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	3ES2PE03	Course Name				Digital Signal Processing for Embedded Systems			
Teaching Scheme						Examination Scheme (Marks)			
(Per week)	Lecture (DT)		Practical (Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	0	-	3	Theory	50	50	100
Hours	3	0	0	-	3	Practical	00	00	00

Pre-requisites

Basic understanding of signals and systems, engineering mathematics (especially complex numbers, matrices, and Fourier series), and programming concepts in C/C++. Familiarity with digital electronics and microprocessor/microcontroller fundamentals will help in understanding digital signal processing algorithms and their implementation on embedded systems.

Course Outcomes

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

CO1	To introduce fundamentals of discrete-time signals and systems.
CO2	To provide understanding of digital filter design techniques.
CO3	To enable implementation of DSP algorithms on embedded/ARM Cortex processors.
CO4	To build practical skills in real-time signal processing for sensor and audio applications.

Theory Syllabus

Unit	Content	Hrs.
1	**Discrete-Time Signals and Systems:** Continuous vs discrete signals; sampling theorem, aliasing; discrete-time sequences and systems; linear time invariant (LTI) systems; convolution; difference equations; z-transform basics.	7
2	**Frequency Domain Analysis:** Discrete Fourier Transform (DFT); Fast Fourier Transform (FFT) algorithms (radix-2 DIT/DIF); frequency response of systems; spectral analysis of sensor/audio signals; windowing techniques.	7
3	**Digital Filter Design:** FIR filters — design methods (windowing, frequency sampling); IIR filters — design from analog prototypes (Butterworth, Chebyshev); filter realization structures (direct form, cascade, lattice); comparison of FIR vs IIR for embedded use.	8
4	**Fixed-Point and Real-Time DSP Implementation:** Fixed-point vs floating-point arithmetic; quantization effects and overflow handling; Q-format representation; optimizing DSP code for ARM Cortex-M/DSP-capable cores; use of CMSIS-DSP library.	8
5	**DSP on Embedded/ARM Platforms, Applications & Case Studies:** Real-time constraints in DSP applications; interfacing ADC/DAC for signal acquisition; implementing FFT/filtering on microcontrollers; audio signal processing basics (noise filtering, echo); sensor signal conditioning using DSP techniques. Speech/audio processing	15

	case study; vibration/sensor signal analysis; biomedical signal processing basics (ECG/EMG filtering); introduction to adaptive filters; mini project — real-time filter implementation on an embedded board.	
Practical Content		
Practical, assignments and tutorials are based on above syllabus.		
Text Books		
1	John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson — the standard foundational DSP textbook covering discrete-time signals, DFT/FFT, and filter design (Units I–III).	
Reference Books		
1	Alan V. Oppenheim & Ronald W. Schafer, Discrete-Time Signal Processing, Pearson — the other classic DSP reference, rigorous treatment of z-transforms and system analysis, complements Proakis with deeper theory.	
2	Rulph Chassaing & Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK (or equivalent ARM Cortex-M DSP text) — practical, implementation-focused book bridging theory to real-time DSP on embedded/DSP hardware (Units IV–VI).	
ICT/MOOCs Reference		
1	https://youtube.com/playlist?list=PLUQpHm_JtukLkIO7QB6dp3KITCOM0ChGq&si=iBPmF92Q3LVKLh25	
2	https://youtube.com/playlist?list=PLgwJf8NK-2e48gQ7yi8K7d4L0gvA4XYKp&si=BFO89CyQ5NLC0Lcp	

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	3	2	2	2	1	1	1	1	1	1	2	3	2	1
CO2	3	3	3	3	3	2	1	1	2	2	2	2	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	2	2	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	2	3	3	3	3