



TAKSHASHILA UNIVERSITY

(Tamil Nadu State Private University)

ONGUR, TINDIVANAM TK, VILLUPURAM DT

FACULTY OF ENGINEERING AND TECHNOLOGY SCHOOL OF COMPUTATIONAL ENGINEERING

Department of Artificial Intelligence and Data Science
(IBM)

REGULATION – R24

CURRICULUM & SYLLABI

V Semester



VISION AND MISSION OF UNIVERSITY

VISION:

To create change makers and world leaders similar to the ancient Takshashila University.

MISSION:

The brightest minds and the best resources are used to nurture and develop the leaders of tomorrow, where they are encouraged to be eternally curious and ethically sound.

DEPARTMENT VISION AND MISSION

VISION:

To be a center of excellence in Artificial Intelligence and Data Science by fostering transformative education, interdisciplinary research and innovation to develop intelligent, ethical, and sustainable solutions that address global challenges and contribute to societal progress.

MISSION:

M1: Academic Excellence	Deliver a contemporary, outcome-based curriculum that equips students with strong foundations in Artificial Intelligence, Data Science and computational thinking to solve complex real-world problems.
M2: Research and Innovation	Promote interdisciplinary research, innovation, and the adoption of emerging AI and data-driven technologies to develop impactful solutions for industrial and societal needs.
M3: Industry Readiness and Entrepreneurship	Strengthen employability and entrepreneurial capabilities through industry collaborations, experiential learning, internships, professional certifications and start-up incubation.
M4: Ethics and Lifelong Learning	In still ethical values, responsible AI practices, professional integrity, and a commitment to lifelong learning to develop socially responsible leaders capable of driving sustainable technological advancement.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in continuous learning in the face of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Competitive Platform

To create a competitive platform for solving critical problems in a wide variety of fields.

PEO2: Exploration

Enthusiastic participation in learning, understanding, designing and applying new innovative research ideas as the field evolves.

PEO3: Career

Applying cutting-edge technology that improves knowledge and to commit students for life-long learning to reach the leading positions in the career.

PEO4: Professional Values

Simulate the graduates to hold the responsibilities in the context of technology, ethics, society and humanity.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: AI and Data Analytics Competency

Apply the principles of Artificial Intelligence and Data Science to develop intelligent, data-driven solutions for complex real-world problems.

PSO2: Research and Innovation

Design and implement AI-based and data-centric solutions using modern tools, emerging technologies and research methodologies to address industrial and societal challenges.

PSO3: Professional Competence

Demonstrate professional ethics, entrepreneurial mind-set and lifelong learning to excel in careers, higher education, research, and innovation in Artificial Intelligence and Data Science.



**TAKSHASHILA
UNIVERSITY**

(Established Under Tamil Nadu State Private Universities Act 2019 &
Recognized by UGC u/s 2(f) of the UGC Act, 1956)

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FACULTY OF ENGINEERING AND TECHNOLOGY
B.TECH. IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
(REGULATION – R24)
SEMESTER – V

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Hrs.	Max. Marks								
				L	T	P			CAT Theory (Best of two)	ASS	MCQ	ATT	SEM	P	CAM	ESM	Total
1	U24MAT501	Numerical Method	BS	3	1	0	4	60	20	5	5	5	5	-	40	60	100
2	U24CEB501	Computer Networks	PC	3	0	2	4	75	20	5	5	5	5	10	50	50	100
3	U24CET502	Theory of Computation	PC	3	1	0	4	60	20	5	5	5	5	-	40	60	100
4	U24ADB565	Deep Learning	PC	3	1	0	4	60	20	5	5	5	5	10	50	50	100
5	U24*****	Professional Elective - II	PE	3	0	0	3	45	20	5	5	5	5	-	40	60	100
6	U24*****	Open Elective	OE	3	0	0	3	45	20	5	5	5	5	-	40	60	100
7	U24*****	Generic Elective - III	GE	2	0	0	2	30	20	5	5	5	5	-	100	-	100
				Total			24	375							360	340	700
8	U24CEW501	Mini Project - II	PW	0	0	4	2	60	-	-	-	-	-	-	50	50	100
				Total:			2	60							50	50	100
9	U24UMP591	Takshashila Innovative Learning - V	TIL	0	0	2	1	30	40	20	20	20	-	-	100	-	100
10	U24UMP592	Foreign Language - I	FL	0	0	2	1	30	40	20	20	20	-	-	100	-	100
11	U24UMP593	Green Credit - V	GC	0	0	2	1	30	40	20	20	20	-	-	100	-	100
				Total:			3	45							300	-	300
				Semester Total:			29	480							710	390	1100

Note:

L – Lecture

T – Tutorial

P – Practical

PW – Project Work

ASS – Assignment

ATT – Attendance

CAM – Continuous Assessment Marks

SEM – Seminar

CAT – Continuous Assessment Test

ESM – End Semester Exam Marks

Page 5 of 52

B.Tech. in Artificial Intelligence and Data Science with IBM

BoS Chairman

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U24MAT501	Numerical Methods	L	T	P	C	Total
		3	1	0	4	60

COURSE OBJECTIVES:

•	To Understand the fundamental concepts and techniques of numerical methods for solving mathematical problems arising in science and engineering
•	To Apply direct and iterative methods to solve systems of linear algebraic equations and nonlinear equations using numerical methods
•	To Compute numerical differentiation and numerical integration using interpolation and quadrature techniques
•	To Solve ordinary differential equations with initial conditions using single-step and multi-step numerical methods
•	To Develop computational skills to obtain approximate solutions when analytical methods are difficult or impossible

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Apply direct and iterative numerical methods to solve systems of linear equations and analyze their accuracy and computational efficiency.
CO2:	Solve nonlinear equations using numerical root-finding techniques.
CO3:	Approximate derivatives of functions using interpolation-based numerical differentiation methods.
CO4:	Evaluate definite and double integrals numerically using Newton-Cotes quadrature formulas, Trapezoidal rule, Simpson's rules, and Romberg integration.
CO5:	Solve initial value problems in ordinary differential equations by using various methods.

UNIT I: SYSTEMS OF LINEAR EQUATIONS	12 Hrs.
Direct methods: Gaussian Elimination - Gauss-Jordan Elimination - LU Decomposition and Cholesky Factorization - Iterative methods: Jacobi Method - Gauss-Seidel Method.	

UNIT II: NUMERICAL SOLUTIONS OF NONLINEAR EQUATIONS	12 Hrs.
Bisection method - Regula Falsi Method - Fixed point iteration method - Newton-Raphson method - Secant method.	

UNIT III: NUMERICAL DIFFERENTIATION	12 Hrs.
Approximation of derivatives using Newton's forward and backward interpolation formulas, Stirling's formula, and Bessel's formula.	

UNIT IV: NUMERICAL INTEGRATION	12 Hrs.
Newton-Cotes quadrature formulas - Trapezoidal Rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule - Romberg Integration - Evaluation of Double Integrals using Trapezoidal and Simpson's 1/3 Rules.	

UNIT V: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	12 Hrs.
Single-step methods: Taylor's Series Method - Euler's Method - Modified Euler's Method - Second order Runge-Kutta Method. Multi-step methods: Milne's Predictor-Corrector Method and Adams-Bash forth Predictor-Corrector Method.	

Total Hours: 60

TEXT BOOKS:	
1.	S. Grewal and J. S. Grewal, Numerical Methods in Engineering and Science, Khanna Publishers, 9 th Edition, 2013.
2.	C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, 6 th Edition, 2006.
3.	Richard L. Burdman and J. Douglas Faires, Numerical Analysis, Cengage Learning, Boston, 10 th Edition, 2015.

REFERENCE BOOKS:	
1.	C. Chapra and R. P. Canale, Numerical Methods for Engineers, Tata McGraw-Hill, 5 th Edition, 2009.
2.	Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, 2007.
3.	Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, 3 rd Edition, 2007.
4.	E. Balagurusamy, "Numerical methods, McGraw Hill Education, 2 nd Edition, 2017.
5.	M. K. Jain, S. R. K. Iyengar, R. K. Jain, " Numerical methods for Scientific and Engineering Computation", New Age International Publisher, 6 th Edition, 2012.

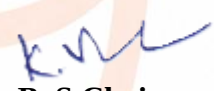
WEB REFERENCES:

1.	https://nptel.ac.in/courses/111107105
2.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ma54
3.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ge22
4.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ma35
5.	https://nptel.ac.in/courses/111107105

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	-	-	-	1	3	2	1
2	3	3	2	2	2	-	-	-	-	-	-	1	3	3	1
3	3	3	1	2	2	-	-	-	-	-	-	1	2	2	1
4	3	3	2	3	2	-	-	-	-	-	-	1	3	2	1
5	3	3	2	3	3	-	-	-	-	-	-	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High


BoS Chairman

U24CEB501	Computer Networks	L	T	P	C	Total
		3	0	2	4	75

COURSE OBJECTIVES:

• To understand the basic concepts of computer networks and network architecture
• To learn IP addressing, subnetting, and the functions of network devices
• To understand routing concepts and commonly used routing protocols
• To learn medium access control, flow control, error control, and data link layer protocols
• To understand transport and application layer protocols and perform basic network analysis using Wireshark

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand the fundamentals of computer networks, network architectures, transmission media, switching techniques, and performance metrics.
CO2:	Apply IPv4 addressing, subnetting, VLSM, NAT, and network device concepts to design and configure computer networks.
CO3:	Analyze IP packet forwarding, routing algorithms, and routing protocols, and describe the fundamentals of IPv6 addressing and multicasting.
CO4:	Evaluate medium access control techniques, flow control, error detection and correction methods, and data link layer protocols for reliable data communication.
CO5:	Demonstrate the working principles of transport and application layer protocols, analyze network traffic using Wireshark, and troubleshoot basic network communication issues.

UNIT I: INTRODUCTION TO NETWORKS	9 Hrs.
Network Types: LAN, MAN, PAN, WAN - Network Topology: BUS, STAR, RING, MESH, HYBRID - Switching: Circuit Switching, Packet Switching - OSI Layered Architecture - TCP/IP Model - Physical Layer Overview - Latency, Bandwidth, Delay - Guided Media: Twisted pair, Coaxial cable, Fiber optic cable - Unguided Media: Radio waves, Microwaves, Infrared.	

UNIT II: ADDRESSING	9 Hrs.
IPV4 Addressing - Address space - Classful addressing - Subnet mask - FLSM - Classless Addressing - VLSM - NAT - Super netting - Network Devices: Hub, Repeaters, Switch, Bridge, Router.	

UNIT III: ROUTING	9 Hrs.
Forwarding of IP Packets - Static and Default Routing - Unicast Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing - Protocols: RIP V1, RIP V2, OSPF, BGP, EIGRP - Multicasting Basics - IPV6 Addressing Basics	

UNIT IV: MEDIUM ACCESS CONTROL	9 Hrs.
ALOHA, CSMA/CD, CSMA/CA, Ethernet, Token Ring - Flow Control: Stop and Wait, Sliding Window - Error Control: Stop and Wait ARQ, Sliding Window ARQ - Error Detection: Parity Check, Checksum, CRC - Error Correction: Hamming codes - Data-Link Layer Protocols: HDLC, PPP.	

UNIT V: TRANSPORT AND APPLICATION LAYER PROTOCOLS	9 Hrs.
Port Numbers - User Datagram Protocol - Transmission Control Protocol - WWW and HTTP - FTP - Email - TELNET – DNS- Packet Analysis using Wireshark.	

Total Hours: 45

List of Exercises	
1.	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2.	Write a HTTP web client program to download a web page using TCP sockets.
3.	Applications using TCP sockets like: a) Echo client and echo server b) Chat
4.	Simulation of DNS using UDP sockets.
5.	Use a tool like Wireshark to capture packets and examine the packets
6.	Write a code simulating ARP /RARP protocols.
7.	Write a program for Distance Vector/ Link State Routing algorithm.

8.	Write a program for an error correction code (like CRC)
9.	Implement TCP and UDP client-server communication and analyze the packet flow using Wireshark.
10.	Implement an application-layer communication using HTTP/FTP and analyze the captured packets using Wireshark.

Total Hours: 30

TEXT BOOKS:

1.	Andrew S. Tanenbaum and Nick Feamster, <i>Computer Networks</i> , 6th Edition, Pearson Education, 2021.
2.	Behrouz A. Forouzan, <i>Data Communications and Networking</i> , 6th Edition, McGraw-Hill Education, 2023.

REFERENCE BOOKS:

1.	Keith W. Ross and James F. Kurose, <i>Computer Networking: A Top-Down Approach Featuring the Internet</i> , Pearson Education, 8th Edition, 2022.
2.	James F. Kurose and Keith W. Ross, <i>Computer Networking: A Top-Down Approach</i> , 8th Edition, Pearson Education, 2021.
3.	William Stallings, <i>Data and Computer Communications</i> , Pearson Education, 11th Edition, 2020.

WEB REFERENCES:

1.	https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-computer-networking.html
2.	https://www.geeksforgeeks.org/computer-network-tutorials
3.	https://nptel.ac.in/courses/106105183

COs/POs/PSOs Mapping:															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	-	1	-	-	-	-	2	-	1	2	1	2
2	3	3	2	1	2	-	-	-	-	-	-	1	3	2	1
3	3	3	3	2	3	-	-	-	2	1	1	2	3	3	2
4	3	3	2	3	2	-	-	-	1	-	-	2	2	3	1
5	3	3	2	2	2	1	-	-		1	-	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U24CET502	Theory of Computation	L	T	P	C	Total
		3	1	0	4	60

COURSE OBJECTIVES:

To understand the fundamental concepts of automata theory, formal languages, and computational models
To describe the concepts and notation of regular expressions and regular languages
To discuss Chomsky hierarchy and grammar classifications.
To illustrate the techniques for simplifying Context-Free Grammars by eliminating useless symbols, ϵ-productions, and unit productions
To compare recursive and recursively enumerable languages.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Convert Nondeterministic Finite Automata into equivalent Deterministic Finite Automata and Minimize the Deterministic Finite Automata.
CO2:	Construct deterministic finite automata into equivalent regular expressions using the state elimination method and transitive closure concepts.
CO3:	Transform CFGs into equivalent PDAs and PDAs into CFGs, and compare deterministic and nondeterministic pushdown automata.
CO4:	Construct equivalent CNF and GNF representations.
CO5:	Solve PCP and MPCP to establish undecidability.

UNIT I: FINITE AUTOMATA AND FORMAL LANGUAGES	12 Hrs.
Introduction to Finite Automata – Concepts of Automata Theory – Alphabets – Strings – Languages – Finite Automata (FA): Deterministic Finite Automata (DFA) – Nondeterministic Finite Automata (NFA) – Equivalence of DFA and NFA – Equivalence of NFA's with and without ϵ -moves – Conversion of NFA into DFA – Minimization of DFAs.	

UNIT II: REGULAR EXPRESSIONS AND REGULAR LANGUAGES	12 Hrs.
Regular expression – Regular Languages – DFA to Regular Expressions: Eliminating States – Transitive Closure – Regular Expressions to Automata – Thompson’s Rules – Properties of Regular Languages – Proving Languages not to be Regular – Closure Properties of Regular Languages.	

UNIT III: CONTEXT-FREE GRAMMARS AND PUSHDOWN AUTOMATA	12 Hrs.
Chomsky’s hierarchy of languages – Types of Grammar – Context-Free Grammar (CFG) and Languages – Derivations: Leftmost and Rightmost Derivations – Parse Trees – Ambiguity in Grammars and Languages – Pushdown Automata (PDA): Definition – Moves – Instantaneous Descriptions – Languages of Pushdown Automata – Acceptance by Empty Stack and Final State – Equivalence of PDA’s and CFG’s: CFG to PDA – PDA to CFG.	

UNIT IV: CONTEXT-FREE LANGUAGE SIMPLIFICATION AND TURING MACHINES	12 Hrs.
Context-Free Languages (CFL) – Simplification of Context-Free Grammar (CFG): Eliminating Useless Symbols – Eliminating ϵ -Productions – Eliminating Unit Productions – Normal Forms: Chomsky Normal Form (CNF) – Greibach Normal Form (GNF) – Pumping Lemma for Context-Free Languages – Closure Properties of Context-Free Languages – Turing Machine – Notation for the Turing Machine (TM) – Instantaneous Description – The Language of a Turing Machine – Programming Techniques for Turing Machines – Multitape Turing Machines – Halting problem of Turing Machine.	

UNIT V: DECIDABILITY, UNDECIDABILITY AND COMPUTATIONAL COMPLEXITY	12 Hrs.
Decidability – Decidable Languages – Undecidable Languages – Recursive and Recursively Enumerable Languages – Rice Theorem – Universal Turing machine – Post Correspondence Problem (PCP) – Modified Post Correspondence Problem (MPCP) – Class P – Class NP – Class NP Completeness.	

Total Hours: 60

TEXT BOOKS:	
1.	John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, <i>Introduction to Automata Theory, Languages and Computation</i> , 3rd Edition, Pearson. 2006.
2.	Michael Sipser, <i>Introduction to the Theory of Computation</i> , 3rd Edition, Cengage Learning, 2012.

REFERENCE BOOKS:

1.	K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science Automata, Languages and Computation, 3rd Edition, Prentice Hall of India, 2008.
2.	Kamala Krithivasan and R. Rama, Introduction to Formal Languages, Automata Theory and Computation, 1st Edition, Pearson Education India, 2009.
3.	D. Shanthi, N. Uma Maheshwari, S. Jeyanthi, Theory of Computation, 2nd Edition, Yesdee Publication, 2019.
4.	Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, 2nd Edition, Pearson Education, PHI Learning, 2008.

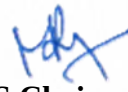
WEB REFERENCES:

1.	https://nptel.ac.in/courses/106104028
2.	https://nptel.ac.in/courses/106104148
3.	https://brilliant.org/wiki/pushdown-automata
4.	https://plato.stanford.edu/entries/turing-machine
5.	https://cglab.ca/~michieli/TheoryOfComputation

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	–	–	–	–	–	–	2	2	1	1
2	3	3	3	2	1	–	–	–	–	–	–	2	2	2	1
3	3	3	3	3	1	–	–	–	–	–	–	2	2	2	1
4	3	2	3	2	1	–	–	–	–	–	–	2	2	2	1
5	3	3	2	3	–	–	–	–	–	–	–	3	1	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation


BoS Chairman

U24ADB565	Deep Learning	L	T	P	C	Total
		3	1	0	4	60

COURSE OBJECTIVES:

• To Learn and Understand about Deep Learning concepts
• To know the building blocks of complex Neural Networks and applications of Deep Learning across industries
• To focus on the concepts of Neural Networks, Mathematical Representation and Activation Functions
• To explain the concepts and techniques associated with Recurrent Neural Network (RNNs) and Long Short-Term Memory Architecture (LSTM)
• To Learn and Understand about Deep Learning concepts.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Recognize the characteristics of deep learning models that are useful to solve real-world problems.
CO2:	Understand different methodologies to create application using deep nets.
CO3:	Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.
CO4:	Apply and Implement Convolution Operations, Understanding the needs of CNNs.
CO5:	Design the test procedures to assess the utility of the developed model and deploy.

UNIT I: INTRODUCTION TO DEEP LEARNING	12 Hrs.
Deep Learning - Understand the need and applications of Deep Learning – Neural Networks - Explain Neural Networks - Advantages & Disadvantages of Deep Learning.	

UNIT II: INTRODUCTION TO PERCEPTRONS	12 Hrs.
Explain what a “Perceptron” is - Perceptron – Mathematical Representation - Simple Logic Circuits – AND, OR, NAND, XOR - Explain Weights, Bias in Perceptron’s - Explain Multi-Layer Perceptron (MLP) Architecture - Apply concepts to Hands-On Exercises.	

UNIT III: NEURAL NETWORKS AND TRAINING	12 Hrs.
Explain what a Neural Network is - Neural Network – Mathematical Representation - Activation Functions – Step, Sigmoid, ReLU, Softmax - Explain the terms – Gradient Descent, Loss Function, Learning Rate - Explain Forward Propagation & Backward Propagation - Explain Multi-Layer Perceptron Architecture - Understand and explain how a Neural Network gets trained - Apply concepts to Hands-On Exercises.	

UNIT IV: CONVOLUTIONAL NEURAL NETWORK	12 Hrs.
Explain the issues with Multi-Layer Perceptron Architecture - Understand the need and advantages of CNNs - Explain the Convolution Operation, Bias, Padding, Stride and Pooling Operation - Apply concepts to Hands-On Exercises.	

UNIT V: RECURRENT NEURAL NETWORKS AND LONG SHORT-TERM MEMORY	12 Hrs.
Explain Recurrent Neural Networks - Comparing RNNs and Standard Neural Networks - Understand the unfolding of RNNs - Understand the components of an RNN Cell – Weights, Activation Function & Model Training - Understand issues with RNNs, and how LSTMs help in solving Them - Comparing RNN and LSTM - Understand the components of LSTM – Cell State, Forget Gate, Input Gate, Output Gate.	

Total Hours: 60

TEXT BOOKS:	
1.	John D Kelleher, “ <i>Deep Learning</i> ”, MIT Press, Cambridge, Massachusetts, First Edition, 2016.
2.	Francois Chollet, “ <i>Deep Learning with Python</i> ”, Manning Publications, Shelter Island, New York, Second Edition, 2021.
3.	Charu C. Aggarwal, “ <i>Neural Networks and Deep Learning</i> ”, Springer, Cham, Switzerland, First Edition, 2018.
4.	Nithin Buduma, Nikhil Buduma, and Joe Papa with contributions by Nicholas Locascio, “ <i>Fundamentals of Deep Learning</i> ”, O'Reilly Media, Sebastopol, California, Second Edition, 2022.

REFERENCE BOOKS:	
1.	Simon Haykin, “ <i>Neural Networks: A Comprehensive Foundation</i> ”, Pearson Education, New Delhi, Second Edition, 2007.
2.	Christopher M. Bishop, “ <i>Pattern Recognition and Machine Learning</i> ”, Springer, New York, First Edition, 2006.

3.	Jeremy Howard, Sylvain Gugger, “ <i>Deep Learning for Coders with Fastai and PyTorch</i> ”, O'Reilly Media, Sebastopol, California, First Edition, 2020.
4.	Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, Orlando De Jesús, “ <i>Neural Network Design</i> ”, PWS Publishing Company, Boston, Massachusetts, Second Edition, 2014.
5.	Josh Patterson, Adam Gibson, “ <i>Deep Learning: A Practitioner's Approach</i> ”, O'Reilly Media, Sebastopol, California, First Edition, 2017.

WEB REFERENCES:

1.	https://pytorch.org/tutorial/
2.	https://cs231n.stanford.edu/
3.	https://www.deeplearning.ai/resources/
4.	https://developers.google.com/machine-learning/crash-course/

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	-	-	-	-	-	-	2	3	2	1
2	3	2	2	2	3	-	-	-	1	1	-	2	3	3	2
3	3	3	3	3	3	1	-	-	1	1	1	2	3	3	2
4	3	3	3	2	3	1	-	-	1	1	1	2	3	3	2
5	3	3	3	3	3	1	-	1	2	2	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

PROFESSIONAL ELECTIVE COURSES

Professional Elective – II (Offered in Semester V)		
Sl. No.	Course Code	Course Title
1.	U24ADT521	Responsible AI
2.	U24ADT522	Information Retrieval Techniques
3.	U24CET521	Internet of Things
4.	U24MLT521	Solving Business Problems with AI
5.	U24MLT522	Soft Computing



BoS Chairman

U24ADT521	Responsible AI	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To acquire foundational knowledge of AI, common misconceptions, responsible AI principles, and implementation challenges.
• To examine and assess biases in AI, fairness metrics, and mitigation techniques.
• To explore explainability, its challenges, methods, and evaluation approaches for interpretable machine learning models.
• To develop awareness of AI safety, security, privacy, and resilience, including model and data protection.
• To explore ethical issues and implications of AI in various real-world applications.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Describe the principles, characteristics, and challenges of Responsible AI, including ethical, legal, and societal considerations.
CO2:	Assess bias and fairness issues in datasets and AI models using fairness metrics and bias mitigation techniques.
CO3:	Apply explainability and interpretability methods to understand and communicate AI model decisions.
CO4:	Analyze AI safety, security, privacy, and operational risks and recommend appropriate mitigation strategies.
CO5:	Critically evaluate real-world AI deployments and case studies from a Responsible AI perspective to support ethical decision-making.

UNIT I: INTRODUCTION TO RESPONSIBLE AI	9 Hrs.
Overview of AI – Common misconception of AI – Introduction to Responsible AI – Characteristics of Responsible AI – Key principles of responsible AI - Challenges in implementing responsible AI – ELSI - Framework and AI - Safety and Alignment – Fairness and Privacy.	

UNIT II: FAIRNESS AND BIAS	9 Hrs.
Human Bias - Types of biases - Effects of biases on different demographics - Bias vs Fairness - Sources of Biases - Exploratory data analysis - Bias Mitigation Techniques - Pre-processing techniques – In -processing techniques - Post-processing techniques - Bias detection tools -	

Overview of fairness in AI -Demographic parity - Equalized odds - Simpson's paradox and the risks of multiple testing – Group fairness and Individual fairness - Counterfactual fairness - Fairness metrics - Bias and disparity mitigation with Fair learn.

UNIT III: EXPLAINABILITY & INTERPRETABILITY

9 Hrs.

Importance of Explainability and Interpretability – Challenges - Interpretability through simplification and visualization - Intrinsic interpretable methods - Post Hoc interpretability – Interpretability Evaluation methods - Explainability through causality - Model agnostic Interpretation - LIME (Local Interpretable Model-agnostic Explanations) - SHAP (Shapley Additive explanations).

UNIT IV: SAFETY, SECURITY AND PRIVACY

9 Hrs.

Overview of safety – security – privacy - resilience - Taxonomy of AI safety and Security - Adversarial attacks and mitigation - Model and data security - The ML life cycle - Adopting an ML life cycle MLOps and ModelOps - Model drift - Data drift - Concept drift - Privacy-preserving AI techniques- Differential privacy - Federated learning.

UNIT V: CASE STUDIES AND ETHICAL CHALLENGES

9 Hrs.

COMPAS Algorithm - Google Photos Tagging Controversy - ProPublica's Analysis of Recidivism Predictions - Amazon's AI Recruiting Tool - Facial Recognition Technology Misidentification - AI in Healthcare: Predictive Analytics in Patient Care - Tesla Autopilot and Ethical Implications of Autonomous Vehicles.

Total Hours: 45

TEXT BOOKS:

1. Virginia Dignum, *"Responsible Artificial Intelligence": How to Develop and Use AI in a Responsible Way*, Springer Nature, 2022.
2. Solon Barocas, Moritz Hardt, and Arvind Narayanan, *"Fairness and Machine Learning"*, MIT Press (Open Access), 2023.
3. Stuart Russell and Peter Norvig, *"Artificial Intelligence": A Modern Approach*, 4th Edition, Pearson, 2021.

REFERENCE BOOKS:

1. Andriy Burkov, *Machine Learning Engineering*, True Positive Inc., 2020.
2. Christoph Molnar, *Interpretable Machine Learning*, 2nd Edition, Lulu.com, 2024.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd Edition, O'Reilly Media, 2023.

4.	S. Matthew Liao (Ed.), Ethics of Artificial Intelligence, Oxford University Press, 2020.
5.	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.

WEB REFERENCES:

1.	https://www.nist.gov/itl/ai-risk-management-framework
2.	https://oecd.ai/en/ai-principles
3.	https://christophm.github.io/interpretable-ml-book/
4.	https://www.nptel.ac.in/courses/106106472

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	–	–	–	3	2	3	–	–	–	2	1	1	1
2	2	3	1	2	3	2	–	2	–	–	–	1	3	2	2
3	2	2	–	2	3	–	–	1	–	3	–	1	3	2	2
4	2	3	2	2	3	3	1	2	–	–	1	1	3	2	3
5	1	3	2	2	1	3	2	3	1	2	–	2	1	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation


BoS Chairman

U24ADT522	Information Retrieval Techniques	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To acquire foundational knowledge of information retrieval, with emphasis on modeling, query operations, and indexing.
• To explore machine learning techniques for text classification and clustering.
• To examine various applications of information retrieval, with particular emphasis on multimedia IR and web search.
• To analyze machine learning techniques used for text classification and clustering.
• To gain familiarity with the concepts and components of digital libraries.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Build an Information Retrieval system using the available tools.
CO2:	Identify and design the various components of an Information Retrieval system.
CO3:	Categorize the different types of IR Models.
CO4:	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO5:	Design an efficient search engine and analyze the Web content structure.

UNIT I: INTRODUCTION: MOTIVATION	9 Hrs.
Basic Concepts – Practical Issues – Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine.	

UNIT II: MODELING	9 Hrs.
Taxonomy and Characterization of IR Models – Boolean Model – Vector Model – Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models – Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.	

UNIT III: INDEXING	9 Hrs.
Static and Dynamic Inverted Indices – Index Construction and Index Compression- Searching – Sequential Searching and Pattern Matching. Query Operations - Query Languages – Query	

Processing – Relevance Feedback and Query Expansion – Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

UNIT IV: EVALUATION AND PARALLEL INFORMATION RETRIEVAL

9 Hrs.

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce.

UNIT V: SEARCHING THE WEB

9 Hrs.

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis – XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

Total Hours: 45

TEXT BOOKS:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “*Introduction to Information Retrieval*”, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Buttcher, “*Implementing and Evaluating Search Engines*”, The MIT Press, Cambridge, Massachusetts London, England, 2016

REFERENCE BOOKS:

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, (2011) “*Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books)*”, Second Edition
2. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “*Information Retrieval*
3. Bruce Croft, Donald Metzler, Trevor Strohman, “*Search Engines: Information Retrieval in Practice*”, Pearson Education (2010)
4. Soumen Chakrabarti, “*Mining the Web: Discovering Knowledge from Hypertext Data*”, Morgan Kaufmann (Elsevier)2002.
5. Ian H. Witten, Alistair Moffat, Timothy C. Bell, “*Managing Gigabytes: Compressing and Indexing Documents and Images*“,2nd Edition Morgan Kaufmann (Elsevier).

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106106852>
2. <https://www.nptel.ac.in/courses/106105084>

3. <https://web.stanford.edu/class/cs276/index.html>

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	3	-	-	-	1	2	-	1	3	2	2
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4	3	3	3	2	3	1	-	-	2	3	1	1	3	3	3
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Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U24CET521	Internet of Things	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To describe the fundamentals, architecture and components of IoT
• To explain IoT networking and communication technologies, protocols, and standardization techniques in IoT
• To develop IoT system using sensors, actuators and microcontroller boards like Arduino Uno and Node-MCU
• To implement IoT solutions using embedded programming and cloud platforms, data acquisition, storage, and device integration.
• To analyze and design IoT-based solutions for real-world applications

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the fundamentals, architecture, and components of IoT.
CO2:	Analyze IoT networking concepts, communication technologies, protocols, and standardization for connected devices.
CO3:	Develop IoT system by interfacing sensors and actuators with Arduino, Node-MCU and Raspberry Pi using appropriate programming environments.
CO4:	Implement cloud-enabled IoT solutions using data acquisition, storage, MQTT brokers, ThingSpeak API, web servers, and authentication mechanisms.
CO5:	Design and evaluate IoT-based solutions for real-world applications like home automation or weather monitoring system.

UNIT I: BASICS OF INTERNET OF THINGS	9 Hrs.
Introduction to IoT - Applications of IoT - Building blocks of IoT device: sensors – processors-gateways - applications- Embedded Boards for IoT: Arduino Uno - Raspberry Pi - Node Microcontroller Unit - ESP32 - Arduino Uno Hardware Architecture and Peripheral features - Arduino programming	

UNIT II: IoT CONNECTIVITY AND PROTOCOLS	9 Hrs.
IoT Network Configurations – IoT Gateways - Data Protocol: MQTT – CoAP- AMQP- DDS- XMPP - Communication Protocols: IEEE Standards 802.3, 802.11 and 802.15 -Z Wave -Bluetooth	

– ZigBee - 6LowPAN - HART and Wireless HART – NFC- RFID - Software-Defined Networking Protocol - Standardization for IoT - M2M and Wireless Sensor Network (WSN) Protocols - SCADA and RFID Protocols - Issues with IoT Standardization - Unified Data Standards

UNIT III: SENSORS AND ACTUATORS

9 Hrs.

Sensors: Definition - Property of Sensors - Types of Sensors: Transducers- Temperature Sensors - Humidity Sensors- Pressure Sensors -Proximity Sensors - Level Sensors – Accelerometers - Gyroscope - Gas Sensors etc., Actuators: Actuator Types: Hydraulic, Pneumatic- Electrical - Thermal/ Magnetic -Mechanical- Soft Actuators- Shape memory polymer (SMP)- Motor Actuators: Servo motor - Stepper motor- Hydraulic motor- Solenoid Relay

UNIT IV: PROGRAMMING IN IoT

9 Hrs.

Introduction to Arduino Programming - Arduino IDE - Integration and calibration of Sensors and Actuators with Arduino - Implementation of IoT: Introduction to Node-MCU (ESP8266) board - Programming Node-MCU using Arduino - Connectivity of Sensors and Actuators with Node-MCU -Introduction to Raspberry Pi – Python Programming for IoT using Raspberry Pi

UNIT V: IoT APPLICATIONS

9 Hrs.

IoT Physical Devices and Endpoints - Domain specific IoTs - IoT Physical Servers - Cloud Computing: Introduction to Cloud Service models (SaaS, PaaS, IaaS, XaaS etc.) - Deployment models - Cloud storage APIs - Web server for IoT - ThingSpeak API - MQTT Broker - IoT Application Development - Solution framework - Device integration - Data acquisition and integration - Device Data Storage on cloud/local server - Authentication and Authorization of IoT devices- Case Study: Home Automation - Weather Monitoring System - Smart Agriculture

Total Hours: 45

TEXT BOOKS:

- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 2nd Edition, Cisco Press, 2023.
- Raj Kamal, Internet of Things: Architecture and Design Principles, 2nd Edition, McGraw Hill Education (India), 2022.

REFERENCE BOOKS:

- Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, 2nd Edition, Universities Press, 2023.
- Maciej Kranz, Building the Internet of Things, Updated Edition, Wiley, 2022.

3.	Ammar Rayes and Samer Salam, Internet of Things from Hype to Reality: The Road to Digitization, 3rd Edition, Springer, 2022.
4.	F. John Dian, Fundamentals of Internet of Things: For Students and Professionals, 1st Edition, John Wiley & Sons, 2022.

WEB REFERENCES:

1.	https://docs.aws.amazon.com/iot/latest/developerguide/what-is-aws-iot.html
2.	https://iot.eclipse.org/projects/getting-started/
3.	https://kafka.apache.org/43/getting-started/introduction/
4.	https://www.rishabhsoft.com/blog/iot-data-analytics-use-cases-and-benefits
5.	https://imply.io/blog/what-is-iot-analytics/

COs/POs/PSOs Mapping:

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3	3	3	3	2	3	2	2	1	2	2	2	3	3	3	3
4	3	3	2	2	3	1	2	1	1	2	1	2	2	3	2
5	3	3	3	2	3	2	2	2	2	3	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, ‘-’ - no correlation



BoS Chairman

U24MLT521	Solving Business Problems with AI	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand the fundamentals of Artificial Intelligence and its role in solving business problems
• To Apply AI-based data analytics techniques to identify and analyze business problems
• To Analyze the application of AI technologies across various business function
• To Examine AI tools, machine learning models, and intelligent automation for business decision-making
• To Evaluate AI implementation strategies, ethical issues, and emerging trends in business applications.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand the fundamentals of AI and its applications in solving business problems.
CO2:	Apply AI and data analytics techniques to identify and solve business problems.
CO3:	Analyze AI applications in marketing, finance, HR, supply chain, healthcare, and other business domains.
CO4:	Examine machine learning models, intelligent agents, chatbots, and automation tools for business decision-making.
CO5:	Evaluate AI implementation strategies, ethical considerations, governance, and future trends in business.

UNIT I: INTRODUCTION TO AI FOR BUSINESS	9 Hrs.
Introduction to Artificial Intelligence – Evolution of AI – AI in Business – Types of AI – AI Technologies – Machine Learning, Deep Learning and Generative AI – AI Applications in Business – AI Development Lifecycle – AI Tools and Platforms – Challenges and Opportunities.	

UNIT II: BUSINESS PROBLEM IDENTIFICATION AND DATA ANALYTICS	9 Hrs.
Business Problem Identification – Problem Framing – Data Collection – Data Preparation – Data Visualization – Exploratory Data Analysis – Business Intelligence – Predictive and Prescriptive Analytics – Data-Driven Decision Making – Case Studies.	

UNIT III: AI SOLUTIONS FOR BUSINESS FUNCTIONS	9 Hrs.
AI in Marketing – Customer Relationship Management – Sales Forecasting – Finance and Risk Analysis – Human Resource Analytics – Supply Chain and Logistics – Manufacturing – Healthcare – Retail – Smart Business Applications.	

UNIT IV: AI MODELS, TOOLS AND AUTOMATION	9 Hrs.
Machine Learning Models – Supervised and Unsupervised Learning – Recommendation Systems – Natural Language Processing – Computer Vision – Intelligent Agents – Chatbots and Virtual Assistants – Robotic Process Automation (RPA) – Generative AI for Business Applications.	

UNIT V: AI IMPLEMENTATION, ETHICS AND FUTURE TREND	9 Hrs.
AI Project Planning – AI Implementation Strategy – AI Adoption in Organizations – AI Governance – Ethical AI – Bias and Fairness – Data Privacy and Security – Explainable AI – AI Regulations – Emerging Trends and Future of AI in Business.	

Total Hours: 45

TEXT BOOKS:	
1.	Doug Rose, Artificial Intelligence for Business, Pearson Education, 2021.
2.	Alex Castrounis, AI for People and Business, O'Reilly Media, 2019.
3.	Foster Provost and Tom Fawcett, Data Science for Business, O'Reilly Media, 2013.

REFERENCE BOOKS:	
1.	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.
2.	Prediction Machines, Ajay Agrawal, Joshua Gans and Avi Goldfarb, Harvard Business Review Press, 2018.
3.	Competing in the Age of AI, Marco Iansiti and Karim R. Lakhani, Harvard Business Review Press, 2020.

WEB REFERENCES:	
1.	https://www.lexalytics.com/blog/how-to-use-ai-solve-business-problems/

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	2	-	-	-	-	-	-	-	3	2	1
2	3	3	3	2	3	-	1	-	-	-	-	-	3	3	2
3	3	3	3	3	3	-	2	-	-	1	-	-	3	3	3
4	3	3	3	3	3	1	2	-	-	2	-	1	3	3	3
5	2	2	2	2	3	3	2	2	2	2	-	2	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U24MLT522	Soft Computing	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To Understand the basic concepts and applications of soft computing
• To Learn the fundamentals of artificial neural networks
• To apply fuzzy logic and its real-world applications
• To analyze the principles and applications of genetic algorithms
• To study rough set theory and the integration of soft computing techniques.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand the concepts and applications of soft computing.
CO2:	Apply neural network models to solve computational problems.
CO3:	Implement fuzzy logic techniques for decision-making problems.
CO4:	Apply genetic algorithms for optimization problems.
CO5:	Analyze rough set theory and integrate soft computing techniques to solve complex problems.

UNIT I: BASICS OF SOFT COMPUTING	9 Hrs.
Definition – Hard computing vs. soft computing – Components of soft computing – Recent Trends in Soft Computing, Characteristics of Soft computing, Applications of Soft Computing Techniques.	

UNIT II: FUNDAMENTALS OF NEURAL NETWORKS	9 Hrs.
Neuron, Nerve Structure and Synapse, Artificial Neuron and its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks. Various Learning Techniques; Perception and Convergence Rule, Auto-Associative and Hetero-Associative Memory	

UNIT III: FUZZY COMPUTING	9 Hrs.
Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion Membership Functions, Interference in Fuzzy Logic, Fuzzy If – Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzy Controller, Industrial Applications.	

UNIT IV: GENETIC ALGORITHM	9 Hrs.
Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications	

UNIT V: ROUGH SETS	9 Hrs.
Rough Sets-Rough Sets-Rule Induction-Discernibility Matrix-Integration of Soft Computing Techniques.	

Total Hours: 45

TEXT BOOKS:	
1.	S. N. Sivanandam & S.N.Deepa, “Principles of Soft Computing”, 2nd edition, Wiley India, 2008.
2.	B.K. Tripathy and J. Anuradha, “Soft Computing – Advances and Applications”, Cengage Learning, Jan 2015.

REFERENCE BOOKS:	
1.	S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2.	Melanie Mitchell, “An Introduction to Genetic Algorithm”, PHI, 1998.
3.	J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education 2004.
4.	G.J. Klir & B. Yuan, “Fuzzy Sets & Fuzzy Logic”, PHI, 1995.
5.	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw- Hill International Editions, 1995.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106105173>

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	1	-	-	-	-	-	-	1	3	2	2
2	3	3	2	2	3	-	-	-	-	-	-	1	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	1	3	3	3
4	3	3	3	2	3	-	-	-	-	-	-	2	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

OPEN ELECTIVE COURSES

(Offered in Semester - V)

Sl. No.	Course Code	Course Title
1.	U24BAT567	Theory and Practice of Entrepreneurship
2.	U24CMT577	Innovation, Entrepreneurship and Start-up Management
3.	U24EC5E09	Fundamentals of Nano electronics



BoS Chairman

U24BAT567	Theory and Practice of Entrepreneurship	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To learn about the scope of Entrepreneurship skills
• To understand entrepreneurial environment
• To understand the role and significance of MSMEs
• To understand the process of preparing a business plan
• To understand startup formation and registration procedures.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the concepts, characteristics, classifications and influencing factors of entrepreneurship.
CO2:	Analyze the entrepreneurial process, environment, growth, challenges and entrepreneurial ecosystem in India.
CO3:	Evaluate the role of MSMEs, government support schemes, and opportunities through creativity and innovation.
CO4:	Develop business models and business plans for different forms of entrepreneurial ventures.
CO5:	Assess entrepreneurial financing options, venture capital, registration procedures, and startup challenges.

UNIT I: INTRODUCTION TO ENTREPRENEURSHIP	9 Hrs.
Entrepreneurship - Characteristics and Qualities of an Entrepreneur - Entrepreneurs and Managers - Types of Entrepreneurships (Startup, Technology, Social, Green) - Design Thinking for Entrepreneurship - Risk Management and Decision Making - Entrepreneurial Mindset and Competency Development - Intrapreneurship and Corporate Entrepreneurship - Factors Influencing Entrepreneurship.	

UNIT II: ENTREPRENEURSHIP PROCESS	9 Hrs.
Entrepreneurial Environment - Entrepreneurial Growth - Problems and Challenges of Entrepreneurs - Entrepreneurial Scenario in India - Business Opportunity Validation - Feasibility Analysis and Market Assessment - SWOT Analysis for Business Opportunities - Digital Entrepreneurship and E-commerce Ventures - Startup Ecosystem in India.	

UNIT III: MICRO, SMALL AND MEDIUM ENTERPRISES (MSME)	9 Hrs.
MSMEs – Definition and Significance in Indian Economy - MSME Schemes - Udyam Registration and MSME Digital Platforms - Identification of Business Opportunities - Startup India and Make in India Initiatives - Intellectual Property Rights (IPR) and Patents.	

UNIT IV: BUSINESS MODEL AND PLAN	9 Hrs.
Forms of Business - Business Model Canvas (BMC) - Value Proposition Design - Market Research and Customer Discovery - Business Plan - Format and Uses of Business Plan - Digital Marketing for Startups - Pitch Deck Preparation and Business Presentation - Women Entrepreneurship - Rural Entrepreneurship - Family Business and first-Generation Entrepreneurs - Sustainable Entrepreneurship – Environmental, Social and Governance (ESG).	

UNIT V: FINANCING AND STARTUP BUSINESS	9 Hrs.
Financial opportunity identification - Banking sources - Non-banking Institutions and Agencies - Venture Capital – Meaning and Role in Entrepreneurship - Procedure for getting License and Registration, Challenges and difficulties in starting an Enterprise - Startup Funding - Startup Cost Estimation and Financial Planning.	

Total Hours: 45

TEXT BOOKS:	
1.	Jayshree Suresh, <i>Entrepreneurial Development</i> , Margham Publications, Chennai, 2011.
2.	Charantimath, P. M., <i>Entrepreneurship Development and Small Business Enterprises</i> , 2nd Edition, Pearson Education, 2014.
3.	Khanka, S. S., <i>Entrepreneurial Development</i> , S. Chand Publishing, 3rd Edition, 2019.
4.	Desai, V., <i>Dynamics of Entrepreneurial Development and Management</i> , Himalaya Publishing House, 7th Revised Edition, 2020.

5.	Gupta, C. B., & Srinivasan, N. P., <i>Entrepreneurial Development</i> , Sultan Chand & Sons, 3rd Edition, 2021.
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REFERENCE BOOKS:

1.	Hisrich, R. D., Peters, M. P., & Shepherd, D. A., <i>Entrepreneurship</i> , 11th Edition, McGraw-Hill Education, 2020.
2.	Raj Shankar, <i>Entrepreneurship: Theory and Practice</i> , Vijay Nicole Imprints Pvt. Ltd., 2nd Edition, 2018.
3.	Drucker, P. F., <i>Innovation and Entrepreneurship</i> , Harper Business, Reprint Edition, 2015.
4.	Martin, R. L., <i>The Design of Business: Why Design Thinking is the Next Competitive Advantage</i> , Harvard Business Review Press, 2009.
5.	Roy, R., <i>Entrepreneurship</i> , 3rd Edition, Oxford University Press, 2018.

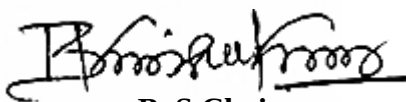
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1.	https://www.startupindia.gov.in/
2.	https://udyamregistration.gov.in/
3.	https://www.investindia.gov.in/
4.	https://ipindia.gov.in/
5.	https://www.sidbi.in/

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	1	-	1	2	1	2	2	1	1	2	1	1	3
2	1	3	2	2	1	2	2	2	2	2	2	2	1	2	3
3	1	2	2	2	2	2	2	2	1	2	2	2	2	2	3
4	1	2	3	2	2	2	2	2	2	3	3	2	2	3	3
5	1	2	2	2	2	2	1	2	1	2	3	3	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U24CM577	Innovation, Entrepreneurship and Start-up Management	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand the concepts, significance, and processes of innovation, entrepreneurship, and start-up development
• To develop entrepreneurial mind-set, creativity, opportunity recognition, and problem-solving skills
• To familiarize students with business model development, feasibility analysis, and business planning
• To provide knowledge of start-up financing, incubation, venture capital, and government support systems
• To equip learners with the skills required to launch, manage, scale, and sustain innovative ventures.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the concepts, theories, and importance of innovation, entrepreneurship, and start-ups.
CO2:	Identify entrepreneurial opportunities and apply creativity and innovation tools to develop business ideas.
CO3:	Perform engineering economic analysis using interest, depreciation, and investment appraisal techniques.
CO4:	Evaluate various funding options, incubation support systems, and government initiatives for start-ups.
CO5:	Analyze the challenges involved in establishing and managing start-ups in a dynamic business environment.

UNIT I: FOUNDATIONS OF INNOVATION AND ENTREPRENEURSHIP	9 Hrs.
Nature and Importance of Entrepreneurship - Evolution of Entrepreneurship - Types of Entrepreneurs and Entrepreneurship - Entrepreneurial Traits, Competencies and Skills - Innovation:	

Concept, Types and Importance - Creativity and Innovation Process - Design Thinking and Entrepreneurial Mind-set - Role of Entrepreneurship in Economic Development.

UNIT II: OPPORTUNITY IDENTIFICATION AND BUSINESS MODEL DEVELOPMENT	9 Hrs.
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Idea Generation Techniques - Opportunity Recognition and Evaluation - Problem Identification and Solution Design - Market Research and Customer Discovery - Feasibility Analysis - Business Model Canvas - Lean Start-up Methodology - Value Proposition Design.

UNIT III: START-UP CREATION AND BUSINESS PLANNING	9 Hrs.
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Start-up Ecosystem in India - Steps in Establishing a Start-up - Forms of Business Organization - Legal and Regulatory Requirements - Business Plan Preparation - Marketing, Operations and Financial Planning - Intellectual Property Protection for Start-ups - Pitch Deck Preparation and Investor Presentation.

UNIT IV: START-UP FINANCING AND ENTREPRENEURIAL SUPPORT SYSTEMS	9 Hrs.
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Sources of Finance for Start-ups - Bootstrapping and Crowdfunding - Angel Investors and Venture Capital - Private Equity and Seed Funding - Incubators and Accelerators - Government Schemes: Start-up India, Stand-Up India, SIDBI – Entrepreneurship Development Institutions - Venture Funding Process.

UNIT V: GROWTH, SCALING AND SUSTAINABILITY OF START-UPS	9 Hrs.
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Growth Strategies for Start-ups - Scaling Entrepreneurial Ventures - Technology and Digital Entrepreneurship - Social Entrepreneurship and Sustainable Innovation - Risk Management in Start-ups - Start-up Failure and Turnaround Strategies - Exit Strategies: Merger, -Acquisition and IPO - Case Studies of Successful Indian Start-ups.

Total Hours: 45

TEXT BOOKS:

- | | |
|----|---|
| 1. | Hisrich, Robert D., Peters, Michael P. & Shepherd, Dean A. (2024), Entrepreneurship, McGraw-Hill Education. |
| 2. | Khanka, S.S. (2024), Entrepreneurial Development, S. Chand Publishing. |
| 3. | Ries, Eric (2023), The Lean Start-up, Crown Business. |

4.	Dollinger, Marc J. (2023), Entrepreneurship: Strategies and Resources, Pearson Education.
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REFERENCE BOOKS:	
1.	Drucker, Peter F. (2023), Innovation and Entrepreneurship, Routledge/Elsevier.
2.	Barringer, Bruce R. & Ireland, R. Duane (2024), Entrepreneurship: Successfully Launching New Ventures, Pearson.
3.	Osterwalder, Alexander & Pigneur, Yves (2023), Business Model Generation, Wiley.
4.	Bygrave, William D. & Zacharakis, Andrew (2024), Entrepreneurship, Wiley India.
5.	Kuratko, Donald F. (2024), Entrepreneurship: Theory, Process and Practice, Cengage Learning.
6.	Tidd, Joe & Bessant, John (2024), Managing Innovation, Wiley.

WEB REFERENCES:	
1.	https://www.startupindia.gov.in?utm_source=chatgpt.com
2.	https://www.sidbi.in?utm_source=chatgpt.com
3.	https://msme.gov.in?utm_source=chatgpt.com
4.	https://nptel.ac.in/courses?utm_source=chatgpt.com
5.	https://swayam.gov.in?utm_source=chatgpt.com

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2	2	3	3	2	2	1	2	–	2	2	1	2	2	3	2
3	2	2	3	2	2	1	–	1	2	3	3	2	2	2	3
4	1	2	2	1	–	2	2	2	–	1	3	2	1	3	2
5	1	3	2	2	1	3	3	2	2	2	2	3	2	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation


BoS Chairman

U24EC5E09	Fundamentals of Nano electronics	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To discuss the fundamentals of nanoscience and nanoelectronics
• To explain quantum mechanical concepts in nanoscale devices
• To analyse nanomaterials and nanoscale fabrication techniques
• To explain various nanoelectronic devices and architectures
• To discuss applications of nanoelectronics in modern electronic systems

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	To demonstrate the fundamentals of nanoscience and nanoscale phenomena.
CO2:	To examine quantum mechanical effects and carrier transport in nanoelectronic devices.
CO3:	To experiment with nanomaterials and nanofabrication techniques used in nanoelectronics.
CO4:	To analyze nanoelectronic devices and their operational characteristics.
CO5:	To determine the applications and future trends of nanoelectronics in advanced technologies.

UNIT I: INTRODUCTION TO NANO ELECTRONICS	9 Hrs
Introduction to Nanoscience and Nanotechnology – Evolution of Nanoelectronics – Scaling issues in microelectronics – Moore’s law – Size dependent properties – Quantum confinement – Density of states in nanostructures – Nanowires, Quantum wells, Quantum dots – Carbon based nanostructures – Introduction to nanoelectronic systems and applications.	

UNIT II: QUANTUM MECHANICS FOR NANO ELECTRONICS	9 Hrs.
Basic quantum mechanics concepts – Wave particle duality – Schrödinger equation – Quantum tunnelling – Energy bands in solids – Fermi level – Ballistic transport – Coulomb blockade – Single electron phenomena – Quantum conductance – Carrier transport mechanisms in nanoscale devices.	

UNIT III: NANOMATERIALS AND FABRICATION TECHNIQUES	9 Hrs.
Classification of nanomaterials – Carbon nanotubes (CNT) – Graphene – Fullerene – Semiconductor nanomaterials – Properties and applications – Top-down and Bottom-up fabrication approaches – Lithography techniques – Chemical Vapor Deposition (CVD) – Molecular Beam Epitaxy (MBE) – Self-assembly techniques – Characterization methods: SEM, TEM, AFM and STM.	

UNIT IV: NANO ELECTRONIC DEVICES	9 Hrs.
MOSFET scaling and limitations – Silicon on Insulator (SOI) devices – FinFET – Tunnel FET – Single Electron Transistor (SET) – Carbon Nanotube Field Effect Transistor (CNTFET) – Quantum dot devices – Spintronic devices – Nano memories – Nano sensors – Device characteristics and performance analysis.	

UNIT V: APPLICATIONS OF NANO ELECTRONICS	9 Hrs.
Nanoelectronics in computing systems – Flexible electronics – Wearable devices – Nano sensors in biomedical applications – Nanoelectronics in communication systems – Energy efficient nano devices – Quantum computing basics – Nanoelectronic memory technologies – Challenges in nanoelectronics – Future trends and emerging technologies.	

Total Hours: 45

TEXT BOOKS:	
1.	Vladimir V. Mitin, Viatcheslav A. Kochelap and Michael A. Stroscio, “Introduction to Nanoelectronics”, Cambridge University Press, 2008.
2.	Rainer Waser, “Nanoelectronics and Information Technology”, Wiley-VCH, 3rd Edition, 2012.

REFERENCE BOOKS:	
1.	George W Hanson, “Fundamentals of Nanoelectronics”, Pearson Education, 2009.
2.	Sulabha K. Kulkarni, “Nanotechnology: Principles and Practices”, Springer, 4th Edition, 2015.
3.	Ali Javey and Jing Kong, “Carbon Nanotube Electronics”, Springer, 2009.

WEB REFERENCES:	
1.	https://ocw.mit.edu/

2.	https://ieeenano.org/
3.	https://nanohub.org/

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2	3	2	3	-	1	-	-	-	-	-	-	1	3	3	2
3	3	2	2	-	2	1	-	-	-	-	-	1	3	2	2
4	3	2	3	-	2	1	-	-	-	-	-	1	3	3	2
5	3	2	1	-	3	1	1	-	-	1	-	2	2	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

S. Mangayath
BoS Chairman

U24CEW501	Mini Project - II	L	T	P	C	Hrs
		0	0	4	2	60

COURSE OBJECTIVES:

- To assimilate the theoretical knowledge gained in the courses for real-life practical applications in order to have effective learning and skill development, mainly, from the point of view of employability in industries.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	To Practice how to work together in a team. An essential skill in the industry.
CO2:	To apply the theoretical knowledge learned from other courses, which is required by industry.
CO3:	To learn how to make presentations in a team. A soft skill needed in research and industry.
CO4:	To develop peer-learning skills by evaluating other teams' work, an essential competency in the workforce.
CO5:	To examine different hardware/software components and their working.

GUIDELINE FOR MINI PROJECT:

1.	Participants will be divided into teams of two or three members within the first week of the starting of the course by the course coordinators depending on the number of participants registered in the course.
2.	The teams will have a team coordinator or leader, which will be identified by the coordinators of the course.
3.	The projects could be of the following types:
a.	Literature search (LS) type: Studying about an aspect of AI, Data science, Machine learning and Robotics, say, vision, robot kinematics, dynamics, controls, etc.
b.	Application Development: Apply the existing algorithm to solve real-world problems. For example, developing software/hardware applications using machine learning libraries/frameworks.
c.	Algorithm development (AD) type: Analyse, say, a robot kinematics using RoboAnalyzer or PythonNimpy / Octave / Freemat / Scilab / Matlab software or write

an algorithm using any programming language (Python, etc.). For example, writing forward kinematics of a robot or image processing in Vision.

- d. Design/synthesis (DS) type: Proposing a new type of system/device for performing certain task.

4. The teams will be asked to contact their team members within a week and decide their topic with two weeks, i.e., within first 3 weeks of the starting of the course.

5. Students MUST spend minimum of twenty-five hours to discuss their progress together, study together or individually, write programmes, fabricate circuits, etc.

6. During the five-lecture hour the coordinators will explain how to do literature survey, how to find the sources of hardware, which software to use for a particular purpose, what are the opensource licensing models available, how to maintain an opensource software etc.

GUIDELINE FOR ASSESSMENT OF MINI PROJECT / ORAL EXAMINATION:

1. At the end of the course duration, each team will submit a presentation of minimum 10 slides in.pdf file, a video of one min to showcase their project and a printed report of minimum 30 pages.

MINI PROJECT SHALL BE ASSESSED BASED ON FOLLOWING POINTS:

1. Peer Evaluations (20%): Presentations in .pdf will be evaluated by two other teams and grade them out of 10 marks.
2. Expert evaluation (80%): Coordinators will take a presentation of 3 mins. plus, Q&A in a common session to give marks out of 80.

BoS Chairman

U24UMP591	Takshashila Innovative Learning - V	L	T	P	C	Total
		0	0	2	1	30

This course enables students to apply the knowledge and skills acquired through online learning platforms by undertaking domain-specific certification courses, guided mini projects, internships, and portfolio development. Students will strengthen their technical competencies in their respective disciplines through hands-on learning while enhancing their professional profile with industry-recognized credentials and practical experience.

COURSE OBJECTIVES:

• To encourage students to complete advanced domain-specific online certification courses
• To apply theoretical knowledge through guided projects and practical assignments
• To develop problem-solving, analytical, and professional skills relevant to industry
• To build a digital portfolio showcasing certifications, projects, and technical competencies
• To prepare students for internships, placements, and higher studies through experiential learning.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Select and complete an advanced online certification relevant to their discipline.
CO2:	Apply technical knowledge to solve real-world problems through guided projects or internships.
CO3:	Demonstrate practical competency using modern tools and technologies in their domain.
CO4:	Develop and present a professional digital portfolio highlighting certifications and project outcomes.
CO5:	Enhance employability through industry-oriented learning, documentation, and professional communication.

COURSE STRUCTURE:

• Online domain-specific certification through recognized platforms.
• Guided project/internship activities and mentor interactions.

• Weekly progress review and documentation.
• Portfolio development and technical presentation.
• Final assessment based on certification, project completion, and portfolio

MODULE I : Learning Plan & Certification	6 Hrs.
Selection of a domain-specific certification course based on career interests – Goal setting and preparation of a personalized learning plan – Enrollment in the certification course – Understanding course objectives - learning outcomes and assessment requirements.	

MODULE II : Certification Progress & Practical Learning	6 Hrs.
Completion of certification modules – Hands-on practical assignments - laboratory exercises and skill-based activities – Guided project or internship activities aligned with the selected domain – Regular mentor interaction and progress monitoring.	

MODULE III : Project Development & Application	6 Hrs.
Application of concepts learned through certification by developing a case study - mini project or internship-based solution – Project implementation – testing - validation and documentation – Review of project progress with mentor feedback.	

MODULE IV : Documentation & Professional Portfolio	6 Hrs.
Preparation of project documentation and certification progress report – Development of a professional digital portfolio including certificates, project reports - GitHub repository - LinkedIn profile, and other technical achievements – Research paper or technical article preparation (where applicable).	

MODULE V: Presentation & Career Readiness	6 Hrs.
Finalization of certification, project, or internship deliverables – Preparation of technical presentation and project demonstration – Portfolio evaluation - viva voce - reflection on learning outcomes - career planning and submission of all required documents.	

Total Hours: 30


BoS Chairman

U24UMP592	Foreign Language - I	L	T	P	C	Total
		0	0	2	1	30

Foreign Language – Online Mode

(Replace with language of choice: French, German, Spanish, Japanese, Korean, etc.)

COURSE OBJECTIVES:

• To introduce students to the fundamentals of a foreign language of their choice
• To develop basic listening, speaking, reading, and writing skills for everyday communication
• To build essential vocabulary, grammar, and pronunciation in the selected language
• To promote cultural awareness and global communication through language learning
• To encourage self-directed learning using online language learning platforms.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Demonstrate basic proficiency in listening, speaking, reading, and writing in the chosen foreign language.
CO2:	Use common vocabulary and simple grammatical structures in everyday communication.
CO3:	Apply basic conversational skills in familiar real-life situations with confidence.
CO4:	Demonstrate awareness of the culture, customs, and etiquette associated with the chosen language.
CO5:	Utilize online learning resources for continuous language development and progression to higher levels of proficiency.

COURSE MODULES & DELIVERY:

The course spans five weeks and is structured around key language learning components delivered fully online.

Week 1:	Introduction to the Chosen Foreign Language - Importance of learning foreign languages - Alphabet/Script (where applicable) - Greetings, introductions, numbers, and common expressions
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	• Basic pronunciation
Week 2:	Vocabulary and Basic Grammar • Everyday vocabulary • Basic grammar (nouns, pronouns, verbs, simple sentence formation) • Asking and answering simple questions • Listening and pronunciation practice
Week 3:	Communication Skills • Self-introduction • Family, education, hobbies, and daily routine • Reading simple texts • Writing basic sentences and short paragraphs
Week 4:	Practical Language Usage • Conversations related to shopping, travel, food, and directions • Role plays and interactive speaking activities • Listening comprehension exercises • Vocabulary enrichment
Week 5:	Culture, Assessment and Presentation • Cultural awareness and etiquette of the chosen language • Revision of key concepts • Online assessment • Short oral/video presentation demonstrating basic language proficiency and reflection on learning outcomes

ASSESSMENT & EVALUATION

Student performance is evaluated continuously and cumulatively using online tools. **Weekly quizzes** hosted on the LMS contribute **20%**, testing vocabulary and grammar understanding. Active **discussion forum participation** carries **10%**, promoting engagement and cultural exchange. **Voice and video assignments** submitted weekly make up **20%**, assessing pronunciation and communication. A **final online test**, combining a written component and a speaking task, accounts for **30%** of the grade. Additionally, a **cultural reflection task** in the form of a presentation or 2-minute video contributes the remaining **20%**, encouraging learners to connect language learning with global cultural perspectives.


BoS Chairman

U24UMP593	Green Credit -V	L	T	P	C	Total
		0	0	2	1	30

TERRACE GARDEN ESTABLISHMENT

COURSE OBJECTIVES

- To illustrate the methods and techniques for growing vegetables & their cultural activities in terrace conditions due to the absence of sufficient knowledge on terrace cultivation
- To analyze the management practices associated with water, soil, pest etc.

COURSE OUTCOMES

After completion of the course, the students will be able to

CO1:	Gain knowledge in the popular methods used in terrace gardening and understand the benefits of growing our own food.
CO2:	Acquire the practices of safe, pesticide-free, healthy green and fresh fruits or vegetables via terrace gardening.

MODULE -1 INTRODUCTION

- Definition and importance of terrace gardening
- Types of terrace gardening
- Selection of site and layout
- Benefits of a terrace garden
- Basic tools and materials required

MODULE-2 MANAGEMENT PRACTICES

- Water management
- Soil management
- Pest management
- Plant maintenance
- Plant protection measures


BoS Chairman