# M. Tech (Computer Science and Engineering)
## EVALUATION SCHEME (JAN 2026- JUNE 2026)

**SEMESTER: II**

| COURSE MODULE | | | | TEACHING PERIODS | | | WEIGHTAGE : EVALUATION | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COURSE | | | Credits | L | T | P | CWA | MSE | ESE | Total |
| Code | Title | Component | | | | | | | | |
| MCS-201 | Deep Learning | CC | 3 | 3 | - | - | 25 | 25 | 50 | 100 |
| MCS-202 | Advanced Operating System | CC | 3 | 3 | - | - | 25 | 25 | 50 | 100 |
| MCS-203 | Reinforcement Learning | CC | 3 | 3 | - | - | 25 | 25 | 50 | 100 |
| MRD-201 | Introduction to Research Methodology | CC | 3 | 3 | - | - | 25 | 25 | 50 | 100 |
| | Program Elective -II | PEC | 3 | 3 | - | - | 25 | 25 | 50 | 100 |
| | | | | | | | | | | |
| MCS-254 | Computing Lab II (Deep Learning + Reinforcement Learning) | CC | 2 | - | - | 4 | 25 | 25 | 50 | 100 |
| MCS-214 | Seminar | SM | 1 | - | - | - | - | - | - | 100 |
| GP-201 | General Proficiency | GP | 1 | - | - | - | - | - | - | 100 |
| | **Total** | | **19** | **15** | | **4** | **150** | **150** | **300** | **800** |

**PROGRAM ELECTIVE COURSES:**

| ELECTIVE NO. | ELECTIVES (CODE WITH SUBJECT NAME) | |
|---|---|---|
| Program Elective-II | MCS-271 | 1. Data Visualization and Interpretation |
| | **MCS-272** | **2. Cyber Security Compliance** |
| | MCS-273 | 3. Quantum Computing |
| | MCS-274 | 4. Affective Computing |
| | MCS-275 | 5. Graph Database |
| | MCS-276 | 6. Applied Time Series Analysis |
| | MCS-277 | 7. Edge Computing |

# M. Tech (Computer Science and Engineering)
## EVALUATION SCHEME (JAN 2026- JUNE 2026)

**SEMESTER: IV**

| | COURSE DETAILS | | | TEACHING PERIODS | | | WEIGHTAGE: EVALUATION | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COURSE | | | Credits | L | T | P | C WA | MSE | ESE | Total |
| Course | Title | Component | | | | | | | | |
| MCS-400 | Dissertation Phase-II | DS | 24 | - | - | - | 25 | - | 75 | 100 |
| MCS-411 | Seminar | SM | 1 | - | - | - | - | - | - | 100 |
| MCS-462 | Comprehensive Viva-Voce | CM | 2 | - | - | - | - | - | - | 100 |
| GP-401 | General Proficiency | GP | 1 | - | - | - | - | - | - | 100 |
| | Total | | **28** | **-** | **-** | **-** | **25** | | **75** | **400** |

**Name of Department: Computer Science & Engineering**

1. Subject Code: MCS 201 Course Title: **Deep Learning**
2. Contact Hours: L: T: - P:
3. Examination Duration (Hrs): Theory 3 Hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Knowledge of linear algebra, probability and statistics, machine learning fundamentals, and basic programming skills.
9. Objective: To impart comprehensive knowledge of cyber security laws, standards, and compliance frameworks for secure information systems.

**Learning Outcomes:**

- Understand the theoretical foundations of deep learning, including neural network architectures, loss functions, and optimization techniques
- Design and implement deep neural networks such as convolutional, recurrent, and transformer-based models for real-world problems
- Apply regularization, normalization, and hyperparameter tuning techniques to improve model performance and generalization
- Analyze and evaluate deep learning models using appropriate metrics, interpretability methods, and error analysis
- Develop scalable deep learning solutions using modern frameworks and assess their applications in vision, language, speech, and scientific domains

10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---|---|---|
| Unit-I | **Understanding Deep Learning and its application:** Biologically inspired computing, historical context, Perceptron Learning rule, Backpropagation, Multi-layer Perceptron model, Activation Functions: Sigmoid, Tanh, ReLU, Leaky ReLu, Loss functions, Optimization: Stochastic gradient descent, Training Neural Networks, weight initialization, batch normalization, hyper parameter optimization, parameter updates, model ensembles, dropout, Variance, Bias. | 10 |
| Unit II | **Convolutional Neural Networks (CNN):** Introduction, history, architectures, convolution layer, pooling layer, fully connected layer, Conv Net, Case study of ImageNet challenge -LeNet, AlexNet, VGG, GoogLeNet, ResNet, InceptionNet etc. Regularization Techniques, Data Augmentation: zooming, rotation, cropping, blurring, noise addition, self-supervision techniques, Transfer Learning, freezing the input layers, fine tuning output layers. | 10 |
| Unit III | **Transfer Learning:** Transfer Learning Scenarios, Applications of Transfer Learning, TransferLearning Methods, Fine Tuning and Data Augmentation, Related Research Areas | 8 |

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| Unit IV | **Applications of Recurrent and Recursive Neural Networks:** Understanding Recurrent and Recursive Neural Networks, Word Embedding, Language Models, Text Classification, Named-Entity Recognition, Machine Translation, Parsing, Sentiment Analysis, Speech Recognition, Encoder Decoder architectures, Attention Model, Transformer, BERT, ChatGPT. | 8 |
| Unit V | **Generative Network**: Understanding Generative Adversarial Networks, Image Inpainting, ImageSuper Resolution, Colorization of Black and White Images, Human Face Generation, Text2Image. | 8 |
| | Total | 44 |

**Textbooks:**

- Deep Learning: Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press
- Neural Networks and Deep Learning: Charu C. Aggarwal, Springer
- Deep Learning with Python: François Chollet, Manning

**Reference Books:**

- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Aurélien Géron, O'Reilly
- Deep Learning for Computer Vision: Rajalingappaa Shanmugamani, Packt
- Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer
- Deep Learning: A Practitioner's Approach: Adam Gibson & Josh Patterson, O'Reilly

**Name of Department: Computer Science & Engineering**

1. Subject Code: MCS 202 Course Title: **Advanced Operating Systems**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Student should have studied operating system concepts
9. Objective: To get a comprehensive knowledge of distributed systems and its architecture.

**Learning Outcomes:**

- Have a good understanding of process and thread management.
- To understand basics of inter process communication between co-operating processes.
- To understand the deadlock and shared memory issues and their solutions in distributed environments.
- To know the security issues and protection mechanisms for distributed environments.
- To get a knowledge of multiprocessor operating systems and database operating systems.

10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---|---|---|
| Unit-I | **Introduction:** Operating Systems Strategies: User' perspectives, technologies and examples of Batch Systems, Timesharing Systems, Personal computer systems, Embedded systems, and small communicating computers; The genesis of modern operating systems. | 8 |
| Unit II | **Using the Operating Systems:**The programmer's abstract machine; Resources; Processes and threads; **Process Synchronization:** Inter-process communication; Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores. | 8 |
| Unit III | **Operating Systems Organization:** Basic functions; General implementation considerations; Contemporary OS kernels. *Design Strategies:* Design considerations; Monolithic kernels; Modular organization; Microkernel; Layered organizations; Operating Systems for distributed system. Primary and Secondary Memory Management. | 10 |

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| Unit IV | Distributed Process Management; Process Migration; Distributed Global States; Distributed Mutual Exclusion; Distributed Deadlock. | 10 |
| Unit V | **Real World Examples:** Linux, Windows NT/2000/XP: Process descriptors, Thread descriptors, Thread scheduling. Linux, Windows NT/2000/XP: Kernel | 8 |
| | Total | 44 |

**Textbooks:**

- Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2004.
- William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2008.

**Reference Books:**

- Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
- Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006.
- Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007

**Name of Department: Computer Science & Engineering**

1. Subject Code: MCS 203 Course Title: **Reinforcement Learning**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Understanding of probability theory, Markov processes, optimization concepts, and basic machine learning techniques.
9. Objective: To develop the ability to model and solve sequential decision-making problems using reinforcement learning algorithms.

**Learning Outcomes:**

- Understand and explain the fundamental concepts of reinforcement learning, including MDPs, value functions, and policies
- Analyze and apply dynamic programming, Monte Carlo, and temporal-difference learning algorithms to decision-making problems
- Design and implement model-free and model-based reinforcement learning solutions for control and optimization tasks
- Evaluate the role of function approximation and deep learning techniques in solving large-scale reinforcement learning problems
- Critically assess advanced reinforcement learning methods and apply them to real-world applications such as robotics, games, and autonomous systems

10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---|---|---|
| Unit-I | **Foundations of Reinforcement Learning:** Introduction to reinforcement learning, learning paradigms (supervised, unsupervised, reinforcement), agent–environment interaction, reward signal, state, action, policy, value function, episodic and continuing tasks, return and discount factor, Markov property, Markov reward processes, Markov decision processes, Bellman equations for prediction, applications of reinforcement learning. | 8 |
| Unit II | **Dynamic Programming and Monte Carlo Methods:** Policy evaluation, policy improvement, policy iteration, value iteration, convergence of dynamic programming, limitations of dynamic programming, Monte Carlo prediction, first-visit Monte Carlo, every-visit Monte Carlo, Monte Carlo control, exploring starts, on-policy and off-policy learning, importance sampling, comparison of dynamic programming and Monte Carlo methods. | 9 |

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| Unit III | **Temporal Difference Learning:** Temporal difference (TD) learning, TD prediction, TD (0) algorithm, advantages of TD methods, SARSA algorithm, Q-learning algorithm, expected SARSA, bias–variance trade-off, convergence issues in TD learning, eligibility traces, TD(λ) methods. | 9 |
| Unit IV | **Function Approximation and Deep Reinforcement Learning:** Curse of dimensionality, function approximation in reinforcement learning, linear function approximation, gradient descent methods, value function approximation, policy approximation, introduction to deep reinforcement learning, neural networks as function approximators, deep Q-networks, experience replay, target networks, stability and convergence challenges in deep reinforcement learning. | 9 |
| Unit V | **Advanced Topics and Applications:** Policy gradient methods, REINFORCE algorithm, actor–critic methods, advantage actor–critic algorithms, proximal policy optimization, multi-agent reinforcement learning, exploration–exploitation strategies, hierarchical reinforcement learning, model-based and model-free reinforcement learning, safe and ethical reinforcement learning, applications in robotics, autonomous systems, games, finance, and remote sensing. | 9 |
| | Total | 44 |

**Textbooks:**

- Reinforcement Learning An Introduction, Richard S Sutton, Andrew G Barto, MIT Press
- Algorithms for Reinforcement Learning, Csaba Szepesvari, Morgan and Claypool
- Deep Reinforcement Learning Hands-On, Maxim Lapan, Packt Publishing

**Reference Books:**

- Reinforcement Learning and Dynamic Programming Using Function Approximators, Lucian Busoniu, CRC Press
- Foundations of Reinforcement Learning with Applications in Finance, Ashwin Rao, Springer
- Practical Reinforcement Learning, Ivan Gridin, Packt Publishing

**Name of Department: Computer Science & Engineering**

1. Subject Code: MCS 201 Course Title: **Introduction to Research Methodology**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Basic knowledge of engineering mathematics, statistics, and familiarity with technical documentation.
9. Objective: To equip students with essential research skills for problem formulation, experimental design, data analysis, and scholarly writing.

**Learning Outcomes:**

- Identify research problems and formulate clear research objectives, questions, and hypotheses
- Select appropriate research designs, sampling methods, and data collection techniques for engineering research
- Apply statistical and analytical methods to analyze research data and interpret results effectively
- Demonstrate competence in scientific writing, research documentation, and ethical publication practices
- Develop research proposals and critically evaluate contemporary research literature in engineering and technology

10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---|---|---|
| Unit-I | **Fundamentals of Research:** Nature and objectives of research, types of research (basic, applied, exploratory, descriptive, experimental), scientific method, research process and steps, identification of research problem, formulation of research objectives, research questions and hypotheses, literature survey and review techniques, research gaps identification, plagiarism and research ethics, introduction to research metrics. | 8 |
| Unit II | **Research Design and Data Collection Methods:** Research design concepts, qualitative and quantitative research approaches, experimental and non-experimental designs, sampling methods and sampling design, probability and non-probability sampling, data types and sources, primary and secondary data, data collection techniques (questionnaire, interview, observation, surveys), scaling techniques, measurement and validation of data, pilot studies. | 9 |
| Unit III | **Statistical Methods and Data Analysis:** Descriptive statistics, probability concepts, random variables, probability distributions, hypothesis testing, parametric and non-parametric tests, correlation and regression analysis, analysis of variance (ANOVA), multivariate analysis basics, data preprocessing and cleaning, statistical tools and software for research analysis, interpretation of results. | 9 |

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| Unit IV | **Research Writing and Publication:** Structure of a research paper, technical writing skills, abstract and introduction writing, methodology and results presentation, discussion and conclusion writing, citation and referencing styles, journal and conference selection, peer review process, impact factor and indexing, plagiarism detection tools, ethical issues in publication, intellectual property rights and patents. | 9 |
| Unit V | **Advanced Research Practices and Case Studies:** Interdisciplinary research, formulation of research proposals, funding agencies and grant writing, project management in research, reproducibility and open science, research data management, case studies in engineering and technology research, recent trends in research methodologies, societal and environmental impact of research, thesis and dissertation preparation guidelines, viva-voce and research presentation skills. | 9 |
| | Total | 44 |

**Textbooks:**

- Research Methodology Methods and Techniques, C R Kothari, Gaurav Garg, New Age International
- Research Methodology A Step-by-Step Guide for Beginners, Ranjit Kumar, SAGE Publications
- Research Design Qualitative Quantitative and Mixed Methods Approaches, John W Creswell, J D Creswell, SAGE Publications

**Reference Books:**

- The Craft of Research, Wayne C Booth, Gregory G Colomb, Joseph M Williams, University of Chicago Press
- Practical Research Planning and Design, Paul D Leedy, Jeanne Ellis Ormrod, Pearson
- Technical Communication Principles and Practice, Meenakshi Raman, Sangeeta Sharma, Oxford University Press

**Name of Department: Computer Science & Engineering**

1. Subject Code: MCS 201 Course Title: **Cyber Security Compliance**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 1
7. Subject Area: Core Course
8. Pre-requisite: Fundamentals of computer networks, operating systems, and basic concepts of information security.
9. Objective: To impart comprehensive knowledge of cyber security laws, standards, and compliance frameworks for secure information systems.

**Learning Outcomes:**

- Understand the principles of cyber security governance, risk management, and compliance frameworks
- Interpret and apply national and international cyber laws, regulations, and security standards to organizational contexts
- Conduct cyber risk assessments, compliance audits, and gap analyses using established methodologies
- Design and implement compliant security controls and incident response mechanisms across IT and cloud environments
- Analyze emerging cyber security compliance challenges and recommend ethical, legal, and sustainable solutions

10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---|---|---|
| Unit-I | **Fundamentals of Cyber Security and Compliance:** Introduction to cyber security, information security principles (confidentiality, integrity, availability), cyber threats and attack vectors, risk management concepts, governance, risk and compliance (GRC) framework, role of compliance in cyber security, security policies and standards, security controls (administrative, technical, physical), compliance lifecycle, overview of global cyber security regulations. | 8 |
| Unit II | **Cyber Laws, Regulations, and Standards:** Cyber laws and legal frameworks, Information Technology Act and amendments, data protection and privacy regulations, General Data Protection Regulation (GDPR), sector-specific regulations, international cyber laws and treaties, ISO/IEC 27001 and 27002 standards, NIST cyber security framework, COBIT framework, compliance requirements mapping, regulatory audits and assessments. | 9 |

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| Unit III | **Risk Assessment, Auditing, and Compliance Management:** Cyber risk assessment methodologies, threat modeling, vulnerability assessment and penetration testing overview, compliance risk analysis, internal and external security audit planning and execution, compliance documentation and reporting, security metrics and key performance indicators, continuous monitoring and compliance automation, third-party risk management. | 9 |
| Unit IV | **Implementation of Security Controls and Incident Compliance:** Design and implementation of security controls, access control and identity management compliance, network and application security compliance, cloud security compliance models, data classification and protection, incident response planning, breach notification requirements, digital forensics basics, business continuity and disaster recovery compliance, compliance in DevSecOps environments. | 9 |
| Unit V | **Emerging Issues, Ethics, and Case Studies:** Ethical and professional responsibilities in cyber security, privacy by design and by default, compliance challenges in emerging technologies, compliance in Internet of Things and cyber-physical systems, artificial intelligence and cyber law implications, cross-border data transfer issues, compliance case studies, cyber insurance and liability management, future trends in cyber security compliance, organizational compliance culture and awareness programs. | 9 |
| | Total | 44 |

**Textbooks:**

- Cybersecurity and Cyberlaw, K S Bhushan, Wiley India
- Information Security Governance and Risk Management, Krag Brotby, Auerbach Publications
- Cybersecurity Compliance Framework and Implementation, Stephen Northcutt, Springer

**Reference Books:**

- ISO IEC 27001 2022 A Pocket Guide, Alan Calder, Steve Watkins, IT Governance
- NIST Cybersecurity Framework A Pocket Guide, Alan Calder, IT Governance
- Cyber Law and Cyber Security, Pavan Duggal, LexisNexis