MAHARAJA SUHEL DEV UNIVERSITY

AZAMGARH, UTTAR PRADESH

EVALUATION SCHEME & SYLLABUS
FOR

B.E. 4TH YEAR

CSE-Artificial Intelligence Machine Learning
And
Data Science

Based On

AICTE Model Curriculum & NEP2020

(Effective from the Session: 2025-26)

SEMESTER- VII

Sl. No.	Subject Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BAI701	Deep Learning	Offline	3	-	-	15	10	25		75		100	4
2	Deptt-Elective-IV	Deptt- Elective-IV	Offline	3	-	-	15	10	25		75		100	3
3	BOEM**	Open Elective-II	Offline/ MOOC's	3	0	0	15	10	25		75		100	3
4	BAI751	Deep Learning Lab	Offline	0	0	2				25		75	100	2
5	BCS752	Mini Projects or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BCS753	Project-1		0	0	10				150		-	150	6
7	BCS754	Startup and Entrepreneurial Activity Assessment		0	0	4				100			100	2
		Total		**9**	**0**	**20**							**750**	**22**

*The Mini Project or internship (5-6 weeks) conducted during summer break after VI semester will be assessed during VII semester.

Semester VIII

Sl. No.	Subject Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOENM**	Open Elective-III	MOOC'S	3	0	0	15	10	25		75		100	4
2	BOENM**	Open Elective-IV	MOOC'S	3	0	0	15	10	25		75		100	4
4	BCS851	Project-II		0	0	18				100		450	550	14
		Total		**6**	**0**	**18**							**750**	**22**

The Internal Assessment of MOOCs will be done by the respective institute, and the External Assessment (End Semester Examination) will be done by the University.

Departmental Elective-IV

1. BCS070- Internet of Things
2. BCS072- Cryptography & Network Security
3. BAI070- Principles of Generative AI
4. BAI071- Blockchain Architecture Design

DEEP LEARNING (BAI701)

Unit I: Introduction to Machine Learning and Neural Networks

Introduction to machine learning, linear models including Support Vector Machines (SVMs), Perceptrons, and Logistic Regression. Fundamentals of neural networks, shallow neural networks, loss functions, backpropagation algorithm, stochastic gradient descent, and neural networks as universal function approximators.

Unit II: Deep Networks

History and evolution of deep learning, probabilistic theory of deep learning, backpropagation and regularization techniques, batch normalization, VC dimension and neural networks, comparison of deep and shallow networks, convolutional neural networks, generative adversarial networks (GANs), and semi-supervised learning.

Unit III: Dimensionality Reduction and Convolutional Networks

Dimensionality reduction techniques including Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), manifold learning, and metric learning. Autoencoders and their role in dimensionality reduction. Introduction to convolutional neural networks and popular architectures such as AlexNet, VGG, Inception, and ResNet. Training techniques including weight initialization, batch normalization, and hyperparameter optimization.

Unit IV: Optimization and Generalization

Optimization techniques in deep learning, non-convex optimization for deep networks, stochastic optimization, and generalization in neural networks. Spatial Transformer Networks, Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, language modeling using RNNs, word-level RNNs, deep reinforcement learning, and applications in computational and artificial neuroscience.

Unit V: Case Studies and Applications

Applications of deep learning in ImageNet classification, object detection, WaveNet for audio processing, natural language processing, Word2Vec, joint detection systems, bioinformatics, face recognition, scene understanding, and automatic image caption generation.

Text books:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

SWAYAM/NPTEL/MOOCs Certification: https://onlinecourses.nptel.ac.in/noc18_cs41/preview

BCS070: Internet of Things

Unit I: Introduction to Internet of Things

Internet of Things (IoT): Vision, definition, conceptual framework, architectural view, technologies behind IoT, sources of IoT, Machine-to-Machine (M2M) communication, and IoT examples.

Design principles for connected devices: IoT/M2M system layers, design standardization, communication technologies, data enrichment and consolidation, ease of design, and affordability.

Unit II: Hardware and Embedded Platforms for IoT

Hardware for IoT: Sensors, digital sensors, actuators, Radio Frequency Identification (RFID) technology, wireless sensor networks, and participatory sensing technology.

Embedded platforms for IoT: Embedded computing fundamentals and overview of IoT-supported hardware platforms such as Arduino, NetArduino, Raspberry Pi, BeagleBone, Intel Galileo boards, and ARM Cortex-based systems.

Unit III: Network and Communication Aspects in IoT

Wireless medium access issues, survey of MAC protocols, routing protocols for sensor networks, sensor deployment, node discovery, data aggregation, and data dissemination techniques.

Unit IV: Programming the Arduino

Arduino platform and board architecture, Arduino IDE, coding and program development, use of emulators, libraries and extensions, additional Arduino components, and programming Arduino for IoT applications.

Unit V: Challenges and Applications of IoT

Design challenges in IoT including development challenges, security challenges, and other implementation issues.

IoT applications including smart metering, e-health systems, city automation, automotive applications, home automation, smart cards, communication between hardware units, mobile devices and tablets, and design of smart street lighting systems for smart cities.

Text books:

1. Olivier Hersent,David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", wiley
2. Jeeva Jose, Internet of Things, Khanna Publishing House
3. Michael Miller "The Internet of Things" by Pearson
4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016
5. ArshdeepBahga, Vijay Madisetti "Internet of Things (A hands on approach)" 1ST edition, VPI publications,2014

Adrian McEwen,Hakin Cassimally "Designing the Internet of Things" Wiley India

BCS072: Cryptography & Network Security

Unit I: Introduction to Cryptography and Classical Encryption

Introduction to security attacks, security services, and security mechanisms. Classical encryption techniques including substitution ciphers, transposition ciphers, cryptanalysis, steganography, stream ciphers, and block ciphers.

Modern block ciphers: Principles of block ciphers, Shannon's theory of confusion and diffusion, Feistel structure, Data Encryption Standard (DES), strength of DES, differential cryptanalysis, block cipher modes of operation, and Triple DES.

Unit II: Advanced Encryption and Public Key Cryptography

Introduction to groups, fields, finite fields GF(p), modular arithmetic, prime and relatively prime numbers, and the Extended Euclidean Algorithm.

Advanced Encryption Standard (AES) encryption and decryption. Fermat's theorem, Euler's theorem, primality testing, Chinese Remainder Theorem, Discrete Logarithmic Problem, principles of public key cryptosystems, RSA algorithm, and security of RSA.

Unit III: Message Authentication and Digital Signatures

Message Authentication Codes (MAC): Authentication requirements, authentication functions, message authentication codes, hash functions, birthday attacks, security of hash functions, and Secure Hash Algorithm (SHA).

Digital Signatures: Concepts of digital signatures, ElGamal digital signature technique, Digital Signature Standard (DSS), and proof of digital signature algorithms.

Unit IV: Key Management and Authentication Applications

Key management and distribution techniques including symmetric key distribution, Diffie-Hellman key exchange, public key distribution, X.509 certificates, and Public Key Infrastructure (PKI).

Authentication applications: Kerberos, electronic mail security, Pretty Good Privacy (PGP), and Secure/Multipurpose Internet Mail Extensions (S/MIME).

Unit V: Network and System Security

IP Security (IPSec): Architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), combining security associations, and key management.

Introduction to Secure Socket Layer (SSL) and Secure Electronic Transaction (SET). System security concepts including intrusion detection, intrusion detection systems, viruses and related threats, and firewalls.

Text books:

- William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education.
- Behrouz A. Frouzan: Cryptography and Network Security, McGraw Hill .
- C K Shyamala, N Harini, Dr. T.R.Padmnabhan Cryptography and Security ,Wiley
- Bruce Schiener, "Applied Cryptography". John Wiley & Sons
- Bernard Menezes," Network Security and Cryptography", Cengage Learning.

AtulKahate, "Cryptography and Network Security", McGraw Hill

BAI070: Principles of Generative AI

Unit I: Foundations and Fundamentals of Generative AI

Introduction to Artificial Intelligence including definitions, foundations, scope, and applications. Implications of AI across various industries.

Fundamentals of Generative AI: Concept, evolution, capabilities, and applications of Generative AI in different domains. Introduction to Generative AI platforms such as ChatGPT (OpenAI), Gemini (Google), and GitHub Copilot (Microsoft).

Unit II: Prompt Engineering and Prompt Optimization Techniques

Basics of prompt engineering and different types of prompts including declarative, interrogative, and instructional prompts.

Advanced prompt engineering techniques such as Chain-of-Thought Prompting, Zero-Shot Prompting, Few-Shot Prompting, and prompt optimization methods. Practical use cases in coding, content writing, and customer interaction.

Unit III: Generative AI Applications in Workplace and Education

AI applications in office productivity including email writing, report drafting, minutes of meetings (MoM), proposal writing, summarization, and task automation.

Generative AI in education for content creation, summarization, explanation, curriculum design, assessment, feedback generation, and visualization using tools such as mind maps and infographics.

Unit IV: Domain-Specific Applications of Generative AI

Generative AI in digital marketing including content strategy for YouTube, Facebook, Instagram, X (Twitter), and LinkedIn.

AI in professional branding, email marketing automation, and e-commerce. Applications of Generative AI in healthcare and agriculture including diagnosis assistance, patient data summarization, crop monitoring, and yield prediction.

Unit V: Creative and Technical Aspects of Generative AI

AI-assisted programming including code generation and automated debugging using tools such as GitHub Copilot and GPT-based systems.

Generative AI in creative domains including image and design generation, music composition, gaming, animation, scenario generation, and NPC scripting. Customer interaction automation through chatbots, virtual assistants, and voice AI.

Exploration of popular AI platforms and tools including RunwayML, Jasper, Synthesia, Lumen5, and other Generative AI applications.

Text Book (s)

1. Emerson, J, Ripples of generative AI: Navigating AI's impact on society. AI Press (2023).

Reference Book (s)

1. Pandit, R., Generative AI (Hardcover), Notion Press (2024).
2. OpenAI. (n.d.). OpenAI, from https://openai.com/
3. Google. (n.d.). Gemini, from https://gemini.google.com/
4. Microsoft. (n.d.). Copilot, from https://copilot.microsoft.com/chats/VkLP7TbPcVtu4dDjpDVTv

SWAYAM/NPTEL/MOOCs Certification:

1. https://onlinecourses.swayam2.ac.in/imb25_mg135/preview
2. https://onlinecourses.swayam2.ac.in/nou25_ge85/preview

BAI071: Blockchain Architecture Design

Unit I: Introduction to Blockchain and Architecture

Introduction to Blockchain, evolution from digital money to distributed ledgers, and design primitives including protocols, security, consensus, permissions, and privacy.
Blockchain architecture and design, cryptographic primitives such as hashing and digital signatures, hash chains, blockchains, and basic consensus mechanisms.

Unit II: Consensus and Permissioned Blockchains

Requirements for consensus protocols, Proof of Work (PoW), and scalability aspects of blockchain consensus mechanisms.
Permissioned blockchains, design goals, and consensus protocols used in permissioned blockchain environments.

Unit III: Hyperledger Fabric

Hyperledger Fabric architecture, decomposition of the consensus process, Hyperledger Fabric components, chaincode design, and implementation.
Advanced Hyperledger Fabric concepts including Fabric SDK, frontend integration, and Hyperledger Composer tools.

Unit IV: Blockchain Applications in Finance and Supply Chain

Blockchain applications in financial software and systems including settlements, Know Your Customer (KYC), capital markets, and insurance.
Blockchain applications in trade and supply chain management including provenance of goods, visibility, supply chain finance, invoice management, and discounting.

Unit V: Blockchain Applications in Government and Security

Blockchain applications for government services including digital identity management, land records, record keeping among government entities, public distribution systems, and social welfare systems.
Blockchain cryptography, privacy mechanisms, and security issues in blockchain networks.

Text books:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits – https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

BAI751: Deep Learning Lab

Detailed Syllabus

1. **Implementation of Perceptron**
   - Write a Python program to implement a Perceptron for understanding the working of a single-layer neural network.
2. **Visualization of Activation Functions**
   - Write a Python program to visualize commonly used activation functions such as Sigmoid, ReLU, and Tanh.
3. **Feedforward Neural Network**
   - Develop a simple Feedforward Neural Network using a deep learning framework and analyze its performance.
4. **MNIST Digit Classification**
   - Implement handwritten digit recognition using the MNIST dataset with Keras/TensorFlow.
5. **Convolutional Neural Network (CNN) Layers**
   - Create and visualize different CNN layers to understand feature extraction and representation.
6. **CIFAR-10 Image Classification**
   - Build a CNN model for multiclass image classification using the CIFAR-10 dataset.
7. **Image Augmentation Techniques**
   - Apply image preprocessing and augmentation techniques to improve model robustness and performance.
8. **Dropout for Regularization**
   - Implement Dropout in neural networks and analyze its effect on reducing overfitting and improving generalization.
9. **Deep Learning with PyTorch**
   - Develop and train a deep learning model using the PyTorch framework.
10. **Batch Normalization Analysis**
    - Compare model training with and without Batch Normalization and evaluate its impact on convergence speed and performance.