GANPAT UNIVERSITY									
FACULTY OF ENGINEERING & TECHNOLOGY									
Programme	Master of Technology					Branch/Spec.	Electronics and Communication Engineering – Embedded Systems		
Semester	I					Version	1.0.0.0		
Effective from Academic Year	2026-27					Effective for the Batch admitted in	July 2026		
Course Code	3ES1101	Course Name	ARM Cortex Processor Architecture & Programming						
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
Basic knowledge of Digital Electronics, Microprocessors & Microcontrollers, Computer Organization, and C Programming.

Course Outcomes	
On successful completion of the course, the students will be able to:	
CO1	Understand ARM Cortex processor architecture, instruction sets, exception handling, and memory organization for embedded applications.
CO2	Develop ARM Cortex-based embedded firmware using CMSIS and peripheral programming techniques.
CO3	Design optimized low-power embedded systems utilizing ARM Cortex advanced features such as DSP extensions and Floating-Point Units.
CO4	Interface peripherals and implement basic embedded applications using ARM Cortex microcontrollers.

Theory Syllabus

Unit	Content	Hrs.
1	**ARM Cortex Overview:** Introduction to ARM architecture, ARM processor evolution, ARM Cortex processor family overview, Cortex-M0, Cortex-M3, Cortex-M4, and Cortex-M7 features, ARM Cortex processor applications, Harvard Architecture concepts, ARM Programmer's model, CPU register organization, General-purpose registers, Special function registers, Stack pointer, Program counter, Link register.	8
2	**Exceptions & Interrupt System:** Introduction to Exceptions and Interrupts, ARM Exception model, Exception vector table, Nested Vector Interrupt Controller (NVIC), Interrupt processing mechanism, Interrupt Priorities and Preemption, Interrupt Latency and Tail Chaining, SysTick timer architecture, System Exceptions, Fault Exceptions, Hard fault, Bus fault, Usage fault, PendSV and SVC Exceptions.	10
3	**Memory & Bus Architecture:** ARM Cortex Memory Organization, Memory Map and Address Space, Flash, SRAM, Peripheral Memory Regions, Bit-band Memory Concept, ARM Bus Architecture Overview, Advanced High-performance Bus (AHB), Advanced Peripheral Bus (APB), Bus arbitration concepts, Memory access mechanisms, Direct Memory Access (DMA) basics, Memory Protection Unit (MPU), Access Permissions and Memory Attributes.	10
4	**Peripheral Programming** CMSIS Architecture and Libraries, Peripheral Programming Methodologies, GPIO Configuration and Interfacing, Digital input and output control, Timer and Counter Programming, PWM Signal Generation, ADC Fundamentals and Configurations, UART Communication Protocol, Serial Communication Techniques, SPI communication interface, Master and Slave Communication, I2C Protocol and Interfacing.	8
5	**Advanced Features & Project:** ARM Cortex Low Power Architecture, Sleep and Deep Sleep Modes, Power Management Techniques, Wake-up Sources and Power Control, DSP Extensions in Cortex-M4/M7, SIMD	9

	Instruction Concepts, Digital Signal Processing Applications, Floating Point Unit (FPU) Architecture, Floating Point Computation Techniques, Performance Optimization using DSP and FPU, Real-time Embedded Application Design, Firmware Integration Techniques.	
Practical Content		
Practical, assignments and tutorials are based on above syllabus.		
Text Books		
1	Joseph Yiu – The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, Newnes.	
Reference Books		
1	Jonathan W. Valvano – Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, Cengage Learning.	
2	Trevor Martin – The Insider's Guide to the ARM Cortex-M Microcontrollers, Hitex Press.	
ICT/MOOCs Reference		
1	https://www.youtube.com/watch?v=-wClEbZpJxk&list=PLbMVogVj5nJRDS4w20GO7l4SepLhuAj9X	
2	https://www.youtube.com/watch?v=IhjY1x7O_r8&list=PLbMVogVj5nJRDS4w20GO7l4SepLhuAj9X&index=3	

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