GANPAT UNIVERSITY									
FACULTY OF ENGINEERING & TECHNOLOGY									
Programme	Master of Technology					Branch/Spec.	Electronics and Communication Engineering – Embedded Systems		
Semester	II					Version	1.0.0.0		
Effective from Academic Year		2026-27				Effective for the Batch admitted in		July 2026	
Course Code	3ES2102	Course Name				Advanced Embedded Systems			
Teaching Scheme						Examination Scheme (Marks)			
(Per week)	Lecture (DT)		Practical (Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	1	-	4	Theory	50	50	100
Hours	3	0	2	-	5	Practical	25	25	50

Pre-requisites

Knowledge of Embedded System Design, ARM Cortex Processors, Embedded C Programming, RTOS Fundamentals, and Hardware-Software Co-Design Concepts.

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	Explain advanced embedded architectures including multicore processors, heterogeneous computing platforms, SoCs, and embedded Linux systems.
CO2	Design embedded systems using hardware-software co-design methodologies, modern communication architectures, and high-performance embedded platforms.
CO3	Develop intelligent embedded applications integrating RTOS/Linux, Edge AI, IoT connectivity, and hardware accelerators.
CO4	Analyze and optimize advanced embedded systems for performance, energy efficiency, reliability, and industrial deployment.

Theory Syllabus

Unit	Content	Hrs.
1A	**Advanced Embedded System Architectures:** Evolution of Advanced Embedded Systems, Modern Embedded Computing Platforms, Advanced Microcontroller Architectures, Multi-core and Many-core Processors, Symmetric and Asymmetric Multiprocessing (SMP/AMP), Heterogeneous Computing Architectures, CPU–GPU–DSP–NPU Integration, System-on-Chip (SoC) Architecture, Embedded FPGA and Adaptive SoCs, Memory Hierarchy, Cache Architecture, DMA, High-Speed Bus Architectures (AMBA, AXI, PCIe), Inter-Core Communication Mechanisms.	7
2	**Hardware-Software Co-Design:** Embedded System Design Flow, Requirement Analysis, Hardware–Software Partitioning, Functional and Behavioral Modeling, System-Level Design, Platform-Based Design, Model-Based Design Concepts, Rapid Prototyping, FPGA-Based Embedded Systems, High-Level Synthesis (Introduction), Hardware Accelerators, Embedded Software Integration, Design Space Exploration, Communication Interfaces, Verification and Co-Simulation Techniques.	9
3	**Intelligent Embedded Platforms:** Embedded Virtualization (Introduction), Edge Computing Platforms, AI-enabled Embedded Platforms (NVIDIA Jetson, Raspberry Pi AI, NXP i.MX, STM32 Edge AI). Interrupt Latency	10

	Optimization, Context Switching Optimization, Cache and Memory Performance Tuning, Embedded System Profiling Techniques, CPU Utilization Analysis, Dynamic Voltage and Frequency Scaling (DVFS), Power-Aware Scheduling, Low-Power Embedded Design Techniques.	
4	**Performance Optimization and Edge Intelligence:** Embedded Performance Analysis, Memory Optimization Techniques, Cache Optimization, DMA Optimization, Parallel Programming Concepts, Accelerator-Based Computing, Power-Aware Embedded Design, Thermal Management, Reliability and Fault Tolerance, Edge AI Fundamentals, TinyML Concepts, AI Model Deployment on Embedded Devices, AI Hardware Accelerators, Embedded Vision Systems, AI Optimization Techniques (Quantization, Pruning), Performance Benchmarking of Embedded AI Systems.	10
5	**Capstone Project:** Intelligent Secure Edge-Based Embedded Monitoring and Automation System **Project Components:** Multi-tasking RTOS-based architecture, IoT-enabled sensor communication, Edge AI inference for intelligent decision-making, Secure communication and authentication, Low-power operation and real-time monitoring	9

Practical Content
Practical, assignments and tutorials are based on above syllabus.

Text Books	
1	Tammy Noergaard – Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Elsevier

Reference Books	
1	Frank Vahid & Tony Givargis – Embedded System Design: A Unified Hardware/Software Introduction, Wiley
2	David E. Simon – An Embedded Software Primer, Pearson Education

ICT/MOOCs Reference	
1	https://www.youtube.com/watch?v=I3XuxQurw1U&list=PLp6ek2hDcoNAxTQ7uyp68N_RpuULV-zrX&index=4
2	https://www.youtube.com/watch?v=U7jAXAP00nk&list=PLp6ek2hDcoNAxTQ7uyp68N_RpuULV-zrX&index=11

Mapping of CO with PO and PSO :															
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	2	2	2	2	1	1
CO2	3	3	3	2	2	2	1	1	2	2	2	2	3	2	2
CO3	3	3	3	3	3	2	2	1	2	2	2	2	3	3	2
CO4	3	3	3	3	3	3	2	2	2	3	2	3	3	3	3