startup* – Penguin.
- Blank, S., and Dorf, B. – *The Startup Owner's Manual* – K & S Ranch.
- Barrow, C., Barrow, P., and Brown, R. – *The Business Plan Workbook* (10th ed.) – Kogan Page.

REFERENCE BOOKS:

- Aulet, B. – *Disciplined Entrepreneurship* – Wiley.
- Mullins, J. – *The New Business Road Test* (5th ed.) – FT Publishing.
- Kawasaki, G. – *The Art of the Start 2.0* – Portfolio Penguin.
- Thiel, P. – *Zero to One* – Crown Business.
- Maurya, A. – *Running Lean* (2nd ed.) – O'Reilly.

ONLINE RESOURCES:

- Coursera: "Entrepreneurship Specialization" (Wharton), "Startup Entrepreneurship" (Technion).
- edX: "Entrepreneurship in Emerging Economies" (HarvardX), "Innovation and Entrepreneurship" (DelftX).

Udemy: Courses on Business Plan Writing, Startup Funding, and Digital Marketing.



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

SEMESTER-II

SUBJECT CODE: MTCSE201

SUBJECT NAME: ADVANCED COMPUTER NETWORKS

Course Objectives:

- To provide an in-depth understanding of modern network architectures, protocols, and their design principles.
- To analyze performance, scalability, and security aspects of wired and wireless networks.
- To explore emerging networking paradigms including SDN, NFV, IoT networks, and 5G/6G architectures.
- To develop skills in network simulation, analysis, and troubleshooting using advanced tools.
- To prepare students for research and industry roles in network design, cloud networking, and network security.

Course Outcomes: At the end of the course students shall be able to

CO1	Analyze and compare different network architectures and protocols for performance and scalability.
CO2	Design and evaluate network solutions using Software-Defined Networking (SDN) and Network Function Virtualization (NFV).
CO3	Implement and troubleshoot advanced routing protocols, QoS mechanisms, and network security solutions.
CO4	Develop solutions for emerging network technologies including IoT, 5G/6G, and network automation.

Unit	Content	Credit	Weightage
I	ADVANCED NETWORK ARCHITECTURES & PROTOCOLS <ul style="list-style-type: none">• Network Architecture Evolution:<ul style="list-style-type: none">◦ Layered vs. service-oriented architectures◦ Clean-slate network design principles◦ Information-centric networking (ICN)◦ Named Data Networking (NDN)• Advanced Routing Protocols:<ul style="list-style-type: none">◦ BGP enhancements: MP-BGP, BGP Security (RPKI, BGPSEC)◦ OSPF/IS-IS for large-scale networks◦ Segment Routing (SR-MPLS, SRv6)• Transport Layer Enhancements:<ul style="list-style-type: none">◦ TCP variants: BBR, CUBIC, QUIC◦ Multipath TCP (MPTCP)◦ Performance-oriented Congestion Control (PCC)• Quality of Service (QoS):<ul style="list-style-type: none">◦ Differentiated Services (DiffServ)◦ Integrated Services (IntServ) with RSVP	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Traffic engineering with MPLS-TE• Network Virtualization:<ul style="list-style-type: none">○ VLANs, VXLAN, NVGRE○ Network slicing concepts <p>Applications:</p> <ul style="list-style-type: none">• Cloud backbone networks• Content delivery networks (CDNs)• Large-scale enterprise networks		
II	<p>SOFTWARE-DEFINED NETWORKING & NETWORK FUNCTION VIRTUALIZATION</p> <ul style="list-style-type: none">• SDN Architecture:<ul style="list-style-type: none">○ Control and data plane separation○ Southbound APIs (OpenFlow, P4, gRPC)○ Northbound APIs and network applications○ SDN Controllers: OpenDaylight, ONOS, Ryu• Network Function Virtualization:<ul style="list-style-type: none">○ NFV architecture (MANO framework)○ Virtual Network Functions (VNFs)○ Service Function Chaining (SFC)○ Containerized network functions• Programmable Data Planes:<ul style="list-style-type: none">○ P4 programming language○ Protocol-independent switch architecture○ In-band Network Telemetry (INT)• SD-WAN:<ul style="list-style-type: none">○ Architecture and components○ Policy-based routing○ Security in SD-WAN• Network Automation:<ul style="list-style-type: none">○ NETCONF/YANG models○ Ansible for network automation○ Zero-touch provisioning <p>Applications:</p> <ul style="list-style-type: none">• Cloud data centers• Enterprise network automation• Telecom operator networks	1	25%
III	<p>WIRELESS & MOBILE NETWORKS</p> <ul style="list-style-type: none">• 5G Network Architecture:<ul style="list-style-type: none">○ 5G core network (5GC)○ Network slicing in 5G○ Multi-access Edge Computing (MEC)• Wireless Technologies:<ul style="list-style-type: none">○ Wi-Fi 6/6E/7 (802.11ax/be)○ Millimeter-wave communications○ Massive MIMO and beamforming• IoT Networks:	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ LPWAN technologies: LoRaWAN, NB-IoT, Sigfox○ Wireless sensor networks○ IoT protocol stack: CoAP, MQTT, 6LoWPAN● Mobile Network Protocols:<ul style="list-style-type: none">○ Mobile IP○ Proxy Mobile IPv6 (PMIPv6)○ Mobility management in 5G● Vehicular Networks:<ul style="list-style-type: none">○ VANET architecture○ V2X communications● Network Security in Wireless:<ul style="list-style-type: none">○ 5G security architecture○ Authentication and key management <p>Applications:</p> <ul style="list-style-type: none">● Smart cities● Industrial IoT		
IV	<p>NETWORK SECURITY & EMERGING TRENDS</p> <ul style="list-style-type: none">● Advanced Network Security:<ul style="list-style-type: none">○ Zero Trust Architecture (ZTA)○ Micro-segmentation○ Distributed Denial of Service (DDoS) mitigation○ Blockchain for network security● Privacy in Networks:<ul style="list-style-type: none">○ Encrypted traffic analysis○ Privacy-preserving routing○ Anonymous communication (Tor, I2P)● Network Monitoring & Analytics:<ul style="list-style-type: none">○ sFlow, NetFlow, IPFIX○ Streaming telemetry○ Machine learning for network analytics○ Anomaly detection in network traffic● Emerging Network Paradigms:<ul style="list-style-type: none">○ 6G vision and requirements○ Quantum networking basics○ Space-terrestrial integrated networks○ Neuromorphic networking● Green Networking:<ul style="list-style-type: none">○ Energy-efficient protocols○ Network power management● Research Frontiers:<ul style="list-style-type: none">○ AI/ML in network management○ Intent-based networking	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Self-driving networks <p>Applications:</p> <ul style="list-style-type: none">• Cybersecurity operations centers• Government and military networks• Critical infrastructure protection• Future network research		
--	--	--	--

TEXT BOOKS:

- Kurose, J.F., & Ross, K.W. – *Computer Networking: A Top-Down Approach* (8th ed.) – Pearson.
- Peterson, L.L., & Davie, B.S. – *Computer Networks: A Systems Approach* (6th ed.) – Morgan Kaufmann.
- Tanenbaum, A.S., & Wetherall, D.J. – *Computer Networks* (6th ed.) – Pearson.
- Zhang, Y., & Ansari, N. – *Software-Defined Networking with OpenFlow* – Packet.

REFERENCE BOOKS:

- McKeown, N., et al. – *Software-Defined Networking: The New Norm for Networks* – ONF White Paper.
- Halpern, J., & Pignataro, C. – *Service Function Chaining Architecture* – IETF RFC 7665.
- Stallings, W. – *Wireless Communications & Networks* (3rd ed.) – Pearson.
- Moura, G., & Hutchison, D. – *Blockchain for Networking* – Springer.
- Varga, A., & Hornig, R. – *An Overview of the OMNeT++ Simulation Environment* – ICST.
- 3GPP Specifications – *5G System Architecture* – 3GPP TS 23.501.

ONLINE RESOURCES:

1. Coursera:
 - *Software Defined Networking* (University of Chicago)
 - *5G for Everyone* (Qualcomm)
 - *Computer Communications* (University of Colorado)
2. edX:
 - *Networking in Google Cloud*
 - *IoT Networks and Protocols* (Curtin University)
 - *Introduction to 5G* (IMT)

SUBJECT CODE: MTCSE202

SUBJECT NAME: CLOUD COMPUTING AND VIRTUALIZATION

Course Objectives:

- To provide a comprehensive understanding of cloud computing architectures, service models, and deployment models.
- To master virtualization technologies at different layers (server, network, storage) and their role in cloud infrastructure.
- To design, implement, and manage cloud-native applications using containerization, orchestration, and serverless computing.
- To develop skills in cloud security, cost optimization, and performance management across major cloud platforms.
- To prepare students for industry certifications and roles in cloud architecture, DevOps, and cloud security.

Course Outcomes: At the end of the course students shall be able to



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

CO1	Analyze and compare different cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid).
CO2	Design and implement virtualization solutions using hypervisors, containers, and virtual networking.
CO3	Develop and deploy cloud-native applications using container orchestration platforms (Kubernetes) and serverless frameworks.
CO4	Implement cloud security best practices, identity management, and compliance frameworks.

Unit	Content	Credit	Weightage
I	<p>CLOUD COMPUTING FOUNDATIONS & VIRTUALIZATION</p> <ul style="list-style-type: none">Cloud Computing Essentials:<ul style="list-style-type: none">Evolution from distributed computing to cloudNIST cloud definition and characteristicsService models: IaaS, PaaS, SaaS, FaaS, DBaaSDeployment models: Public, Private, Hybrid, Community, Multi-cloudVirtualization Technologies:<ul style="list-style-type: none">Type 1 vs Type 2 hypervisors (Bare-metal vs Hosted)Full virtualization, paravirtualization, hardware-assisted virtualizationHypervisors: VMware ESXi, Microsoft Hyper-V, KVM, XenVirtual machine migration: Live migration, storage migrationResource Virtualization:<ul style="list-style-type: none">CPU virtualization (VT-x, AMD-V)Memory virtualization (Shadow page tables, EPT)I/O virtualization (SR-IOV, VFIO)GPU virtualization (vGPU, GPU passthrough)Storage Virtualization:<ul style="list-style-type: none">SAN vs NASStorage area networks virtualizationSoftware-defined storage (Ceph, vSAN)Object storage vs block storage vs file storage	1	25%
II	<p>CONTAINERIZATION & ORCHESTRATION</p> <ul style="list-style-type: none">Container Fundamentals:<ul style="list-style-type: none">Container vs VM: Architecture comparison	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Linux namespaces (pid, net, mnt, ipc, uts, user)○ Control groups (cgroups)○ Union filesystems (OverlayFS, AUFS)● Docker Ecosystem:<ul style="list-style-type: none">○ Docker architecture: Docker Engine, Docker Hub, Docker Desktop○ Dockerfile best practices○ Docker networking models (bridge, host, overlay, macvlan)○ Docker storage drivers and volumes● Container Orchestration:<ul style="list-style-type: none">○ Kubernetes architecture: Master components, Node components○ Pods, Services, Deployments, StatefulSets○ ConfigMaps and Secrets○ Persistent volumes and storage classes○ Ingress controllers and service mesh (Istio basics)● Advanced Container Topics:<ul style="list-style-type: none">○ Container security: Image scanning, runtime security○ Container registries (Docker Hub, Harbor, ECR)○ GitOps with ArgoCD/Flux○ Serverless containers (AWS Fargate, Google Cloud Run)		
III	CLOUD PLATFORMS & SERVICES <ul style="list-style-type: none">● AWS Core Services:<ul style="list-style-type: none">○ Compute: EC2, Lambda, ECS, EKS○ Storage: S3, EBS, EFS, Glacier○ Database: RDS, DynamoDB, Redshift○ Networking: VPC, CloudFront, Route 53○ Security: IAM, KMS, Secrets Manager● Azure Core Services:<ul style="list-style-type: none">○ Compute: Virtual Machines, App Service, Azure Functions○ Storage: Blob Storage, Azure Files, Managed Disks○ Database: Azure SQL, Cosmos DB○ Networking: Virtual Network, Azure CDN, Load Balancer● Google Cloud Platform:<ul style="list-style-type: none">○ Compute: Compute Engine, Cloud Functions, GKE○ Storage: Cloud Storage, Persistent Disk○ Database: Cloud SQL, Firestore, Bigtable	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Networking: VPC, Cloud Load Balancing○ AI/ML services: Vertex AI, AutoML● Cloud Management:<ul style="list-style-type: none">○ Infrastructure as Code: Terraform, CloudFormation, ARM Templates○ Configuration management: Ansible, Chef, Puppet○ Monitoring and logging: CloudWatch, Azure Monitor, Stackdriver○ Cost management and optimization tools		
IV	<p>CLOUD SECURITY, MIGRATION & FUTURE TRENDS</p> <ul style="list-style-type: none">● Cloud Security:<ul style="list-style-type: none">○ Shared responsibility model○ Identity and Access Management (IAM) best practices○ Network security: Security groups, NACLs, web application firewalls○ Data encryption: At-rest, in-transit, client-side○ Compliance frameworks: GDPR, HIPAA, PCI-DSS, SOC 2○ Security monitoring and incident response● Cloud Migration Strategies:<ul style="list-style-type: none">○ 6 R's of migration: Rehost, Refactor, Revise, Rebuild, Replace, Retain○ Migration assessment tools (AWS MGN, Azure Migrate)○ Database migration strategies● Multi-cloud and Hybrid Cloud:<ul style="list-style-type: none">○ Multi-cloud management challenges○ Hybrid cloud connectivity (VPN, Direct Connect, ExpressRoute)○ Cloud management platforms (vRealize, CloudHealth)○ Kubernetes federation● Emerging Trends:<ul style="list-style-type: none">○ Serverless computing and Function as a Service○ Edge computing and cloud-edge continuum○ AI/ML in cloud operations (AIOps)○ Quantum computing as a service○ Green cloud computing and sustainability● Cloud Economics:<ul style="list-style-type: none">○ Total Cost of Ownership (TCO) analysis○ Reserved instances vs spot instances	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Cost optimization techniques○ FinOps principles		
--	--	--	--

TEXT BOOKS:

- Buyya, R., Broberg, J., & Goscinski, A. – *Cloud Computing: Principles and Paradigms* – Wiley.
- Maurer, N., & O'Reilly, T. – *Cloud Native Patterns* – Manning Publications.
- Turnbull, J. – *The Docker Book* – Self-published.
- Hightower, K., Burns, B., & Beda, J. – *Kubernetes: Up and Running* (3rd ed.) – O'Reilly.
- Wittig, M., & Wittig, A. – *Amazon Web Services in Action* (2nd ed.) – Manning.

REFERENCE BOOKS:

- Fehling, C., et al. – *Cloud Computing Patterns* – Springer.
- Varia, J., & Mathew, S. – *Overview of Amazon Web Services* – AWS Whitepaper.
- Rhoton, J., & Haukioja, R. – *Cloud Computing Architected* – Recursive Press.
- Luszczek, P. – *High Performance Computing* – CRC Press.
- Srivastava, A., & Pal, R. – *Multi-Cloud Handbook for Developers* – Apress.

ONLINE RESOURCES:

- AWS Training & Certification (Free tier, Skill Builder)
- Microsoft Learn (Azure modules and learning paths)
- Google Cloud Skills Boost (Qwiklabs, Coursera)

PRACTICAL LIST:

- Implement secure VPC with public and private subnets
- Set up IAM policies with least privilege principle
- Perform lift-and-shift migration of VM to cloud
- Implement disaster recovery strategy across regions
- Conduct cloud cost analysis and optimization exercise

SUBJECT CODE: MTCSE203

SUBJECT NAME: BLOCK CHAIN

Course Objectives:

- To provide a comprehensive understanding of blockchain fundamentals, architectures, and consensus mechanisms.
- To explore cryptocurrency systems, smart contracts, and decentralized applications (dApps) development.
- To analyze blockchain security, privacy mechanisms, and cryptographic foundations.
- To examine enterprise blockchain platforms, interoperability solutions, and real-world applications.
- To prepare students for roles in blockchain development, architecture, and research in Web3 ecosystems.

Course Outcomes: At the end of the course students shall be able to

CO1	Analyze and compare different blockchain architectures, consensus algorithms, and cryptographic foundations.
CO2	Design, develop, and deploy smart contracts and decentralized applications on major blockchain platforms.
CO3	Implement blockchain solutions with appropriate security measures, privacy protocols, and scalability techniques.



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

CO4	Evaluate enterprise blockchain platforms and design solutions for specific industry use cases.
-----	--

Unit	Content	Credit	Weightage
I	BLOCKCHAIN FUNDAMENTALS & CRYPTOGRAPHIC FOUNDATIONS <ul style="list-style-type: none">Introduction to Distributed Ledger Technology:<ul style="list-style-type: none">Evolution from distributed databases to blockchainKey characteristics: Decentralization, Immutability, TransparencyTypes of blockchains: Public, Private, Consortium, HybridBlockchain vs traditional databasesCryptographic Foundations:<ul style="list-style-type: none">Hash functions: SHA-256, Keccak (SHA-3), RIPEMD-160Digital signatures: ECDSA, EdDSA, Schnorr signaturesPublic Key Infrastructure (PKI) in blockchainMerkle Trees and Patricia Merkle TreesBlockchain Architecture:<ul style="list-style-type: none">Block structure: Header, Transactions, NonceBlockchain data structureNetwork architecture: P2P networks, gossip protocolsWallets: Hot vs Cold, HD wallets, mnemonic phrasesConsensus Mechanisms:<ul style="list-style-type: none">Proof of Work (Bitcoin, Ethereum 1.0)Proof of Stake (Ethereum 2.0, Cardano)Delegated Proof of Stake (EOS, TRON)Practical Byzantine Fault Tolerance (PBFT, Hyperledger)Alternative consensus: Proof of Authority, Proof of Space/Time	1	25%
II	CRYPTOCURRENCIES & SMART CONTRACTS <ul style="list-style-type: none">Bitcoin Ecosystem:<ul style="list-style-type: none">Bitcoin protocol: UTXO model, Script languageBitcoin transactions: Inputs, Outputs, FeesMining process and difficulty adjustmentSegWit, Taproot, and Bitcoin improvementsLightning Network for scalabilityEthereum Virtual Machine (EVM):	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Account-based model vs UTXO○ Gas mechanism and fee market (EIP-1559)○ EVM architecture and opcodes● Smart Contract Development:<ul style="list-style-type: none">○ Solidity programming language○ Smart contract architecture: Functions, Modifiers, Events○ Security patterns and common vulnerabilities (SWC Registry)○ Testing and debugging smart contracts○ Upgradeability patterns (Proxy, Diamond)● Decentralized Applications (dApps):<ul style="list-style-type: none">○ Web3.js and Ethers.js libraries○ Frontend integration with blockchain○ IPFS for decentralized storage○ Oracle integration (Chainlink)		
III	ENTERPRISE BLOCKCHAIN & SCALABILITY SOLUTIONS <ul style="list-style-type: none">● Enterprise Blockchain Platforms:<ul style="list-style-type: none">○ Hyperledger Fabric: Architecture, Channels, Private Data○ Hyperledger Besu: Ethereum for enterprises○ Corda: Financial-grade blockchain○ Quorum: Enterprise Ethereum with privacy● Blockchain Interoperability:<ul style="list-style-type: none">○ Cross-chain communication protocols○ Bridges: Trusted vs Trustless○ Polkadot and Cosmos ecosystems○ Atomic swaps and hashed timelock contracts● Scalability Solutions:<ul style="list-style-type: none">○ Layer 1 solutions: Sharding, DAG-based blockchains○ Layer 2 solutions: Rollups (Optimistic, ZK-Rollups)○ State channels and payment channels○ Sidechains and plasma chains● Privacy-Enhancing Technologies:<ul style="list-style-type: none">○ Confidential transactions○ Zero-knowledge proofs applications○ zk-SNARKs vs zk-STARKs○ Privacy coins: Monero, Zcash● Blockchain as a Service (BaaS):<ul style="list-style-type: none">○ AWS Managed Blockchain○ Azure Blockchain Service○ IBM Blockchain Platform	1	25%
IV	ADVANCED APPLICATIONS & FUTURE TRENDS	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">• Decentralized Finance (DeFi):<ul style="list-style-type: none">◦ Automated Market Makers (Uniswap, Curve)◦ Lending protocols (Aave, Compound)◦ Yield farming and liquidity mining◦ Stablecoins: Algorithmic vs Collateralized◦ Risks and security in DeFi• NFTs and Digital Assets:<ul style="list-style-type: none">◦ NFT standards and metadata◦ Gaming and metaverse applications◦ Royalty mechanisms and IP management◦ Fractionalized NFTs• DAO Governance:<ul style="list-style-type: none">◦ Decentralized Autonomous Organizations◦ Governance tokens and voting mechanisms◦ Treasury management◦ Legal implications of DAOs• Blockchain in Enterprise:<ul style="list-style-type: none">◦ Supply chain traceability◦ Digital identity and verifiable credentials◦ Healthcare data management◦ Real estate tokenization• Regulatory and Legal Aspects:<ul style="list-style-type: none">◦ Global regulatory landscape◦ Anti-Money Laundering (AML) compliance◦ Know Your Customer (KYC) solutions◦ Tax implications of cryptocurrencies• Future Trends:<ul style="list-style-type: none">◦ Web3 and decentralized internet◦ Central Bank Digital Currencies (CBDCs)◦ Blockchain and IoT convergence◦ Quantum-resistant cryptography◦ Sustainability and green blockchain initiatives	
--	---	--

TEXT BOOKS:

- Antonopoulos, A.M. – *Mastering Bitcoin* (2nd ed.) – O'Reilly.
- Antonopoulos, A.M., & Wood, G. – *Mastering Ethereum* – O'Reilly.
- Narayanan, A., et al. – *Bitcoin and Cryptocurrency Technologies* – Princeton University Press.
- Voshmgir, S. – *Token Economy* (2nd ed.) – BlockchainHub.
- Bashir, I. – *Mastering Blockchain* (4th ed.) – Packt.

REFERENCE BOOKS:

- Swan, M. – *Blockchain: Blueprint for a New Economy* – O'Reilly.
- Tapscott, D., & Tapscott, A. – *Blockchain Revolution* – Portfolio.
- Andreas, M. – *The Internet of Money* (Volumes 1-3) – Merkle Bloom.



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT,1956

- Harz, D., & Gudgeon, L. – *Advances in Financial Machine Learning* – Wiley.
- Hyperledger Foundation – *Hyperledger Fabric Documentation* – Linux Foundation.

ONLINE RESOURCES:

- Coursera: *Blockchain Specialization* (University at Buffalo)
- edX: *Blockchain Fundamentals* (Berkeley)

PRACTICAL LIST:

- Build complete DeFi application with staking and farming
- Create DAO with governance token and voting system
- Implement supply chain traceability solution
- Develop blockchain-based digital identity system
- Analyze and audit smart contract for security vulnerabilities

SUBJECT CODE: MTCSE204

SUBJECT NAME: CYBER SECURITY

Course Objectives:

- To provide a comprehensive understanding of cybersecurity principles, threat landscapes, and defense mechanisms.
- To develop expertise in network security, cryptography, and secure system design methodologies.
- To master offensive security techniques, penetration testing methodologies, and vulnerability assessment.
- To explore digital forensics, incident response, and security operations center (SOC) management.
- To prepare students for cybersecurity certifications and roles in threat intelligence, security architecture, and forensic analysis.

Course Outcomes: At the end of the course students shall be able to

CO1	Analyze cybersecurity threats, vulnerabilities, and attack vectors across different environments.
CO2	Design and implement secure network architectures, cryptographic solutions, and access control systems.
CO3	Conduct penetration testing, vulnerability assessment, and security auditing using industry-standard tools.
CO4	Perform digital forensics investigations, incident response, and malware analysis.

Unit	Content	Credit	Weightage
I	ADVANCED CRYPTOGRAPHY & NETWORK SECURITY <ul style="list-style-type: none">• Cryptographic Foundations:<ul style="list-style-type: none">○ Advanced symmetric encryption: AES modes (GCM, CCM), ChaCha20○ Public-key cryptography: RSA, ECC, post-quantum cryptography basics○ Hash functions: SHA-3, BLAKE2, Argon2 for password hashing○ Digital signatures: ECDSA, EdDSA, RSA-PSS	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Key management and PKI implementation● Network Security Protocols:<ul style="list-style-type: none">○ TLS 1.3 deep dive: handshake, cipher suites, session resumption○ IPsec: ESP, AH, IKEv2○ DNSSEC implementation and deployment○ Secure email protocols: S/MIME, PGP○ Wireless security: WPA3, 802.1X/EAP● Secure Network Architecture:<ul style="list-style-type: none">○ Zero Trust Architecture (ZTA) implementation○ Software-Defined Perimeter (SDP)○ Micro-segmentation strategies○ Network deception technologies (honeypots, honeynets)● Cloud Network Security:<ul style="list-style-type: none">○ Cloud security groups and NACLs○ Web Application Firewalls (WAF) configuration○ API security and management○ DDoS protection mechanisms		
II	<p>PENETRATION TESTING & VULNERABILITY ASSESSMENT</p> <ul style="list-style-type: none">● Methodologies & Frameworks:<ul style="list-style-type: none">○ PTES, OWASP Testing Guide, NIST SP 800-115○ Red team vs blue team vs purple team operations○ Threat modeling: STRIDE, DREAD, Attack trees● Reconnaissance & Scanning:<ul style="list-style-type: none">○ Passive and active reconnaissance techniques○ Network scanning: Nmap advanced scripting○ Vulnerability scanning: Nessus, OpenVAS, Qualys○ Web application scanning: Burp Suite, OWASP ZAP● Exploitation Techniques:<ul style="list-style-type: none">○ Buffer overflows: Stack-based, heap-based, ROP chains○ Web exploitation: SQLi, XSS, CSRF, SSRF, XXE○ Binary exploitation: Format string, integer overflow	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">○ Post-exploitation: Privilege escalation, lateral movement● Advanced Persistent Threats (APT):<ul style="list-style-type: none">○ APT lifecycle and tactics○ Living-off-the-land techniques○ Command and control (C2) infrastructure○ Defense evasion techniques● Mobile & IoT Security:<ul style="list-style-type: none">○ Android/iOS application security testing○ IoT protocol vulnerabilities (MQTT, CoAP)○ Firmware analysis and reverse engineering		
III	DIGITAL FORENSICS & INCIDENT RESPONSE <ul style="list-style-type: none">● Forensic Foundations:<ul style="list-style-type: none">○ Digital evidence handling and chain of custody○ Legal considerations: CFAA, GDPR, CCPA○ Forensic acquisition: Disk imaging, memory acquisition○ Timeline analysis and event reconstruction● Disk & File System Forensics:<ul style="list-style-type: none">○ File system analysis: NTFS, EXT4, APFS, exFAT○ File carving and data recovery techniques○ Anti-forensic detection and countermeasures○ Cloud storage forensics● Memory & Malware Forensics:<ul style="list-style-type: none">○ Volatility framework advanced usage○ Malware analysis: Static, dynamic, behavioral○ Reverse engineering malicious binaries○ Ransomware analysis and decryption techniques● Network Forensics:<ul style="list-style-type: none">○ Packet analysis with Wireshark and tcpdump○ NetFlow analysis for anomaly detection○ Intrusion detection system (IDS) log analysis○ Encrypted traffic analysis● Incident Response:<ul style="list-style-type: none">○ NIST SP 800-61 incident handling guide○ IR team roles and responsibilities○ Threat intelligence integration○ SOC operations and SIEM management	1	25%
IV	SECURITY OPERATIONS & EMERGING TECHNOLOGIES	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">• Security Operations Center (SOC):<ul style="list-style-type: none">◦ SOC architecture and tooling◦ Security Information and Event Management (SIEM)◦ Security Orchestration, Automation, and Response (SOAR)◦ Threat intelligence platforms (TIP)• Cloud & Container Security:<ul style="list-style-type: none">◦ Cloud Security Posture Management (CSPM)◦ Container security: Image scanning, runtime protection◦ Kubernetes security: Pod security policies, network policies◦ Serverless security considerations• IoT & OT Security:<ul style="list-style-type: none">◦ Industrial Control System (ICS) security◦ SCADA system protection◦ Automotive and medical device security◦ Smart city security challenges• AI in Cybersecurity:<ul style="list-style-type: none">◦ ML for threat detection and anomaly detection◦ Adversarial machine learning◦ AI-powered security analytics◦ Automated vulnerability discovery• Compliance & Governance:<ul style="list-style-type: none">◦ ISO 27001, NIST CSF, GDPR compliance◦ Risk assessment methodologies◦ Security awareness and training programs◦ Third-party risk management• Emerging Threats & Future Trends:<ul style="list-style-type: none">◦ Quantum computing impact on cryptography◦ 5G security challenges◦ Space system cybersecurity◦ Bio-digital convergence security	
--	--	--

TEXT BOOKS:

- Stallings, W., & Brown, L. – *Computer Security: Principles and Practice* (4th ed.) – Pearson.
- Skoudis, E., & Liston, T. – *Counter Hack Reloaded* (2nd ed.) – Prentice Hall.
- Casey, E. – *Digital Evidence and Computer Crime* (3rd ed.) – Academic Press.
- Ligh, M., et al. – *The Art of Memory Forensics* – Wiley.
- Scarfone, K., & Mell, P. – *Guide to Intrusion Detection and Prevention Systems* – NIST SP 800-94.

REFERENCE BOOKS:



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

- Bejtlich, R. – *The Practice of Network Security Monitoring* – No Starch Press.
- Clark, M. – *Network Forensics* – Prentice Hall.
- Howard, M., & Lipner, S. – *The Security Development Lifecycle* – Microsoft Press.
- Engebretson, P. – *The Basics of Hacking and Penetration Testing* (3rd ed.) – Syngress.
- Chapple, M., et al. – *CISSP Official Study Guide* (9th ed.) – Sybex.

ONLINE RESOURCES:

- Cybrary: Free cybersecurity courses
- TryHackMe / HackTheBox: Hands-on hacking labs
- SANS Cyber Aces: Free security training
- PentesterLab: Web penetration testing exercises

PRACTICAL LIST:

- Build mini-SOC with ELK Stack and Wazuh
- Implement automated threat hunting pipeline
- Develop cloud security monitoring dashboard
- Create AI-based anomaly detection system
- Conduct risk assessment and compliance audit



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

SEMESTER-III

SUBJECT CODE: MTCSE301

SUBJECT NAME: BIG DATA ANALYTICS AND CLOUD AI

Course Objectives:

- To provide a comprehensive understanding of big data technologies, distributed computing frameworks, and cloud-based AI/ML services.
- To develop expertise in processing, analyzing, and deriving insights from massive-scale datasets using scalable cloud platforms.
- To implement end-to-end machine learning pipelines on cloud infrastructure for production-level AI systems.
- To prepare students for roles in data engineering, cloud AI solution architecture, and large-scale AI system deployment.

Course Outcomes: At the end of the course students shall be able to

CO1	Design and implement scalable data processing pipelines using big data technologies.
CO2	Develop and deploy machine learning models on cloud platforms using managed AI services.
CO3	Optimize distributed ML training and inference for large-scale datasets.
CO4	Architect and implement production-grade cloud-native AI systems with MLOps principles.

Unit	Content	Credit	Weightage
I	Big Data Foundations and Distributed Processing Topics: <ul style="list-style-type: none">• Introduction to Big Data: 5 Vs (Volume, Velocity, Variety, Veracity, Value)• Hadoop ecosystem: HDFS, MapReduce, YARN• Apache Spark: RDDs, DataFrames, Spark SQL, Spark MLlib• Distributed data processing patterns and optimizations• NoSQL databases: MongoDB, Cassandra, Redis• Data lakes vs. data warehouses• Real-time stream processing: Apache Kafka, Apache Flink• Applications: Log analysis, clickstream processing, IoT data aggregation	1	25%
II	Cloud Computing for AI <ul style="list-style-type: none">• Cloud computing fundamentals: IaaS, PaaS, SaaS, FaaS• Major cloud platforms: AWS, Azure, Google Cloud Platform• Cloud storage solutions: S3, Azure Blob, Google Cloud Storage	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">Containerization and orchestration: Docker, Kubernetes for AI workloadsServerless computing for AI: AWS Lambda, Azure FunctionsCloud-based ML platforms: SageMaker, Azure ML, Vertex AICost optimization and resource management in cloud AIApplications: Scalable model training, automated ML pipelines, batch inference		
III	Distributed Machine Learning and MLOps Topics: <ul style="list-style-type: none">Distributed training frameworks: Horovod, PyTorch DDP, TensorFlow DistributedModel parallelism and data parallelismHyperparameter tuning at scale: Ray Tune, Optuna on cloudFeature stores: Feast, TectonML pipeline orchestration: Apache Airflow, Kubeflow PipelinesModel versioning and registry: MLflow, DVCMonitoring and logging for ML systems: Prometheus, GrafanaCI/CD for machine learning (MLOps)Applications: Large language model training, recommendation systems at scale	1	25%
IV	Advanced Analytics and Cloud AI Services Topics: <ul style="list-style-type: none">Big data analytics tools: Apache Hive, Presto, Apache DruidData visualization at scale: Tableau, Power BI, Apache SupersetManaged AI services: Computer Vision APIs, NLP services, speech recognitionVector databases and similarity search: Pinecone, Weaviate, MilvusGraph analytics and processing: Neo4j, Amazon NeptuneEdge-cloud AI integrationSecurity, compliance, and governance in cloud AIEthical considerations: Bias in large-scale AI, data privacyApplications: Real-time recommendation engines, fraud detection, predictive maintenance	1	25%

TEXT BOOKS:

- Chambers, B., & Zaharia, M. – *Spark: The Definitive Guide* – O'Reilly.



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT,1956

- Lakshmanan, V., Robinson, S., & Munn, M. – *Machine Learning Design Patterns* – O'Reilly.
- Kimball, R., & Ross, M. – *The Data Warehouse Toolkit* (3rd ed.) – Wiley.
- Huyen, C. – *Designing Machine Learning Systems* – O'Reilly.

REFERENCE BOOKS:

- White, T. – *Hadoop: The Definitive Guide* (4th ed.) – O'Reilly.
- Guller, M. – *Big Data Analytics with Spark* – Apress.
- Kleppmann, M. – *Designing Data-Intensive Applications* – O'Reilly.
- AWS/Azure/GCP – *Official certification guides and whitepapers*.

ONLINE RESOURCES:

- Databricks Community Edition: Free Spark cluster
- Google Colab Pro: GPU access for distributed ML experiments
- AWS Educate/Azure for Students: Free cloud credits
- Coursera: *Big Data Specialization* (University of California San Diego)
- edX: *Data Science and Machine Learning in the Cloud* (Microsoft)

PRACTICAL LIST:

1. Big Data Processing with Apache Spark

Task: Process a multi-terabyte dataset (e.g., Wikipedia dump or Twitter stream) using PySpark on Databricks. Perform data cleaning, aggregation, and analysis. Compare performance between RDD and Data Frame APIs.

2. End-to-End Cloud ML Pipeline

Task: Build a complete ML pipeline on AWS SageMaker or Azure ML including data ingestion, feature engineering, model training (XGBoost/Deep Learning), hyperparameter tuning, and deployment. Implement automated retraining with Airflow.

3. Distributed Deep Learning Training

Task: Train a large vision or language model (ResNet50 or BERT) using distributed training across multiple GPUs/instances on cloud. Implement with Horovod or PyTorch DDP. Compare training time and cost vs. single instance.

4. Real-time Analytics and AI Serving

Task: Create a real-time fraud detection system using Kafka for streaming, Spark Streaming/Flink for processing, and a pre-trained model served via TensorFlow Serving on Kubernetes. Build a monitoring dashboard with Grafana.

SUBJECT CODE: MTCSE302

SUBJECT NAME: DEEP LEARNING AND NEURAL NETWORKS

Course Objectives:

- To provide a comprehensive understanding of neural network architectures and deep learning fundamentals.
- To develop expertise in designing, training, and optimizing various deep learning models.
- To apply deep learning techniques to solve real-world problems in computer vision, NLP, and sequential data.
- To prepare students for research and development in cutting-edge AI applications and emerging deep learning paradigms.

Course Outcomes:

At the end of the course students shall be able to

CO1	Design and implement various neural network architectures
-----	---



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	including CNNs, RNNs, and transformers.
CO2	Train and optimize deep learning models using appropriate regularization, optimization, and hyperparameter tuning techniques.
CO3	Apply deep learning to practical domains such as image recognition, natural language processing, and time-series prediction.
CO4	Evaluate model performance, interpret results, and implement deployment-ready deep learning solutions.

Unit	Content	Credit	Weightage
I	Neural Network Fundamentals and Optimization Topics: <ul style="list-style-type: none">• Biological inspiration and artificial neurons• Perceptron, multi-layer perceptron (MLP)• Activation functions: Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax• Backpropagation algorithm and gradient computation• Loss functions: MSE, Cross-entropy, Hinge loss• Optimization algorithms: SGD, Momentum, RMSProp, Adam• Regularization: Dropout, L1/L2, Batch normalization• Hyperparameter tuning and learning rate schedules• Applications: Digit recognition, basic classification tasks	1	25%
II	Convolutional Neural Networks (CNNs) Topics: <ul style="list-style-type: none">• Convolution operations and feature extraction• CNN architectures: LeNet, AlexNet, VGG, ResNet, Inception• Pooling layers: Max pooling, average pooling• Transfer learning and fine-tuning• Data augmentation techniques• Object detection basics: R-CNN, YOLO, SSD• Semantic segmentation: U-Net, FCN• Visualization: Feature maps, Grad-CAM• Applications: Image classification, object detection, medical imaging	1	25%
III	Recurrent Neural Networks and Sequence Models Topics: <ul style="list-style-type: none">• RNN architecture and limitations (vanishing/exploding gradients)• LSTM and GRU cells• Bidirectional RNNs• Sequence-to-sequence models	1	25%



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

	<ul style="list-style-type: none">Attention mechanismIntroduction to TransformersTime-series forecasting with RNNsApplications: Language modeling, machine translation, stock prediction, speech recognition		
IV	Advanced Architectures and Emerging Topics Topics: <ul style="list-style-type: none">Autoencoders: Variational Autoencoders (VAEs)Generative Adversarial Networks (GANs)Self-supervised learningGraph Neural Networks (GNNs)Neural Architecture Search (NAS)Federated learning basicsModel compression: Pruning, quantization, knowledge distillationEthical considerations in deep learningApplications: Image generation, recommendation systems, drug discovery	1	25%

TEXT BOOKS:

- Goodfellow, I., Bengio, Y., & Courville, A. – *Deep Learning* – MIT Press.
- Chollet, F. – *Deep Learning with Python* (2nd ed.) – Manning Publications.
- Aggarwal, C.C. – *Neural Networks and Deep Learning: A Textbook* – Springer.
- Bishop, C.M. – *Pattern Recognition and Machine Learning* – Springer.

REFERENCE BOOKS:

- Geron, A. – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.) – O'Reilly.
- Zhang, A., Lipton, Z.C., Li, M., & Smola, A.J. – *Dive into Deep Learning* – Cambridge University Press.
- Raschka, S., & Mirjalili, V. – *Python Machine Learning* (3rd ed.) – Packt Publishing.
- Howard, J., & Gugger, S. – *Deep Learning for Coders with fastai and PyTorch* – O'Reilly.

ONLINE RESOURCES:

- Practical deep learning courses
- Coursera: *Deep Learning Specialization*
- edX: *Deep Learning Fundamentals* (IBM)
- Kaggle: Deep learning competitions and datasets
- Papers With Code: State-of-the-art implementations

PRACTICAL LIST:

- Building and Training Basic Neural Networks

- Task: Implement a Multi-Layer Perceptron from scratch using NumPy for MNIST digit classification. Compare with TensorFlow/PyTorch implementation. Experiment with different activation functions, optimizers, and regularization techniques.
 - CNN Architecture for Image Classification

Task: Design and train a CNN model on CIFAR-10 dataset. Implement data augmentation, batch normalization, and dropout. Compare performance of custom CNN with pre-trained



MK UNIVERSITY

PATAN, GUJARAT

ESTABLISHED BY THE GUJARAT GOVT.

RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT, 1956

models (ResNet50) using transfer learning. Visualize learned filters and feature maps.

2. Sequence Modeling with RNN/LSTM

- Task: Build an LSTM-based model for text generation using Shakespeare's works dataset. Implement character-level and word-level models. Extend to sentiment analysis on IMDB reviews using Bi-directional LSTM with attention mechanism.
 1. Advanced Models: Autoencoders and GANs

Task:

Part A: Implement a Variational Autoencoder (VAE) for MNIST digit generation and anomaly detection.

Part B: Build a DCGAN (Deep Convolutional GAN) to generate realistic faces using CelebA dataset.

Compare results and discuss mode collapse, training stability, and evaluation metrics.