# GOA UNIVERSITY

Scheme and Syllabus

of

# MASTER OF ENGINEERING
**IN DATA SCIENCES**

Course Duration: 02 years

# RC 2024-25

**May 2025**

| Semester III | | | | | | |
|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Title of the Course** | **L** | **T** | **P** | **Credits** |
| **Programme Specific Core (PSC) Courses** | | | | | | |
| 1 | **DEN-600** | Machine Learning for Data Sciences | **3** | **0** | **0** | **3** |
| 2 | **DEN-601** | Machine Learning for Data Sciences Lab | **0** | **0** | **1** | **1** |
| 3 | **DEN-602** | Deep Learning for Data Science | **3** | **0** | **0** | **2** |
| 4 | **DEN-603** | Deep Learning for Data Science Lab | **0** | **0** | **1** | **2** |
| **Programme Specific Elective (PSE) Courses** | | | | | | |
| 5 | **DEN-631** | Information Retrieval | **3** | **0** | **0** | **3** |
| 6 | **DEN-632** | Information Retrieval Lab | **0** | **0** | **1** | **1** |
| **OR** | | | | | | |
| 7 | **DEN-633** | Cyber Security and Threat Analysis | **3** | **0** | **0** | **3** |
| 8 | **DEN-634** | Cyber Security and Threat Analysis Lab | **0** | **0** | **1** | **1** |
| **Research Specific Elective (RSE) Courses** | | | | | | |
| 9 | **DEN-661** | Web Mining | **2** | **0** | **0** | **2** |
| 10 | **DEN-662** | Web Mining Lab | **0** | **0** | **2** | **2** |
| **OR** | | | | | | |
| 11 | **DEN-663** | Recommender Systems | **2** | **0** | **0** | **2** |
| 12 | **DEN-664** | Recommender Systems Lab | **0** | **0** | **2** | **2** |
| **General Elective (GE) Courses** | | | | | | |
| 13 | **GEC-681** | Sustainability Principles & Practices | **3** | **0** | **0** | **3** |
| 14 | **GEC-682** | Sustainability Principals Lab | **0** | **0** | **1** | **1** |
| **OR** | | | | | | |
| 15 | **GEC-683** | Project Management | **3** | **0** | **0** | **3** |
| 16 | **GEC-684** | Project Management Lab | **0** | **0** | **1** | **1** |
| | | **TOTAL** | **14** | **0** | **6** | **20** |

| Semester IV | | | | | | |
|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Title of the Course** | **L** | **T** | **P** | **Credits** |
| **General Elective (GE) Courses** | | | | | | |
| 1 | **GEC-685** | Financial Management | **4** | **0** | **0** | **4** |
| **OR** | | | | | | |
| 2 | **GEC-686** | Entrepreneurship | **4** | **0** | **0** | **4** |
| **Dissertation/Internship** | | | | | | |
| 3 | **DEN-698** | Dissertation | **0** | **0** | **0** | **16** |
| **OR** | | | | | | |
| 4 | **DEN-699** | Internship | **0** | **0** | **0** | **16** |
| | | **TOTAL** | **4** | **0** | **0** | **20** |

| | |
|---|---|
| **Name of the Programme:** | **MASTER OF ENGINEERING (DATA SCIENCES)** |
| **Course Code:** | **DEN-600** |
| **Title of the Course:** | **MACHINE LEARNING FOR DATA SCIENCE** |
| **Number of Credits:** | **03 (3L)** |
| **Effective from AY:** | **2025-26** |

| | | | |
|---|---|---|---|
| **Pre-requisites** | **Basic knowledge of Artificial Intelligence.** | | |
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce the fundamental concepts of machine learning, including problem formulation, data representation, forms of learning, and key concepts like bias-variance tradeoff and overfitting.<br>2. To enable understanding and application of basic statistical and decision tree-based classification techniques for structured data analysis.<br>3. To explore various clustering techniques and data transformation methods, along with introducing the basic principles.<br>4. To provide a foundational understanding of artificial neural networks, their biological inspiration, neuron models and training rules including linear and non-linear classification. | | |
| **Content:** | | **No. of hours** | |
| **Unit - 1** | Introduction: Towards Intelligent Machines, Well-Posed Machine Learning Problems, Examples of Applications in Diverse Fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured/Unstructured, Forms of Learning. Supervised Learning: Learning from Observations, Bias and Variance, Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance | **11** | |

| | | | |
|---|---|---|---|
| **Unit - 2** | Statistical Learning: Naive Bayes Classifier, k-Nearest Neighbor (k-NN) Classifier, Linear and Logistic regression.<br><br>Decision Tree Learning: Introduction, Example of a Classification Decision Tree, Measures of Impurity for Evaluating Splits in Decision Trees, ID3 and C4.5 Decision Trees, Pruning the Tree, Strengths and Weaknesses of Decision-Tree Approach, Random Forest algorithm. | **11** | |
| **Unit - 3** | Data Clustering and Data Transformations: Clustering, Engineering the Data, Different Clustering Methods such as Partitional Clustering, Hierarchical Clustering, Clustering using Self-Organizing Maps, Fuzzy K-Means Clustering, Expectation-Maximization (EM) Algorithm, Data transformation techniques. | **12** | |
| **Unit - 4** | Artificial Neural Networks: Introduction to neural networks, structure of biological neuron, Mc-Culloch Pitts neuron model, Logic network realization by using Mc-Culloch Pitts neuron model, Neuron modelling for artificial neuron systems.<br><br>Single layer network: Concept of linear separability and non-linear separability. Training rules: Hebbian learning rule, perceptron learning rule, Delta learning rule and related problems. | **11** | |
| **Pedagogy:** | This course adopts an applied, student-centered pedagogy that integrates **interactive lectures** with **coding exercises** and **real-world case studies** to bridge theory and practice. **Quizzes and assignments** are strategically placed to reinforce key concepts, assess comprehension, and promote independent problem-solving. | | |

| | | |
|---|---|---|
| **References/ Readings:** | Text Books:<br><br>1. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka, "Elements of Artificial Neural Network", Penram Publications, 2nd Edition, 1995.<br>2. M. Gopal, "Applied Machine Learning\|2nd Edition", Mc Graw Hill Publication, 2nd Edition, 2021.<br>3. Siddhanta Bhatta, "Applied Machine Learning Solutions with Python", BPB Publication, 2nd Edition, 2021.<br>4. Tom M Mitchell, "Machine Learning", Indian edition, McGraw Hill Publication, 1997.<br><br>Reference Books:<br><br>1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, 4th Edition, 2020.<br>2. J. Zurada, "Introduction to Artificial neural network", Jaico Publications, 1996.<br>3. Satish Kumar, "Neural Networks A Classroom Approach", VISIONIAS Publication, 2nd Edition, 2020. | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br><br>CO1 **Describe** the fundamentals of machine learning, including problem types, learning paradigms, the bias-variance trade-off, and overfitting.<br><br>CO2 **Apply** statistical and decision tree algorithms for classification tasks, and **evaluate** model performance using appropriate metrics<br><br>CO3 **Analyse** the working of clustering methods such as k-means and hierarchical clustering and **explain** their principles.<br><br>CO4 **Implement** basic neural network models and **apply** learning rules for training single-layer networks. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-601**

**Title of the Course:** **MACHINE LEARNING FOR DATA SCIENCE LAB**

**Number of Credits:** **01 (1L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | **Basic knowledge of python programming.** | |
| **Course Objectives:** | The course will enable the students to:<br>1. Understand the concepts of Machine learning and learn about Python libraries.<br>2. Demonstrate the knowledge of various supervised learning algorithms.<br>3. Implement Python programs for data clustering, transformation and dimensionality reduction techniques.<br>4. Illustrate knowledge of logic functions, linear and non-linear separability concept and different training rules. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |

| | | |
|---|---|---|
| | 1. Study experiment on Machine learning.<br>2. Study of various Python machine learning libraries.<br>3. Implementation of KNN classifier.<br>4. Implementation of Naive Bayes Classifier.<br>5. Implementation of Decision tree classifier ID3.<br>6. Implementation of Decision tree classifier C4.5.<br>7. Implementation of Random Forest algorithm for application<br>8. Implementation of Hierarchical clustering algorithm<br>9. Implementation of Hierarchical clustering algorithm<br>10. Implementation of clustering using SOM | **30 Hours** |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>CO1 Demonstrate an understanding of machine learning fundamentals and effectively utilize Python libraries for data analysis and model development.<br>CO2 Design and implement supervised learning algorithms to solve real-world problems across various domains.<br>CO3 Apply data clustering, transformation, and dimensionality reduction techniques for pattern discovery and feature optimization.<br>CO4 Implement logic functions and neural network models, and apply training rules to address linearly and non-linearly separable problems. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-602**

**Title of the Course:** **DEEP LEARNING FOR DATA SCIENCE**

**Number of Credits:** **03 (3L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites** | **Basic knowledge of Artificial Intelligence.** | |
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce the idea of artificial neural networks and their architecture<br>2. To introduce techniques used for training artificial neural networks<br>3. To enable design of an artificial neural network for classification<br>4. To enable design and deployment of deep learning models for machine learning problems | |
| **Content:** | | **No. of hours** |
| **Unit-1** | **Artificial Neural Networks**: The Neuron-Expressing Linear Perceptrons as Neurons-Feed-Forward Neural Networks- Linear Neurons and Their Limitations –Sigmoid – Tanh – and ReLU Neurons -Softmax Output Layers **Training Feed-Forward Neural Networks:** Gradient Descent -Delta Rule and Learning Rates- Gradient Descent with Sigmoidal Neurons- The Backpropagation Algorithm-Stochastic and Minibatch Gradient Descent | **10** |

| | | |
|---|---|---|
| **Unit-2** | **Implementing Neural Networks in TensorFlow**<br><br>**Beyond Gradient Descent:** Local Minima in the Error Surfaces of Deep Networks- Model Identifiability- Spurious Local Minima in Deep Networks- Flat Regions in the Error Surface – Momentum-Based Optimization. | **10** |
| **Unit-3** | **Convolutional Neural Networks (CNN)**: Architecture -Accelerating Training with Batch Normalization- Building a Convolutional Network using TensorFlow- Visualizing Learning in Convolutional Networks. | **10** |
| **Unit-4** | **Embedding and Representation Learning:** Autoencoder Architecture<br><br>**Models for Sequence Analysis**: Recurrent Neural Networks- Vanishing Gradients Long Short-Term Memory (LSTM) Units. | **10** |
| **Pedagogy:** | This course employs a blended, learner-centered pedagogy that combines **interactive lectures**, **hands-on lab sessions**, and **problem-based learning** to promote deep understanding and practical application of concepts. **Quizzes and assignments** are integrated throughout the course to reinforce learning. | |
| **References/ Readings:** | **Text Books**<br>1. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm", O'Reilly, 2017.<br>2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.<br>**Reference Books**<br>1. Aurélien Géron, "Hands-On Machine Learning with Scikit- Learn and TensorFlow", O'Reilly, 2017.<br>2. Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress,1ST Edition, 2017. | |

| | | |
|---|---|---|
| **Course Outcomes:** | **After taking this course, student will be able to:** | |
| | CO1 | **Describe** the structure and functioning of artificial neurons, including activation functions, and **analyse** the architecture and limitations of feed-forward neural networks |
| | CO2 | **Implement** neural network training using gradient descent and backpropagation and **evaluate** model performance using relevant metrics. |
| | CO3 | **Design** and **develop** convolutional neural networks (CNNs) using TensorFlow, incorporating model optimization and visualization techniques. |
| | CO4 | **Apply** deep learning architectures such as autoencoders and RNNs with LSTM units to tasks involving sequential data and feature representation |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-603**

**Title of the Course:** **DEEP LEARNING FOR DATA SCIENCE LAB**

**Number of Credits:** **01 (1L)**

**Effective from AY:** **2025-26**

| | |
|---|---|
| **Pre-requisites for the Course:** | **Basic knowledge of artificial intelligence** |

| | | |
|---|---|---|
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce the fundamental concepts of artificial neurons, activation functions, and feedforward neural networks.<br>2. To equip students with training techniques for deep neural networks, including gradient-based optimization and overfitting prevention strategies.<br>3. To enable students to design and implement convolutional neural networks (CNNs) and optimize deep models using advanced techniques like batch normalization.<br>4. To explore representation learning using autoencoders and sequential data modeling using recurrent neural networks and LSTM architectures. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |
| | 1. **Implement a basic perceptron model** for binary classification using NumPy or TensorFlow.<br>2. **Visualize and compare activation functions**: Sigmoid, Tanh, and ReLU.<br>3. **Build a feedforward neural network** with softmax output for multi-class classification.<br>4. **Demonstrate gradient descent optimization** with different learning rates on a simple dataset.<br>5. **Implement backpropagation algorithm** for training a neural network.<br>6. **Apply dropout and L2 regularization** to reduce overfitting in a neural network.<br>7. **Develop a CNN model** for image classification using MNIST or CIFAR-10 datasets.<br>8. **Integrate batch normalization** into a CNN and observe its impact on training.<br>9. **Train neural networks using momentum-based optimizers** like SGD, RMSProp, and Adam.<br>10. **Build an autoencoder model** for dimensionality reduction or data denoising. | **30 Hours** |

| | |
|---|---|
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>CO1 **Understand** and **analyse** various artificial neuron models, activation functions, and feedforward architectures.<br>CO2 **Implement** and **train** neural networks using backpropagation, gradient descent, and **apply** regularization to prevent overfitting.<br>CO3 **Design** and **evaluate** convolutional neural networks (CNNs) using TensorFlow and **optimize** them using techniques like batch normalization and advanced optimizers.<br>CO4 **Apply** autoencoders for representation learning. |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-631**

**Title of the Course:** **INFORMATION RETRIEVAL**

**Number of Credits:** **03 (3L)**

**Effective from AY:** **2025-26**

| | |
|---|---|
| **Pre-requisites** | **Basic knowledge of Artificial Intelligence.** |

| | | |
|---|---|---|
| **Course Objectives:** | The course will enable the students to:<br>1. Will be able to explain the basics of information retrieval, and the heart of search engines.<br>2. Will be able to evaluate an information retrieval system based on the relevance feedback, query expansion<br>3. Apply clustering and classification techniques to a corpus of texts for a specific information need<br>4. Understand and apply different IR techniques | |
| **Content:** | | **No. of hours** |
| **Unit-1** | Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities. | **12** |
| **Unit-2** | Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction | **12** |
| **Unit-3** | Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing–rose, Hypertext Linkages Document, (Vector Rating)--adi and Term Clustering: Introduction to Clustering, Thesaurus Generation–saish, Item Clustering–vig | **11** |
| **Unit-4** | User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking,--shaunk Relevance Feedback–duv, Selective Dissemination of Information Search–jesl, Weighted Searches of Boolean Systems–arya, Searching the INTERNET and Hypertext–mansi | **10** |
| **Pedagogy:** | This course adopts a **blended**, **concept-to-practice pedagogical approach**, combining **interactive lectures**, **hands-on coding exercises**, and **problem-based learning** to help students understand and apply core principles of Information Retrieval (IR). Learning is reinforced through a mix of **quizzes, assignments**, and **case-based discussions.** | |

| | |
|---|---|
| **References/ Readings:** | **TEXTBOOKS**<br>1. Gerald J. Kowalski, Mark T. Maybury, "Information Storage and Retrieval Systems – Theory and Implementation", Second Edition, Springer<br>**REFERENCES**<br>1. Bruce Croft, Donald Metzler, and Trevor Strohman ,"Search Engines: Information Retrieval in Practice", Pearson Education, 2009.<br>2. R. R. Korfhage, "Information Storage and Retrieval", John Wiley & Sons, 1997, ISBN 0-471-14338-3<br>3. R. Baeza-Yates, B. Ribeiro-Neto, "Modern Information Retrieval", Addison-Wesley, 1999, Pearson Publishers, ISBN 978-81-317-0977-1.<br>4. C.D., Raghavan, P. and Schütze, H.," Introduction to Information Retrieval by Manning", 2008, Cambridge University Press, ISBN-13: 978-1-107-66639-9. |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>CO1 **Define** the Information retrieval system and its objectives along with various capabilities.<br>CO2 **Explain** and **apply** IR principles to locate relevant information from large datasets using various indexing methods.<br>CO3 **Implement** different user search techniques and **document** clustering algorithms.<br>CO4 **Analyze** different Text Search Algorithms |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-632**

**Title of the Course:** **INFORMATION RETRIEVAL LAB**

**Number of Credits:** **01 (1L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | **Basic knowledge of Artificial Intelligence.** | |
| **Course Objectives:** | The course will enable the students to:<br>1. To understand the architecture and functionality of information retrieval systems.<br>2. To gain hands-on experience with cataloging, indexing, and automatic information extraction techniques.<br>3. To implement document clustering, similarity measures, and ranking methods for IR tasks.<br>4. To explore practical search techniques and web-based information retrieval systems. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |
| | 1. Implement a basic information retrieval system for text document storage and retrieval.<br>2. Demonstrate metadata generation and cataloging using a sample dataset.<br>3. Perform manual and automatic indexing on a text collection.<br>4. Extract key terms from documents using basic NLP techniques.<br>5. Implement statistical indexing using term frequency and inverse document frequency (TF-IDF).<br>6. Generate a simple thesaurus from a text corpus.<br>7. Perform document clustering using K-Means or hierarchical clustering.<br>8. Calculate cosine similarity between documents and a query.<br>9. Implement a ranked retrieval system using vector space model.<br>10. Apply relevance feedback to refine search results. | **30 Hours** |

| | |
|---|---|
| **Course Outcomes:** | **After taking this course, student will be able to:** |

| | |
|---|---|
| CO1 | **Demonstrate** the core components and capabilities of information retrieval systems through practical tools. |
| CO2 | **Implement** indexing and information extraction methods for organizing and retrieving documents. |
| CO3 | **Apply** document clustering and statistical techniques to improve information retrieval performance. |
| CO4 | **Apply** search strategies, ranking algorithms, and relevance feedback mechanisms in real-world information retrieval scenarios. |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-633**

**Title of the Course:**

**CYBER SECURITY AND THREAT ANALYSIS**

**Number of Credits:** **03 (3L)**

**Effective from AY:** **2025-26**

| | |
|---|---|
| **Pre-requisites** | Basic knowledge of computer networks |

| | | |
|---|---|---|
| **Course Objectives:** | The course will enable the students to:<br>1. **Explain** foundational cybersecurity principles, including authentication, cryptography, and network security mechanisms.<br>2. **Analyse** attacker techniques, common vulnerabilities, and exploitation methods used in real-world cyber-attacks.<br>3. **Identify** malware types, privilege escalation techniques, and methods for detecting and analysing malicious code.<br>4. **Explain** defence mechanisms such as memory forensics, intrusion detection systems, and strategies for protecting critical infrastructure and the human element. | |
| **Content:** | | **Sr. No.** |
| **Unit-1** | **Cyber Security Fundamentals:** Authentication, Authorization, Nonrepudiation, Confidentiality, Integrity, Availability, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System, Packet-Filtering Firewalls, Stateful Firewalls, Application Gateway Firewalls, The virtualization Menu, Full Virtualization.<br>**Attacker Techniques and Motivations:** How and why Attackers use proxies, Types of proxies, Detecting the use of proxies, Tunnelling Techniques – HTTP, DNS, ICMP, Detection and prevention, Fraud Techniques, Rogue Antivirus, Threat Infrastructure. | **10** |
| **Unit-2** | **Exploitation:** Shellcode, Integer Overflow Vulnerabilities, Stack based buffer overflows, Format String Vulnerabilities, SQL Injection, Race Conditions, Web Exploit Tools, DoS Conditions, Cross-Site Scripting, Social Engineering, DNS Amplification Attacks.<br>**Malicious Code:** Worms, Viruses, Evading Detection and Elevating Privileges, Rootkits, Spyware, Attacks against Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Virtual Machine Detection, Stealing Information and Exploitation. | **10** |
| **Unit-3** | **Defense and Analysis Techniques:** Why memory Forensics is important, Capabilities of Memory Forensics, Memory Analysis Frameworks, Dumping Physical Memory, Installing and using Volatility, Finding Hidden Processes, Volatile Analyst Pack, Honeypots, Malicious Code Naming, Automated Malicious Code Analysis Systems, Intrusion Detection Systems. | **10** |

| | | |
|---|---|---|
| **Unit-4** | **Protecting Critical Infrastructure:** Introduction, Technology Background Process Control Systems, Threats and Convergence, Real-Life Examples, Plant Meltdown.<br><br>Why PCI is Important: Introduction, what is PCI, Overview of PCI Requirements, Risks and Consequences, Benefits of Compliance.<br><br>Social Engineering: Introduction, Attack the People Layer, Phreaking, Defending the People Layer, Making the Case for stronger Security, People Layer Security Project. | **10** |
| **Pedagogy:** | This course employs a **learner-centered pedagogical approach** that integrates **interactive lectures**, **hands-on labs**, and **case-based problem solving** to equip students with both theoretical foundations and practical skills in cybersecurity and threat analysis. **Laboratory sessions** emphasize experiential learning through simulations, malware analysis, and penetration testing exercises, enabling students to apply techniques in realistic scenarios. | |
| **References/ Readings:** | **Text Books**<br>1. J. Graham, R. Howard, and R. Olson, *Cyber Security Essentials*. Boca Raton, FL, USA: Auerbach Publications, 2011.<br>2. C. Schiller, S. Fogie, C. De Rodeff, and M. Gregg, *Infosecurity 2008 Threat Analysis*. Burlington, MA, USA: Syngress Publishing, 2007.<br>**Reference Books**<br>1. A. Singh, *Introduction to Cyber Security: Concepts, Principles, Technologies and Practices*. Hyderabad, India: Universities Press (India) Pvt. Ltd., 2021. | |
| **Course Outcomes:** | After taking this course, student will be able to:<br>CO1 **Explain** fundamental cybersecurity principles, including authentication, encryption, firewalls, and virtualization, and their role in securing systems and networks.<br>CO2 **Analyse** attacker techniques, vulnerabilities, and exploitation methods such as tunnelling, buffer overflows, and SQL injection, and assess their impact on systems.<br>CO3 **Apply** threat detection and defence mechanisms, including memory forensics, intrusion detection systems, and malicious code analysis tools.<br>CO4 **Evaluate** strategies for protecting critical infrastructure and the human layer, including compliance frameworks, social engineering defences, and real-world case scenarios. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-634**

**Title of the Course:** **CYBER SECURITY AND THREAT ANALYSIS LAB**

**Number of Credits:** **01 (1L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Basic knowledge of computer networks | |
| **Course Objectives:** | The course will enable the students to:<br>1. To provide practical exposure to core cybersecurity principles including authentication, encryption, and network defenses.<br>2. To simulate and analyze common cyber-attacks such as buffer overflows, SQL injection, and DoS.<br>3. To explore detection, analysis, and mitigation techniques for malware and privilege escalation.<br>4. To familiarize students with forensic tools and intrusion detection systems for real-world cyber incident analysis. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |

| | | |
|---|---|---|
| | 1. Create strong passwords and test password strength using online tools or Python scripts.<br>2. Demonstrate basic file encryption and decryption using tools like `gpg` or a simple Python script.<br>3. Explore different types of malware (viruses, worms, spyware) through case studies or simulations.<br>4. Use Wireshark to capture and analyze basic network traffic and identify protocol types.<br>5. Configure a basic firewall using Windows Defender or Linux `ufw` to block/allow ports.<br>6. Simulate a phishing attack using a dummy email and identify red flags in phishing messages.<br>7. Perform port scanning using Nmap and interpret scan results.<br>8. Set up a Virtual Machine (VM) and isolate it for safe testing of tools or suspicious files.<br>9. Use Task Manager and Process Explorer to identify suspicious processes on a Windows system.<br>10. Check system for vulnerabilities using tools like Microsoft Baseline Security Analyzer (MBSA) or Nessus (free trial). | **30 Hours** |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>CO1 **Apply** cryptographic techniques and firewall configurations to secure systems and networks.<br>CO2 **Demonstrate** the ability to exploit and **analyze** common vulnerabilities and attacks.<br>CO3 **Analyze** and **detect** malicious software behavior and privilege escalation attempts.<br>CO4 **Utilize** memory forensics and IDS tools for detecting, analyzing, and mitigating security breaches. | |

| | |
|---|---|

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-661**

**Title of the Course:** **WEB MINING**

**Number of Credits:** **02 (2L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites** | Basic knowledge of Data Analysis | |
| **Course Objectives:** | The course will enable the students to:<br>1. Understand the concepts behind web mining.<br>2. Applying knowledge and understanding to apply supervised and unsupervised techniques<br>3. Understand information retrieval and web search techniques<br>4. Will be able to describe Link Analysis and Web Crawling and Opinion Mining and Web Usage Mining Opinion Mining concepts and techniques. | |
| **Content:** | | **Sr. No.** |
| **Unit-1** | **Introduction to Web Data Mining and Data Mining Foundations**<br>Introduction – World Wide Web (WWW), A Brief History of the Web and the Internet, Web Data Mining-Data Mining, Web Mining. Data Mining Foundations – Association Rules and Sequential Patterns – Basic Concepts of Association Rules, Apriori Algorithm- Frequent Itemset Generation, Association Rule Generation | **7** |
| **Unit-2** | **Supervised and Unsupervised Learning Supervised Learning**<br>– Basic Concepts, Decision Tree Induction – Learning Algorithm, Impurity Function, Handling of Continuous Attributes, Classifier | **7** |

| | | |
|---|---|---|
| | Evaluation, Rule Induction – Sequential Covering, Rule Learning, Classification Based on Associations, Naïve Bayesian Classification, Naïve Bayesian Text Classification – Probabilistic Framework, Naïve Bayesian Model. Unsupervised Learning – Basic Concepts, K-means Clustering – K-means Algorithm, Representation of Clusters, Hierarchical Clustering – Single link method, Complete link Method, Average link method, Strength and Weakness. | |
| **Unit-3** | **Information Retrieval and Web Search:**<br><br>Basic Concepts of Information Retrieval, Information Retrieval Methods – Boolean Model, Vector Space Model--duval and Statistical Language Model, Relevance Feedback--arya, Evaluation Measures, Text and Web Page Preprocessing Stopword RemovalStemming, Web Page Preprocessing------Jeslif –, | **7** |
| **Unit-4** | **Link Analysis and Web Crawling:**<br><br>Link Analysis – Social Network Analysis, Co-Citation and Bibliographic Coupling,---Mansi Page Rank Algorithm--Rose, HITS Algorithm—Shaunak, Community Discovery-Problem Definition, Bipartite Core Communities--Aditi, Maximum Flow Communities, Email Communities--saish. Web Crawling – A Basic Crawler Algorithm- Breadth First Crawlers--Vignesh | **7** |
| **Pedagogy:** | **Inquiry Based Learning, Reflective** | |
| **References/ Readings:** | **TEXTBOOKS**<br><br>**1**.*B. Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, 2nd ed. Berlin, Germany: Springer, 2011. ISBN: 978-3-642-19459-7.*<br><br>**REFERENCES BOOKS:**<br><br>**1.** J. Han and M. Kamber, *Data Mining: Concepts and Techniques*, 2nd ed. San Francisco, CA, USA: Elsevier, 2006. ISBN: 978-1-55860-901-3.<br><br>**2.** S. Chakrabarti, *Mining the Web: Discovering Knowledge from Hypertext Data*. San Francisco, CA, USA: Morgan Kaufmann, 2002. ISBN: 978-1-55860-754-5. | |
| **Course Outcomes:** | **After taking this course, student will be able to:** | |

| | | |
|---|---|---|
| | CO1 | **Explain** the fundamentals of web data mining and the evolution of the World Wide Web and **apply** the A-priori algorithm to generate frequent item sets and discover association rules from web data. |
| | CO2 | **Implement** and **compare** classification and clustering algorithms for effective analysis of web data. |
| | CO3 | **Use** information retrieval models and perform text preprocessing to support accurate and relevant web search outcomes. |
| | CO4 | **Analyse** web link structures using algorithms such as PageRank and HITS and **develop** a basic web crawler for structured data collection. |

| | |
|---|---|
| **Name of the Programme:** | **MASTER OF ENGINEERING (DATA SCIENCES)** |
| **Course Code:** | **DEN-662** |
| **Title of the Course:** | **WEB MINING LAB** |
| **Number of Credits:** | **02 (4P)** |
| **Effective from AY:** | **2025-26** |

| | |
|---|---|
| **Pre-requisites for the Course:** | Basic knowledge of Data Analysis |

| | | |
|---|---|---|
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce tools and techniques for mining structured and unstructured web data.<br>2. To provide hands-on experience with supervised and unsupervised learning methods for web content analysis.<br>3. To develop practical skills in information retrieval and web search evaluation.<br>4. To understand and implement web link analysis and crawling algorithms. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |
| | 1. Implement the A-priori algorithm for frequent itemset generation and rule extraction.<br>2. Perform association rule mining using any dataset and the mlxtend library in Python.<br>3. Build a decision tree classifier using scikit-learn and visualize it with graphviz.<br>4. Implement Naïve Bayes classifier for classifying text documents from the web.<br>5. Apply K-means clustering to group web content (e.g., news articles or HTML text).<br>6. Perform hierarchical clustering and plot dendrograms using SciPy, cluster, hierarchy.<br>7. Preprocess textual web data by removing stop words, tokenizing, and applying stemming or lemmatization.<br>8. Implement the Boolean retrieval model for keyword-based document matching.<br>9. Develop a vector space model and compute TF-IDF scores for a set of documents.<br>10. Calculate cosine similarity between documents and rank them for a user query.<br>11. Simulate the PageRank algorithm on a small manually defined web graph.<br>12. Implement the HITS algorithm to identify authority and hub scores in a hyperlink graph.<br>13. Develop a simple web crawler using requests, urllib, and BeautifulSoup.<br>14. Extract hyperlinks and metadata (e.g., titles, keywords) from a set of web pages.<br>15. Build a basic search engine interface to query a small local document collection. | **60 Hours** |

| | |
|---|---|
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>CO 1 Extract frequent patterns and associations from web data using data mining algorithms.<br>CO 2 Apply classification and clustering techniques to analyze web content<br>CO 3 Implement text preprocessing and evaluate search models for web information retrieval.<br>CO 4 Analyze web link structures and develop basic web crawlers. |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-663**

**Title of the Course:** **RECOMMENDER SYSTEMS**

**Number of Credits:** **02 (2L)**

**Effective from AY:** **2025-26**

| | |
|---|---|
| **Pre-requisites** | Basic knowledge of Data Analysis |
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce the fundamentals of recommender systems and familiarize students with neighbourhood-based collaborative filtering methods.<br>2. To enable students to implement model-based collaborative filtering and content-based recommendation techniques. |

| | | |
|---|---|---|
| | 3. To explore knowledge-based and hybrid recommender system approaches for more personalized recommendations.<br>4. To evaluate recommender systems using suitable metrics and incorporate contextual information for improved recommendations. | |
| **Content:** | | **Sr. No.** |
| **Unit-1** | An Introduction to Recommender Systems: Introduction, Goal of recommender system, Goal of recommender system, Basic model of recommender system, Domain specific challenges of recommender system, Neighborhood Based Collaborative Filtering: Introduction, Key properties of rating matrix, predicting rating with neighbourhood-based methods, Clustering and neighborhood based methods, Dimensionality reduction and neighborhood methods | **7** |
| **Unit-2** | Model Based Collaborative Filtering: Introduction, Decision and Regression Trees, Rule based Collaborative Filtering, Naïve Bayes collaborative Filtering, Using arbitrary classification model as black box, Content Based Recommender Systems: Basic components of content based models, Preprocessing and Feature extraction, Feature Representation and Cleaning, Collecting user likes and dislikes, Supervised feature selection and weighting, | **7** |
| **Unit-3** | Knowledge Based Recommender Systems: Constraint based recommender system, Persistent personalization in Knowledge based system, Case based recommender, Ensemble Based and Hybrid Recommender Systems: Ensemble Methods from classification perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrid, Meta Level Hybrids, Feature Combination Hybrid, Mixed Hybrid | **7** |
| **Unit-4** | Evaluating Recommender Systems: Evaluation Paradigm, General goals of paradigm design, Design issues in offline recommender evaluation, Accuracy metrics in Offline evaluation, limitation of evaluation measures, Context Sensitive Recommender Systems: Multidimensional approach, Contextual pre-filtering, post filtering, Contextual modelling | **7** |

| | |
|---|---|
| **Pedagogy:** | The course will be taught through **interactive lectures**, **coding labs**, **case studies**, and **hands-on projects**. Students will implement algorithms, analyze real-world recommender systems, and engage in **quizzes**, **assignments**, and **peer-reviewed presentations** to apply, evaluate, and create effective recommendation models. |
| **References/ Readings:** | **Textbooks**<br>1. C. C. Aggarwal, *Recommender Systems: The Textbook*. Cham, Switzerland: Springer, 2016. ISBN: 978-3-319-29659-3.<br><br>**Reference Books**<br>1. Francesco Ricci, Lior Rokach, Bracha Shapira, *Recommender Systems Handbook*, Springer, 1st Ed., 2011.<br>2. Yehuda Koren, Robert Bell, and Chris Volinsky, *Matrix Factorization Techniques for Recommender Systems*, IEEE Computer, 2009. |
| **Course Outcomes:** | After taking this course, student will be able to:<br>CO1 **Apply** neighbourhood-based collaborative filtering techniques to build basic recommender systems.<br>CO2 **Implement** model-based and content-based recommendation approaches using machine learning methods.<br>CO3 **Design** knowledge-based and hybrid recommender systems for personalized recommendations.<br>CO4 **Evaluate** recommender systems using standard metrics and **integrate** contextual information for enhanced relevance. |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**

**Course Code:** **DEN-664**

**Title of the Course:** **RECOMMENDER SYSTEMS LAB**

**Number of Credits:** **02 (2L)**

**Effective from AY:** **2025-26**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Basic knowledge of Data Analysis | |
| **Course Objectives:** | The course will enable the students to:<br>1. To introduce the practical implementation of various recommender system models.<br>2. To apply collaborative and content-based filtering techniques using real-world datasets.<br>3. To develop and evaluate hybrid and advanced recommender algorithms using modern libraries.<br>4. To equip students with skills to analyze performance using standard evaluation metrics. | |
| **Content:** | **List of Programs /Experiments** | **No. of hours** |

| | | |
|---|---|---|
| | 1. Implement user-based collaborative filtering using cosine similarity.<br>2. Implement item-based collaborative filtering using Pearson correlation.<br>3. Build a recommender using the MovieLens dataset with k-Nearest Neighbor (KNN).<br>4. Apply matrix factorization (SVD) using the Surprise library.<br>5. Use Alternating Least Squares (ALS) model with PySpark for collaborative filtering.<br>6. Implement content-based filtering using TF-IDF features for movie recommendation.<br>7. Construct a hybrid recommender by combining content-based and collaborative approaches.<br>8. Train a Naive Bayes classifier for text-based recommendation.<br>9. Build a deep learning-based recommender using TensorFlow Recommenders (TFRS).<br>10. Evaluate a recommender system using RMSE, MAE, Precision, and Recall.<br>11. Deploy a simple Flask-based movie recommender web app.<br>12. Perform A/B testing simulation on different recommendation algorithms.<br>13. Visualize user-item interaction matrix using heatmaps.<br>14. Perform cold-start analysis and suggest strategies for new users or items.<br>15. Develop a recommender system using implicit feedback (e.g., clicks, views). | **60 Hours** |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br><br>CO1 — Implement user-based and item-based collaborative filtering using similarity measures.<br><br>CO2 — Demonstrate matrix factorization techniques for building scalable recommender systems.<br><br>CO3 — Design content-based and hybrid recommendation models using real datasets.<br><br>CO4 — Evaluate recommender systems using metrics like RMSE, MAE, Precision, Recall, and deploy models using libraries. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**
**Course Code:** **GEC-681**
**Title of the Course:** **SUSTAINABILITY - PRINCIPLES & PRACTICES**
**Number of Credits:** **03**
**Effective from AY:** **2024-25**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Undergraduate level knowledge of any branch of engineering | |
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of importance of Sustainability Practices<br>2. Explanation of Assessment, Planning and Implementation of Sustainability Principles<br>3. Description of the steps involved in implementing sustainable solutions<br>4. Apply the knowledge of sustainability practices to real life situations. | |
| **Content:** | | **No. of Hours** |
| **Unit-1** | **Overview on Global Sustainability Goals (SDGs):** Industry-Innovation-Infrastructure, Health & Well Being, Clean Water & Sanitation, Education, Responsible Consumption and production, Climate Action, Quality Education, Economic growth, sustainable community living | 10 |
| **Unit-2** | **Sustainability:** Requirements for Sustainability, Approaches towards Sustainable Engineering, Sustainability Challenges, Environmental Challenges–IT2; **Reasons for Un-sustainability** – Economics and Environment, Corporate View of Sustainability, Social Attitude, Approach, Cultural Narratives, Political Aspects, Ethics and Morals. Steps in life cycle impact assessment | 13 |
| **Unit-3** | **Sustainability Assessment:** Steps in assessing life cycle, data availability, process network analysis, Input-Output Analysis–IT2, Hybrid Models; Carbon footprint, Water footprint, Energy analysis of technologies, processes and its economics; Concept of Exergy and Emergy Analysis; Ecosystem Services in Sustainability Assessment; Case Studies | 10 |
| **Unit-4** | **Solutions for Sustainability:** Designing sustainable processes and products; Techno-Economic Analysis; Energy Ecosystem and its dynamic characteristics; Circular Economy; Nature based solutions, Green infrastructure, Techno-ecological synergy; Economic Policies, Societal Developments; Case Studies. | 12 |

| | | |
|---|---|---|
| **Pedagogy** | The course employs a multidisciplinary and experiential teaching methodology that combines interactive lectures, real-world case studies, fieldwork, and collaborative discussions. Emphasis is placed on systems thinking and critical analysis to understand sustainability across environmental, economic, and social dimensions. | |
| **References/ Readings:** | 1. Raj Gaurang Tiwari, 'Sustainability Principles and Applications in Engineering Practices', Nova Science Publishers, 2024, ISBN:9798891136403<br>2. Bhavik R Bakshi, 'Sustainable Engineering', Cambridge University Press, 2019, ISBN:9781108420457<br>3. Margaret Robertson, 'Sustainability – Principles & Practices', Routledge Publishers, 2017, ISBN: 97811138650244 | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>**CO1.** Understand the importance of sustainability practices<br>**CO2.** Assess, Plan and Suggest basic sustainability practices<br>**CO3.** Explain the steps involved in implementing sustainable solutions<br>**CO4.** Prepare a plan for sustainability practices to real life situations. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**
**Course Code:** **GEC-682**
**Title of the Course:** **SUSTAINABILITY - PRINCIPLES & PRACTICES LAB**
**Number of Credits:** **01**
**Effective from AY:** **2024-25**

| | |
|---|---|
| **Pre-requisites for the Course:** | Undergraduate level knowledge of any branch of engineering |
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of importance of Sustainability Development Goals (SDG)<br>2. Explanation on Assessment, Planning and Implementation of SDG<br>3. Description of the steps involved in order to achieve the SDG. |

| | | |
|---|---|---|
| | 4. Apply the knowledge of sustainability practices to real life situations. | |
| **Content:** | | **No. of Hours** |
| | The United Nations has promulgated Sustainable Development Goals (SDG)s. Every student has to prepare a detail report and presentation, based relevant literature, field visits and data collection, interaction with experts, on ANY TWO topics of SDG as applied to the local region or State of Goa.<br><br>(1) No Poverty<br>(2) Zero Hunger<br>(3) Good Health & Well Being<br>(4) Quality Education<br>(5) Gender Equality<br>(6) Clean Water & Sanitation<br>(7) Affordable & Clean Energy<br>(8) Decent Work and Economic Growth<br>(9) Industry, Innovation and Infrastructure<br>(10) Reduce Inequalities<br>(11) Sustainable Cities & Communities<br>(12) Responsible Consumption and Production<br>(13) Climate Action<br>(14) Life Below Water<br>(15) Life on Land<br>(16) Peace, Justice & Strong Institutions | 30 hrs |
| **References/ Readings:** | 1. Raj Gaurang Tiwari, 'Sustainability Principles and Applications in Engineering Practices', Nova Science Publishers, 2024, ISBN:9798891136403<br>2. Bhavik R Bakshi, 'Sustainable Engineering', Cambridge University Press, 2019, ISBN:9781108420457<br>3. Margaret Robertson, 'Sustainability – Principles & Practices', Routledge Publishers, 2017, ISBN: 97811138650244 | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br><br>**CO1.** Understand the importance of sustainability Development Goals (SDGs)<br><br>**CO2.** Assess, Plan and Suggest basic sustainability practices<br><br>**CO3.** Explain the steps involved in order to achieve the SDG<br><br>**CO4.** Prepare a plan for sustainability practices to real life situations. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**
**Course Code:** **GEC-683**
**Title of the Course:** **PROJECT MANAGEMENT**
**Number of Credits:** **03**
**Effective from AY:** **2024-25**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Undergraduate level knowledge of any branch of engineering | |
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of the various features of project management<br>2. Explanation of the relevance of human resource planning and management<br>3. Describes the importance of procurement planning, cost estimation, and quality management.<br>4. Detailed explanation on time and risk management. | |
| **Content:** | | **No. of Hours** |
| **Unit-1** | **Overview on Project Management**: Need for Project Management, Project Life Cycle and its Phases, Scope of the project, requirements and scope, Organizational Influences, Project Management Plan, Integrated Change Control Plan, Agile Project Management and Lean Project Management, Project selection and portfolio management.<br><br>**Economics & Cost Management**: Time Value of Money, Cost-Benefit Ratio, Cost estimation, methods of preparing estimates, budgeting, Cost monitoring and Control, cost on completion. | 10 |
| **Unit-2** | **Human Resource Management,** Planning Human Recourses, Acquiring human resources, developing and strategizing deployment of resources, leadership qualities, team management – motivation, monitoring and control, conflict management and interpersonal relationship management. Importance of Communication and communication management – tools and | |

| | | |
|---|---|---|
| | techniques; basic human fundamentals, ethics and professional conduct, | 12 |
| **Unit-3** | **Procurement Management**- Planning, Implementation – Monitoring and control of goods and services; Stakeholders Management, Contracts drafting, preparation, approval, implementation and closure.<br><br>**Quality Management:** Introduction, quality planning tools and techniques, quality monitoring and control, tools and techniques, | 13 |
| **Unit-4** | **Time Management**: Purpose of Time Management, Time Planning, different methods of activity planning, milestones, resource assignment and time lines. Time monitoring and control - different types of charts; Path Planning – forward, backward, critical, lag and lead time lines.<br><br>**Risk Management** – Risk Identification, Risk Qualitative Analysis, Risk Quantitative Analysis, Risk Response, Monitoring and Control | 10 |
| **Pedagogy** | Students will engage in planning, execution, and evaluation activities to develop critical thinking, collaboration, and decision-making skills essential for effective project management in diverse professional settings. | |
| **References/ Readings:** | 1. J.Michael Bennet, Danny S.K.Ho, 'Project Management for Engineers', World Scientific Publishing, 2014, ISBN: 13-978-981444-7928.<br>2. J. M. Nicholas, Herman Steyn, 'Project Management for Engineering, Business and Technology, 6th Edn, Taylor & Francis Publications, 2021, ISBN: 978-0-367-277730-7<br>3. Neil G Siegel, Engineering Project Management, Wiley Publications, 2019, ISBN: 9781119525769.<br>4. Khanna.R.B., Project Management, PHI Publishing, 2011, ISBN: 978-81-203-4288. | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br><br>**CO1.** Explain the importance of Project Management<br><br>**CO2.** Describe the various components of Project Management<br><br>**CO3.** Analyze the importance of cost, human resource, procurement, quality, time and risk management<br><br>**CO4.** Apply project management knowledge in their professional life. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**
**Course Code:** **GEC-684**
**Title of the Course:** **PROJECT MANAGEMENT LAB**
**Number of Credits:** **01**
**Effective from AY:** **2024-25**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Undergraduate level knowledge of any branch of engineering | |
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of the various features of project management<br>2. Explanation of the relevance of applying project management knowledge to any one domain<br>3. Describes the advantages of applying project management tools & techniques to address specific problems<br>4. Ability to prepare reports and presentation on specific areas by applying knowledge of Project Management | |
| **Content:** | | **No. of Hours** |
| | Project Management is applicable to all types of Human Activities.<br><br>Every Student has to choose ANY TWO topics, prepare a detail report and presentation, based relevant literature, field visits and data collection, interaction with experts in the local region or State of Goa. | |

| | | |
|---|---|---|
| | The student shall apply project management knowledge to any ONE topics given below, the list is only indicative, students can choose topics from related / allied areas:<br><br>(1) Large construction site (on-going projects) – residential, commercial, highways, ports, airports<br>(2) Large Manufacturing Industry in any of the Industrial Areas in Goa, scaling up production, sales / marketing.<br>(3) Waste Management; Water Management;<br>(4) Application of Project Management to Law Enforcement<br>(5) Project Management in Education – infrastructure, skill training<br>(6) Project Management as applied to consumer goods / supplies<br>(7) Manpower Management in the context of AI in software industry<br>(8) Project Management – Global markets for local products using Digital Marketing platforms<br>(9) Project management for Logistics and Transportation<br>(10) Project management for Hospital & Health Management | 30 hrs |
| **References/ Readings:** | 1) J.Michael Bennet, Danny S.K.Ho, 'Project Management for Engineers', World Scientific Publishing, 2014, ISBN: 13-978-981444-7928.<br>2) J. M. Nicholas, Herman Steyn, 'Project Management for Engineering, Business and Technology, 6th Edn, Taylor & Francis Publications, 2021, ISBN: 978-0-367-277730-7<br>3) Neil G Siegel, Engineering Project Management, Wiley Publications, 2019, ISBN: 9781119525769.<br>4) Khanna.R.B., Project Management, PHI Publishing, 2011, ISBN: 978-81-203-4288. | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br><br>**CO1:** Understanding of the various features of project management<br><br>**CO2**: Explanation of the relevance of applying project management knowledge to any one domain<br><br>**CO3**: Describes the advantages of applying project management tools & techniques to address specific problems<br><br>**CO4:** Ability to prepare reports and presentation on specific areas by applying knowledge of Project Management | |

| | |
|---|---|
| **Name of the Programme:** | **MASTER OF ENGINEERING (DATA SCIENCES)** |
| **Course Code:** | **GEC-685** |
| **Title of the Course:** | **FINANCIAL MANAGEMENT** |
| **Number of Credits:** | **04** |
| **Effective from AY:** | **2024-25** |

| | |
|---|---|
| **Pre-requisites for the Course:** | Basic knowledge of Finance, Economics |

| | | |
|---|---|---|
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of Financial Systems and Its Management<br>2. Explanation of Financial Planning, Fund Flow and Cost Analysis<br>3. Analysis of Capital & Working Capital Management, Valuation, Long Term Financing<br>4. Description of product cost analysis, break even analysis and investment management. | |
| **Content:** | | **No. of Hours** |
| **Unit-1** | **Financial Management: An Overview –** Types of Business organizations, Fundamental principle of finance. **The Financial System-** Functions, Financial Assets and Markets, **Financial Statements, Taxes, and Cash Flow**- Balance Sheet, Profit and loss Account, Profits Vs Cash Flow, Taxes; Financial decision making. | 15 hrs |
| **Unit-2** | **Financial Statement Analysis**- Financial Ratios- Liquidity Ratios, Leverage & Profitability Ratios; **Fund Flow Analysis** - Fund Flow Statement; **Breakeven Analysis and Leverages**- Cost Volume Profit Analysis; **Financial Planning & Forecasting-** Financial Planning, Sales Forecast; **Cost Analysis-** Determination of product cost, overhead cost, volume and profits, planning and control on costs and decision making using costs. | 16 hrs |
| **Unit-3** | **Fundamental Valuation Concepts -**The Time Value of Money, Risk and Return. **Capital Budgeting -**Techniques of Capital Budgeting – Capital Budgeting Process, project classification; cash flows, risk analysis, cost of capital; **Investment Criteria**- Net Present value, Benefit Cost Ratio, Internal Rate of return, Payback Period, Accounting rate of Return. | 15 hrs |
| **Unit-4** | **Working Capital Management** -Working Capital Policy, Cash and Liquidity Management, Credit Management, Inventory Management, Working Capital Financing; **Corporate Valuation:** Debt analysis and management, Leasing, Hire Purchase, Valuation, Mergers, acquisitions and Restructuring; **Long Term Financing:** Sources of Long Term Finance, Raising Long Term Finance. | 14 hrs |
| **Pedagogy** | The course adopts a concept-driven and application-oriented pedagogy through a combination of lectures, case studies, problem-solving sessions, and financial analysis exercises. Emphasis is placed on applying financial principles to real-world scenarios, enabling students to develop decision-making skills in various areas. | |

| | | |
|---|---|---|
| **References/ Readings:** | 1. Prasanna Chandra “Financial Management: Theory and Practice” 11th Edition, McGraw Hill Education Publishers, 2023, ISBN: 978-9355-322-203<br>2. Pandey I.M., Finance- A Management Guide for Managing Company Funds and Profits, Prentice Hall India Publications, 1995, ISBN:978-8120-309-180<br>3. Van Horne, J.C, “Fundamentals of Financial Management”, 13th Edition, Pearson Publications, 2015, ISBN:978-933-255-8670.<br>4. Khan, M.Y. and Jain, P.K., “Financial Management”, 8th Edition, McGraw-Hill Education Publishers, 2018, ISBN:978-9353-1622-184 | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>**CO1:** Understand the Financial Systems and Its Management<br>**CO2**: Explain Financial Planning, Fund Flow and Cost Analysis<br>**CO3**: Analyze Capital & Working Capital Management, Valuation, Long Term Financing<br>**CO4:** Describe product cost analysis, break even analysis and investment management. | |

**Name of the Programme:** **MASTER OF ENGINEERING (DATA SCIENCES)**
**Course Code:** **GEC-686**
**Title of the Course:** **ENTREPRENEURSHIP**
**Number of Credits:** **04**
**Effective from AY:** **2024-25**

| | | |
|---|---|---|
| **Pre-requisites for the Course:** | Basic knowledge of Creative Thinking, Innovation, Finance, Economics | |
| **Course Objectives:** | The course aims to provide the student with an:<br>1. Understanding of entrepreneurial skill sets and different types of entrepreneurship.<br>2. Explanation of Differences between New Enterprise, Social Enterprise and Family Business<br>3. Describes the process of preparing business plan, operational plans to start an enterprise<br>4. Apply the knowledge of market analysis, product planning, customer requirements, costing and finance | |
| **Content:** | | **No. of Hours** |
| **Unit-1** | **Entrepreneurial Characteristics:** Overview on Entrepreneurship, Broad classification of entrepreneurs; Leadership, Goal Setting, Time and resource Planning, Communication, Networking, Knowledge & Skill Upgradation; Awareness of Social and Industrial Eco-system; Awareness of Government Policies and Schemes; Digital marketing and business promotion; Local and global market; Basic understanding of Legal and regulatory system, Intellectual Property Rights; Financial Literary; Decision making and risk taking abilities | 18 |
| **Unit-2** | **Creation of New Enterprise:** Creativity, Innovation, technology, wealth creation, social impact, Team building, Business Plan, project formulation and feasibility analysis; business simulation; designing and configuring business models and customers, Enterprise management tools and techniques; Launching and managing enterprises; Sales & Marketing Strategies; Human Resources; Incubation, Costing and Financial Plans, Case Studies | 14 |
| **Unit-3** | **Social Entrepreneurship:** Overview**,** project formulation and feasibility analysis; understanding customer needs, positioning the firm for social change and strategic advantage; social business model; participatory development; stakeholders; social impact | 14 |

| | | |
|---|---|---|
| | assessment; networking; regional economic models; banking and loans; Women Entrepreneurship; Case Studies | |
| **Unit-4** | **Family Business Management :** Small and Medium Business Enterprises; Growth plan formulation; Vision, Values and Strategies, Turn around strategies, cost management, finance and liquidity, family to corporate culture; Case Studies; | 14 |
| **Pedagogy** | Students engage in opportunity identification, business model development, and pitch presentations. Emphasis is placed on fostering creativity, critical thinking, and real-world problem-solving through collaboration with industry mentors and exposure to entrepreneurial ecosystems. | |
| **References/ Readings:** | 1. Nagasubba Rayudu, 'A Textbook on Entrepreneurship & Incubation', Mahi Publications, 2023, ISBN: 978811949282<br>2. Balasubramanya. M.H., 'Entrepreneurial Ecosystems for Tech Startup in India', Verlag Max Publications, 2021, 9783110679298.<br>3. Kenji Uchino, 'Entrepreneurship for Engineers', CRC Press, 2010, ISBN: 978143980063<br>4. Ryszard Praszkier, Andrzej Nowak, 'Social Entrepreneurship', Theory and Practice, Cambridge University Press, 2011, ISBN 9781139504331<br>5. Peter Leach, Tatwamasi Dixit, 'Indian Family Business Mantras', Rupa Publications, 2016, ISBN: 9788129136945<br>6. Bill Bolton, John Thompson, 'Entrepreneurs – Talent, Temperament, Opportunity', Elsevier Publications, 2004, ISBN:0750661283<br>7. John Bessant, Joe Tidd, 'Entrepreneurship', John Wiley Publications, 2015, ISBN: 9781118993095 | |
| **Course Outcomes:** | **After taking this course, student will be able to:**<br>**CO1.** Understand entrepreneurial skill sets and different types of entrepreneurship<br>**CO2.** Classify New Enterprise, Social Enterprise and Family Business<br>**CO3.** Explain process of preparing business plan, operational plans to start an enterprise<br>**CO4.** Apply the knowledge of market analysis, product planning, customer requirements, costing and finance | |