		Theory Hrs	Practical Hrs	utorial Hrs	Theory Credit	actical/Oral Credit	utorial Credits	Total Credits
CEC601	**Machine Learning**	03	–	–	03	–	–	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CEC601	**Machine Learning**	20	20	20	20	60	-	-	-	100

Course Objectives:

1. To understand human learning aspects and relate it with machine learning concepts.
2. To understand the nature of the problem and apply machine learning algorithms.
3. To apply machine learning techniques to solve real world problems.

Course Outcomes: After completion of this course learner will be able to

1. Understand the basic concepts of machine learning.
2. Extract different feature vectors from the given data.
3. Apply different regression techniques on the input data.
4. Apply and analyse the performance of classification algorithms.
5. Form clusters using various similarity measures.
6. Understand the working of reinforcement learning.

Prerequisites:

1. Linear Algebra
2. Statistics
3. Programming Language

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction to Machine Learning**	Introduction, Categories of Learning Algorithms, Machine Learning tasks, Issues, Applications, Key terminologies, Steps in developing machine learning applications.	04	CO1
2	**Data Preprocessing**	Need, creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Dimension Reduction-Principal Component Analysis (PCA)	05	CO2
3	**Learning for Regression**	Linear models, Linear Regression and higher dimensionality Logistic Regression, Classification metrics. Decision Tree, Random forest Introduction to Neural Networks, NN for Regression Model selection, evaluation and validation	08	CO3
4	**Supervised Learning**	Naïve Bayes Classifiers, Support Vector Machine (SVM)-Linear SVM, Decision Tree, Construction of Decision tree for rule-based classification, Ensemble Learning- Random Forest. HMM	10	CO4

		NN for classification- feed forward network Model selection, evaluation and validation		
5	**Unsupervised learning**	Fundamentals, K-means, Hierarchical Clustering, Expectation maximization clustering. NN for clustering- SOM Model selection, evaluation and validation	06	CO5
6	**Reinforcement Learning**	Introduction, Learning Task, Q Learning, Temporal Difference Learning, Generalization Time series forecasting Model selection, evaluation and validation	06	CO6

Text Books:

1. Tom M Mitchell, "Machine Learning", McGraw Hill Education.
2. Peter Harrington "Machine Learning in Action", DreamTech Press.

Reference Books:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN-10: 1785889621, ISBN-13: 978-1785889622.

Evaluation Scheme:

1. **In-Semester Assessment:**
   - Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   - Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.

- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/Oral Credit	Tutorial Credits	Total Credits
CECDLO6031	**Compiler Design**	03	–	—	03	–	—	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CECDLO6031	**Compiler Design**	20	20	20	20	60	–	–	–	100

Course Objectives:

1. To learn the process of translating a modern high-level language to executable code.
2. To provide understanding of the fundamental principles in compiler design.
3. To explore the concepts of run time storage environment.

Course Outcomes: At the end of the course learner will able to

1. Describe design of compilers along with phases and perform lexical analysis on various programs.
2. Develop understanding of the different types of parsing techniques and to construct parsers according to given grammar.
3. Apply semantic analysis over the program to design efficient applications.
4. Evaluate the different run time storage management techniques with respect to efficient application development.
5. Analyze different types of intermediate code to design efficient applications.
6. Apply the optimization techniques to produce an efficient intermediate and machine code.

Prerequisites:

1. Theoretical Computer Science
2. Data Structure
3. Programming Language Fundamentals

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Foundation of System Software and Introduction to Compiler**	Foundation of System Software, Introduction to Compilers. **Lexical Analysis:** Role, Specification and Recognition of Tokens, LEX.	5	CO1
2	**Syntax Analysis**	Overview of Context Free Grammar, Left Recursion, Left Factoring. Top Down Parsing, Bottom up Parsing, YACC.	9	CO2
3	**Semantic Analysis**	Introduction, Need, Type checking and Type conversion. Syntax Directed Translation, Syntax Directed Definition (SDD).	5	CO3
4	**Run Time Environment**	Storage Organization, Storage Allocation Strategies, Activation Records, Handling Recursive calls, Parameter Passing, Dynamic Storage Allocation Strategies	4	CO4
5	**Intermediate code Generation**	Need, Types, Intermediate code generation for various constructs, Translation Scheme, Back Patching.	8	CO5
6	**Code Optimization and code Generation**	**Code Optimization**: Need, Machine dependent and machine independent optimization techniques **Code Generation:** Issues, Basic blocks, Flow Graphs, Simple code generator, optimization of basic blocks.	8	CO6

Text Books:

1. A.V. Aho, R. Shethi, Ulman, “Compilers - Principles, Techniques and Tools'‘, Pearson Education, 1st Edition.
2. John R. Levine, Tony Mason, Doug Brown, “LEX & YACC”, O ‘Reilly, 2nd Edition.
3. Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, “Modern Compiler Design”, Wiley.

Reference Books:

1. Kenneth C. Louden, “Compiler Construction: Principles and practices”, Cengage Learning.
2. K Muneeswaran, “Compiler Design”, Oxford University press.
3. D. M Dhamdhere, “Systems programming and Operating Systems”, Tata McGraw Hill, Revised Second Edition.
4. J. J. Donovan, “Systems Programming”, Tata McGraw Hill, Edition 1991.

Evaluation Scheme:

1 In-Semester Assessment:

- Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
- Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2 End-Semester Examination:

- Question paper will comprise of full syllabus.
- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical / Oral Credit	Tutorial Credits	Total Credits
CECDLO6032	**Data Warehousing and Mining**	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CECDLO6032	**Data Warehousing and Mining**	20	20	20	20	60	–	–	–	100

Course objectives:

1. To identify the scope and essentiality of Data Warehousing and Mining.
2. To analyse data, choose relevant models and algorithms for respective applications.
3. To study spatial and web data mining.
4. To develop research interest towards advances in data mining.

Course outcomes: On successful completion of course learner will be able to:

1. Understand Data Warehouse fundamentals with dimensional modelling
2. Understand OLAP operations in Multidimensional Data Model
3. Understand Data Mining and Data Pre-processing steps.
4. Explore frequent patterns and Association mining algorithms.
5. Apply various classification and clustering techniques on real world scenario.
6. Describes social network in Web Mining and apply web mining algorithm.

Prerequisites:

Database Management Systems

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction to Data-Warehousing**	Introduction to Data Warehouse, Data Warehouse architecture, Data Marts, Datawarehouse schema- Data Cubes, Stars, Snowflakes and Fact Constellations.	05	CO1
2	**Online Analytical Processing (OLAP) and ETL**	Need for Online Analytical Processing; OLTP V/s OLAP,OLAP Operations in Multidimensional Data Model, OLAP Models, ETL: Steps in ETL Process, Data Extraction; Task involved in Data Transformation, Techniques of Data Loading	07	CO2
3	**Data Mining and Data Pre-processing**	Data Mining Process- Task Primitives, Data mining architecture, Knowledge Data Discovery (KDD), Issues and applications of Data mining, Steps in Data pre-processing.	07	CO3
4	**Introduction to Association Mining**	Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Frequent Pattern, Mining, Apriori Algorithm, FP-growth, Mining Multilevel Association Rules, Multidimensional Association Rules.	08	CO4
5	**Classification and Clustering**	Basic concepts in classification, Decision Tree Induction, Bayesian Classification method –evaluating the accuracy of classifier. Clustering techniques, Hierarchical Methods(Agglomerative and Divisive Clustering) ,Density based clustering, Outlier Analysis.	08	CO5
6	**Web Mining**	Introduction, Web Content Mining: Crawlers, Harvest System, Virtual Web View, Personalization, Web Structure Mining: Page Rank, Clever, Web Usage Mining	04	CO6

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd edition.
2. Data Warehousing Fundamentals, P. Ponnian, John Wiley.
3. ReemaTheraja ―Data warehousing‖, Oxford University Press.

Reference Books:

1. Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming, McGraw-Hill Osborne Media, 2011.
2. Ian H. Witten, Eibe Frank and Mark A. Hall " Data Mining ", 3rd Edition Morgan kaufmann publisher.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining", Person Publisher.

Evaluation Scheme:

1. **In-Semester Assessment:**

- Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be a compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
- Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**

- Question paper will comprise a full syllabus.
- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/ Oral Credit	Tutorial Credits	Total Credits
CECDLO6033	**Computer Vision**	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CECDLO6033	**Computer Vision**	20	20	20	20	60	-	-	-	100

Course Objectives:

1. To recognize and describe both the theoretical and practical aspects of computing with images.
2. To connect issues from computer vision to human vision.
3. To explore various vision techniques and build computer vision applications.

Course Outcomes: At the end of the course learner will able to

1. Describe the foundation of image formation and image analysis.
2. Explore various advance approaches in image segmentation.
3. Illustrate ways to describe and represent images.
4. Represent objects using different area features.
5. Apply recognition steps to identify objects.
6. Perceive detailed mechanisms for image alignment and matching.

Prerequisites:

1. Engineering Mathematics
2. Digital Signal and Image Processing

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	Image Formation	Introduction, Photometric Image Formation, Image formation Models, Camera Model, Camera Calibration and Parameters (location, orientation)	4	CO1
2	Binary Machine Vision / Segmentation	Thresholding, connected component labeling, Hierarchal segmentation, Spatial clustering, Graph based segmentation, Rule-based Segmentation, Motion-based segmentation, Semantic Segmentation	8	CO2
3	Image Representation and Description	Morphological Image Processing: Morphological Operations and algorithms, Representation schemes, Boundary descriptors, Region descriptors, SIFT, HoG descriptor	7	CO3
4	Area Extraction and Region Analysis	Region properties, External points, Spatial moments, Mixed spatial gray-level moments Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting)	8	CO4
5	Facet Model Recognition	Recognition Methodology, labeling lines, understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking Algorithm	6	CO5
6	Object Models and Matching	Object representation: Global vs. Local features, General Frameworks for Matching: Distance relational approach, ordered structural matching, View class matching, stereo image matching	6	CO6

Text Books:

1. Shah M., “Fundamentals of Computer Vision”, 1997.
2. Szeliski R., “Computer Vision: Algorithms and Applications”, Springer, 2011

Reference Books:

1. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
2. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach"

Evaluation Scheme:

1. **In-Semester Assessment:**

- Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
- Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**

- Question paper will comprise of full syllabus.
- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/ Oral Credit	Tutorial Credits	Total Credits
CECDLO6034	**Cryptography & Network Security**	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA1	IA2	AVG	Mid Sem Exam					
CECDLO6034	**Cryptography & System Security**	20	20	20	20	60	-	-	-	100

Course Objectives

1. To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
2. To explore the working principles and utilities of various cryptographic algorithms.
3. To explore the design issues and working principles of various authentication protocols, PKI standards and various secure Communication standards.
4. To develop existing cryptographic utilities to build programs for secure communication.

Course Outcomes: On successful completion of course, learner will be able to:

1. Perceive system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2. Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication.
3. Apply the Key distribution and Management techniques

4. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
5. Apply different digital signature algorithms to achieve authentication and design secure applications.
6. Perceive network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols.

Prerequisites:

1. Engineering Mathematics
2. Computer Networks
3. Operating Systems

SNo	Module	Detailed Contents	Hours	CO Mapping
1	**Number Theory and Basic Cryptography**	Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's theorem Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and polyalphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers	08	CO1
2	**Symmetric and Asymmetric key Cryptography**	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), RC5, Stream Ciphers: RC4 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA Cryptosystem, The knapsack cryptosystem	10	CO2
3	**Key Management**	Symmetric Key Distribution: KDC, Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol, Symmetric key agreement: Diffie Hellman, Public key Distribution: Digital Certificate: X.509, PKI	06	CO3

4	**Cryptographic Hash Functions**	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC.	04	CO4
5	**Authentication Protocols & Digital Signature Schemes**	User Authentication, Entity Authentication: Password Base, Challenge Response Based Digital Signature, Attacks on Digital Signature, Digital Signature Scheme: RSA	04	CO5
6	**Network Security and Applications**	Network security basics: TCP/IP vulnerabilities (Layer wise), Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing Denial of Service, Internet Security Protocols: PGP, SSL, IPSEC. Network security: IDS, Firewalls, system security: malicious Programs: Worms and Viruses, SQL injection	07	CO6

Text Book:

1. Bruce Schneier, “Applied Cryptography, Protocols Algorithms and Source Code in C”, Second Edition, Wiley.

References Book:

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill Education, 2003.
2. Eric Cole, “Network Security Bible”, Second Edition, Wiley, 2011.

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
   - Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   - Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **<u>End-Semester Examination:</u>**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

		heory Hrs	ractical Hrs	utorial Hrs	heory redit	Practical/Oral Credit	utorial Credits	Total redits
CDLO6041	Mobile Computing	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
ECDLO6041	Mobile Computing	20	20	20	20	60	-	-	-	100

Course Objectives:

1. To introduce the basic concepts and principles in mobile computing.
2. To explore both theoretical and practical issues of mobile computing.
3. To understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

Course Outcomes: On successful completion of the course, the learner will be able:

1. To identify basic concepts and principles in mobile communication cellular architecture and describe the telecommunications systems.
2. To recognize the significance of Mobile IP, Mobile TCP, and micro-mobility support in mobile environments.
3. To compare and contrast various IEEE 802. x standards.
4. To analyse 4G/5G mobile networks and apply this knowledge to predict network performance.
5. To understand the concept of the Internet of Things.

Prerequisites:

1. Computer Networks

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction to Mobile Networks**	Introduction, Wireless transmission: Frequencies for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Spread spectrum, Cellular systems, Comparison of 1G, 2G, 3G, 4G, 5G, Telecommunications systems (GSM, GPRS, UMTS), Handover	08	CO1
2	**Mobile Networking and Mobility Management**	Motivation for specialized MAC ,SDMA,FDMA,TDMA,CDMA Mobile IP: IP Packet Delivery Advertisement, Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling, Routing (DSDV, DSR) Mobile TCP: Traditional TCP, Classical TCP Improvements (Indirect TCP, Snooping TCP & Mobile TCP) Introduction, IP Mobility, Optimization, IPv6, Macro Mobility: MIPv6, FMIPv6, Micro-Mobility: Cellular IP, HAWAII, HMIPv6	08	CO2
3	**Wireless Technologies**	IEEE technologies : IEEE 802.15: WPAN/Bluetooth, WBAN IEEE 802.11: WLAN (Infrastructure & Ad-hoc mode, Comparison of 802.11 a/b/g/n/ac) IEEE 802.16: WiMAX	04	CO3
4	**Long-Term Evolution (LTE) and LTE-A**	LTE: Relevant features of LTE, Network architecture and protocols, Control and user planes, Multimedia broadcast and multicast service, Stream Control Transmission Protocol,	09	CO4

		Network discovery and selection, Radio resource management, Authentication and authorization, Fundamentals of the MAC layer in LTE, Fundamentals of the LTE physical layer LTE-A: Features of LTE-A, LTE vs. LTE-A, HetNet in LTE Advanced, Small cell concepts, Femtocell and macrocell integration architecture, Picocell and macrocell integration architecture, Interference mitigation in heterogeneous networks, Interference mitigation in the context of two-tier macropicocells, Coordinated multi-point transmission/reception, Carrier aggregation		
5	**5th Genration Mobile Network**	From LTE Advanced to 5G: the big transition, Some characteristics envisioned for 5G, 5G frequencies, High and low platforms, Cloud-RAN	05	CO5
6	**Introduction to Internet of Things …. application**	Introduction, Things in IoT, IoT Protocols, IoT Communication Models, IoT Communication APIs.	05	CO6

Textbooks:

1. Jochen Schiller, "Mobile Communication," Addison wisely, Pearson Education.
2. Khaldoun Al Agha, Guy Pujolle, Tara Ali-Yahiya, "Mobile and Wireless Networks," Wiley Publications.

References:

1. William Stallings, "Wireless Communications & Networks," Second Edition, Pearson Education.
2. Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications," Wiley publications.
3. Ashutosh Dutta, Henning Schulzrinne, "Mobility Protocols and Handover Optimization: Design, Evaluation, and Application" IEEE Press, Wiley Publication.
4. Andreas F. Molisch, "Wireless Communications," Wiley Publications, 2nd edition.

Evaluation Scheme:

1. **In-Semester Assessment:**

- Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be a compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
- Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**

- Question paper will comprise a full syllabus.
- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus

Course Code	Course Name	Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/ Oral Credit	Tutorial Credits	Total Credits
CECDLO6043	Augmented Reality/ Virtual Reality	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CECDLO6043	Augmented Reality / Virtual Reality	20	20	20	20	60	-	-	-	100

Course Objectives:

1. To understand the immersive technologies.
2. To learn AR and VR concepts.
3. To analyse and develop AR and VR apps.
4. To demonstrate projects using AR/VR toolkits.

Course Outcomes: At the end of the course learner will able to

1. Compare and Contrast VR and AR experiences
2. Understand and develop VR apps in Unity
3. Understand and develop AR apps in Unity
4. Demonstrate various tools and programming languages to develop AR/VR applications.
5. Acquire knowledge in VR and AR technologies in terms of used devices, building of the virtual environment and modalities of interaction and modeling.
6. Acquire knowledge about the application of VR and AR technologies in medicine, education, cultural heritage and games.

Prerequisites: Basic knowledge on any Programming Language

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction**	Defining Virtual Reality, History of VR, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies Spectrum Between Real and Virtual Worlds, AR toolkits with existing IDE's (Unity-Vuforia, Visual Studio, Netbeans, intellij IDEA, Android, iOS), connectivity of smart devices with AR. **Case study of a single application using both VR and AR technologies**	5	CO1
2	**VR concepts and app Development**	Geometric Models, Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR. Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Motion in Real and Virtual Worlds, Interaction **Case study on creating 3D objects using Blender.**	7	CO2
3	**AR concepts and App Development**	The Relationship Between Augmented Reality and Other Technologies Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience, Computer Vision for Augmented Reality Marker-based approach, Tracking methods **Case study on use of OpenCV for AR App Development**	7	CO3
4	**Working with VR & AR Devices**	VR Devices, Game scene AR Devices Virtual retinal systems, monitor based systems, Projection displays, Video see-through systems. Advantages and	7	CO4

		Disadvantages of AR and VR technologies. **Case Study on Google Daydream / AjnaLense**		
5	**Programming Languages for AR & VR applications**	C# with Unity – OOL concepts, classes in C#, setting up visual studio or code editor for C#, 3D models compatibility with C#, C# for AR and VR C++ with **Case study on a C# script which plays a video when an image is scanned using AR App (use ARCore & Unity)**	7	CO5
6	**Use Cases for AR and VR applications**	Trending Application Areas - Gaming and Entertainment, Architecture and Construction, Science and Engineering, Health and Medicine, Aerospace and Defence, Education, Telerobotics and Telepresence Human Factors, Legal and Social Considerations - Human Factors Considerations, Legal and Social Considerations, The Future **Case Study on Google Maps AR navigation and how it is used?**	6	CO6

Text Books:

1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", Addison-Wesley Professional, September 2016,
2. Allan Fowler, William Sherif, "Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#", 1st Edition, Apress Publications, 2018

3. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
4. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann Publishers, San Francisco, CA, 2002
5. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
6. Allan Fowler, "AR Game Development", 1st Edition, A press Publications, 2018.
7. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice" by, Pearson Education India; First edition 2016.

Reference Books:

1. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications", Packt publishing, 2019.
2. Jonathan Linowes, Krystian Babilinski, "Augmented Reality for Developers: Build practical augmented reality applications with Unity", Packt Publishing, 2017.

1. MOOC Courses:
   https://www.coursera.org/learn/augmented-reality
   https://www.coursera.org/specializations/unity-xr

Evaluation Scheme:

1 In-Semester Assessment:

- Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
- Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2 End-Semester Examination:

- Question paper will comprise a full syllabus.
- In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/Oral Credit	Tutorial Credits	Total Credits
CECDLO6044	Cyber Security	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA 1	IA 2	AVG	Mid Sem Exam					
CECDLO6044	Cyber Security	20	20	20	20	60	-	-	-	100

Course Objectives:

1. To understand fundamentals of cyber security in cloud.
2. To understand the background of cryptography.
3. To study various types of Cyber threats.
4. To explore the working of Data centre and Data Protection techniques.
5. To investigate the Cloud Native Security.
6. To study Compliance and Security Audits policies for data centres.

Course Outcomes: After completion of the course, learner should be able to:

1. To identify security challenges in cloud environment.
2. To apply the knowledge of different cryptographic algorithms.
3. To identify different Cyber attacks and apply Cyber Security mechanism.
4. To apply different data protection techniques in data centers.
5. To demonstrate cloud security tools.
6. To interpret and appropriately apply the policies on Compliance and Security Audits for data centres.

Prerequisites:

1. Operating System
2. Database Management System
3. Computer Networks

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Cyber security Landscape**	Modern Computing Trends, New Application threat vectors, Turbulence in cloud, SaaS Application Risk.	6	CO1
2	**Applied Cryptography for Cyber Defence**	CIA Traid, Cryptographic Algorithm-Symmetric (DES, AES), Asymmetric algorithm (RSA), Key exchange protocol (DH), Elliptical Curve Cryptography, El-gamal	6	CO2

		cryptosystem, Hash (MD5 and SHA, SHA256), Basics of Authentication, Authorization and Access Control, Cryptographic tools.		
3	**Cyber threats**	Modern cyber attack strategy, types of threats, Malwares (virus, worm, trojan, etc), bot and botnets, Vulnerability exploitation, detection, prevention mechanism.	6	CO3
4	**Data center Security and Data Protection**	Traditional Data security solutions, Implementation of security in Virtual Data centers, East-west Traffic Protections, Types of firewalls, IDS and IPS, DMZ	8	CO4
5	**Cloud Native Security**	4C's of cloud native security, DevOps and DevSecOps, Hybrid Data Center Security	8	CO5
6	**Compliance and Security Audits at data centers**	Privacy Protection Principle, Security Audit	5	CO6

Text Books:

1. Atul Kahate, "Cryptography and Network Security", Tata Mc Graw Hill.
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill.
3. T. J. Klevinsky, Scott Laliberte and Ajay Gupta, Addison-Wesley, "Hack I.T. - Security Through Penetration Testing", ISBN: 0-201-71956-8.

Reference Books:

1. David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni, "Metasploit: The Penetration Tester's Guide", No Starch Press.

2. Wm. Arthur Conklin, “CompTIA Security+ All-in-One Exam Guide”, McGraw Hill.

Evaluation Scheme:

1. **In-Semester Assessment:**
   - Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   - Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

   End-Semester Examination:
   - Question paper will comprise a full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

		Theory Hrs	Practical Hrs	Tutorial Hrs	Theory Credit	Practical/ Oral Credit	Tutorial Credits	Total Credits
CECDLO6042	**Artificial Intelligence**	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		In-Sem Evaluations				End Sem Exam				
		IA1	IA2	AVG	Mid Sem Exam					
CECDLO6042	**Artificial Intelligence**	**20**	**20**	**20**	**20**	**60**	**-**	**-**	**-**	**100**

Course Objectives:

1. To conceptualize the basic ideas and techniques of AI.
2. To understand and distinguish uninformed and informed search techniques.
3. To understand and apply knowledge representation and planning techniques.
4. To become familiar with basics of Propositional, Predicate and Fuzzy Logic and develop Fuzzy inference systems.

Course Outcomes: At the end of the course learner will able to

1. Identify the various characteristics of Artificial Intelligence techniques.
2. Choose an appropriate uninformed problem solving.
3. Apply informed search techniques for real world problem solution.
4. Analyze and apply the knowledge representation and reasoning to AI problem solving.
5. Design fuzzy inference system.
6. Understand and apply various planning strategies to perceive the real world.

Prerequisites:

1. Engineering Maths
2. Discrete Structures
3. Analysis of algorithms

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Fundamentals of Artificial Intelligence**	Introduction, AI Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation	6	CO1
2	**Uninformed Search Strategies**	Formulation of real-world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information.	6	CO2
3	**Informed Search Strategies**	Best First Search, Iterated Hill Climbing, Simulated Annealing, Genetic Algorithm, A* and AO* Algorithm, Game playing: Minimax Search, Alpha-Beta Cutoffs.	8	CO3
4	**Knowledge, Reasoning**	Knowledge based agents, Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.	7	CO4
5	**Fuzzy Logic**	Fuzzy set theory, Fuzzy logic, Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy inference systems,	8	CO5

		Fuzzification and Defuzzification, Fuzzy controllers		
6	**Planning**	Types of Planning: Partial Order, Hierarchical Order Conditional Order, Blocks world, STRIPS	4	CO6

Text Books:

1. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Publication.
2. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach”, Second Edition, Pearson Education.
3. Samir Roy and Chakraborty, “Introduction to soft computing”, Pearson Edition.

Reference Books:

1. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence" Third Edition, McGraw Hill.
2. Nils J Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann Publications, 2000.
3. Zimmermann H.S, "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers.

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