Neuromorphic computing	**L**	**T**	**P**	Electronics, sensors, deep learning, computer vision
	3	**1**	**0**	

Course Objective: To familiarize students with the concept of Neuromorphic computing.

S. NO	Course Outcomes (CO)
CO1	Understand the Biological Foundations of Neuromorphic Computing
CO2	Design and Analyze Neuromorphic Hardware Architectures
CO3	Implement and Evaluate Neuromorphic Algorithms for Real-World Applications
CO4	Apply Simulation Tools to Model and Test Neuromorphic Systems

S. NO	Contents	Contact Hours
UNIT 1	Introduction to Neuromorphic Computing: Foundations of Neuroscience, Neurons and Synapses, Biological neuron structure and function. Synaptic plasticity, Hebbian learning. Neural Networks, Structure and function of biological neural networks.Information processing in the brain. Spiking Neural Networks (SNNs) Neuron models: integrate-and-fire, Hodgkin-Huxley. Temporal encoding and spike-timing-dependent plasticity (STDP).	**8**

UNIT 2	Neuromorphic Hardware and Neuromorphic Processors: Overview of neuromorphic chips (e.g., IBM TrueNorth, Intel Loihi). Design principles and architecture of neuromorphic hardware. Analog and Digital Circuits, Analog VLSI for neuromorphic systems. Mixed-signal circuits, CMOS technology in neuromorphic design. Memristors and Emerging Devices, Memristor theory and applications in neuromorphic systems.	**10**
UNIT 3	Neuromorphic Algorithms Learning Algorithms: Supervised, unsupervised, and reinforcement learning in SNNs. STDP, spike-based learning rules. Pattern Recognition and Sensory Processing, Neuromorphic approaches to vision, auditory, and tactile processing, Neuromorphic Control Systems	**8**
UNIT 4	Simulation Tools and Software Simulation Platforms: NEURON, NEST, BindsNET, and other neuromorphic simulators. Programming Models Programming frameworks for neuromorphic hardware (e.g., PyNN, Lava). Toolchains for Neuromorphic Design CAD tools for neuromorphic VLSI design. Integration of hardware and software in neuromorphic systems.	**8**
UNIT 5	Neuromorphic System Design System-Level Design: Architectures of large-scale neuromorphic systems. Network-on-Chip (NoC) for neuromorphic systems. Integration with Sensors and Actuators Interface design for neuromorphic sensors (e.g., dynamic vision sensors). Real-time neuromorphic processing for robotics and IoT.	**8**
	TOTAL	**42**

REFERENCES

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Neuromorphic Engineering: From Neural Systems to Brain-Like Circuits" by Elisabetta Chicca, Giacomo Indiveri, and Stefan J. Thorpe (2021)	2021
2	Introduction to Neuromorphic Computing" by S. Rajasekaran and G. A. Vijayalakshmi Pai (2021)	2021
3	Learning in Energy-Efficient Neuromorphic Computing: Algorithm, Architecture, and System" by Qingwei Li, Yiran Chen, and Yuan Xie (2020)	2020
4	Brain-Inspired Computing: The Next Revolution in Computational Neuroscience" by Anup Basu (2017)	2017

B.Tech. Information Technology				
Course code:	**Course Structure**			**Pre-Requisite**
Optimization Techniques	**L**	**T**	**P**	
	3	**1**	**0**	