SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET701T	Microwave Engineering	3	0	0	3	30	70	100

Course Objectives	Course Outcomes
1) To introduce basic microwave tubes, limitations and their applications 2) To understand analysis of different microwave devices and measurement techniques 3) To learn basics of microwave communications and RADARs	1) Demonstrate different types of microwave tubes and applications 2) Define and identify and compare different types of microwave components. 3) Demonstrate and classify different types of microwave solid state devices and their applications 4) Identify different microwave measurement techniques 5) Illustrate fundamentals of RADAR and its types .

UNIT- I: Microwave Liner beam tubes	**[8 Hrs]**
Microwave Liner beam tubes: Importance of UHF & Microwave frequency range, Causes of failure of conventional tubes at high frequency, two cavity klystron amplifier, Reflex klystron oscillator, slow wave structure, traveling wave tube	
Unit -II Microwave cross field tubes	**[8 Hrs]**
Microwave cross field tubes: Magnetron: cylindrical magnetron, parallel plate magnetron, voltage tunable magnetron, Forward wave cross field amplifier, backward wave oscillator.	
Unit -III Microwave components & Scattering matrices	**[7 Hrs]**
Microwave components & Scattering matrices: Scattering matrices of transmission lines, microwave junction and tees, Attenuators, Tees, Directional couplers, Circulators, Isolators, Gyrators, Phase shifter, Cavity resonator, Transmission line resonator.	
UNIT- IV: Microwave measurement	**[6 Hrs]**
Microwave measurement: Microwave power measurement, Frequency measurement, VSWR measurement, Attenuation measurement, Impedance and Q factor measurement.	
Unit -V: Applications of Microwave Engineering	**[7 Hrs]**
Basic principles and fundamentals of Radar , block diagram of basic radar, classification, radar performance factors, radar range equation, factors influencing maximum range, effects of noise, Types of Radar, applications of radar	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Microwave Devices and Circuits	S.Y. Liao	-	Prentice Hall India
2	Principles of Radar Engineering	Skolnik	-	McGraw Hill Publications
3	Microwave Engineering	David M. Pozar	-	John Willey & Sons.

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Microwave Engineering	G.S.Raghuwanshi	-	Cengage India
2	Microwave Engineering	R.S. Rao	-	PHI Publications
3	Microwave and Radar Engineering	M.Kulkarni	-	Umesh Publication

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET701P	Microwave Engineering Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
1. To understand the basic concepts of Microwave Sources 2. To understand the basic properties of Microwave components.	1) To apply the concept of microwave engineering to demonstrate and setup the experiment 2) To understand the the working of microwave tube practically and formulate the characteristic 3) To analyze, interprets and conclude the properties of various microwave components/devices. 4) To understand and classify the different methods of VSWR, Attenuation measurement at high frequency

List of Experiment

1	To Study various Components of Microwave Test Bench.
2	To plot the characteristics of Klystron Tube and to determine its electronic tuning range and Verify the power frequency
3	To verify the V-I characteristics of Gunn diode. (Output power and Frequency as a function of Voltage)
4	To verify the properties of Magic Tee, H plane & E plane Tee
5	To Study & verify the functions of Isolator / Calculator by measuring the insertion loss and isolation
6	To Study & verify the functions of Attenuator (Fixed and Variable type) by Attenuation
7	Formulate different parameters of Multi Hole Directional Coupler
8	To Measure Standing Wave-Ratio (VSWR) and Reflection Coefficient.
9	Formulate different parameters of antenna

Reference Books

Lab Manual

S.N	Title	Authors	Edition	Publisher
1	Microwave Engineering	G.S.Raghuwanshi	-	Cengage India
2	Microwave Engineering	R.S. Rao	-	PHI Publications
3	Microwave and Radar Engineering	M.Kulkarni	-	Umesh Publication

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET702T	Digital Signal Processors and Architecture	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1) To provide an understanding of the fundamentals of DSP techniques 2) To introduce architectural features of programmable DSP Processors. 3) To develop the programming knowledge using Instruction set of DSP Processors. 4) To give practical examples of DSP Processor architectures for better understanding.	5) Distinguish between the architectural features of General-purpose processors and DSP processors. 6) Describe the architectural details of programmable Digital Signal Processors TMS320C54x. 7) Describe the architectural details of advanced Digital Signal Processors TMS320C6x. 8) Illustrate various addressing modes of DSP TMS320C54x. 9) Apply the knowledge of mnemonics to determine various operations performed by processor.

UNIT- I: FUNDAMENTALS OF PROGRAMMABLE DSPs	**[9 Hrs]**
Multiplier and Multiplier accumulator, Modified Bus Structures and Memory access in P-DSPs, Multiple access memory, Multi-ported memory, VLIW architecture, Pipelining , Special Addressing modes in P- DSPs , Von Neumann and Harvard Architecture.	
Unit -II PROGRAMMABLE DIGITAL SIGNAL PROCESSOR	**[6 Hrs]**
Architecture of TMS320C54X, Bus Structure & memory, CPU, ALU, Multiplier, CSSU.	
Unit -III ADVANCED DIGITAL SIGNAL PROCESSOR	**[7 Hrs]**
Internal Architecture of TMS320C6x, CPU, and General Purpose register files, Functional Units. Comparison of features of TMS320C54X and TMS 320 C6x.	
UNIT- IV: ADDRESSING MODES OF TMS320C54X	**[6 Hrs]**
Addressing modes: Immediate, Absolute, Accumulator, Direct, Indirect, Memory mapped and Stack addressing, Pipelining.	
Unit -V: PROGRAMMING TMS320C54X	**[8 Hrs]**
Assembly language instructions of TMS320C54x: Arithmetic, Logical. Control, Move, Conditional, Bit manipulation instructions. Applications of TMS320C54X.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Digital Signal Processors, Architecture,	B. Venkata Ramani	-	McGraw-Hill
2	DSP Implementation using DSP	Avtar Singh,	-	Thamson
3	Digital Signal Processing - A Practical	E.C.Ifeachor and B.W	-	Pearson Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	DSP Processor Fundamentals,	Lapsley et al.	-	S. Chand & Co
2	Digital signal processing	Jonathen Stein	-	Wiley
3	Digital Signal Processing	S.K. Mitra	-	Tata McGraw-Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET702P	Digital Signal Processors and Architecture Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
1. To implement the DSP algorithms DSP processors having specially tailored architectures. 2. To enable students to understanddifferent processors architectures and apply them in system design.	1. To study architectures of PDSPs of different families and compare them. 2. To develop programs for DSP operations like filtering etc., using MATLAB. 3. To write assembly language program and observe results using code composer studio. 4. To implement DSP algorithms using development kits like DSK 5416 or DSK 6713.

Minimum 8 practical based on the following list.

Experiment List
Experiment 1 : To Compare architectures of TMS320C54XX & TMS320C6X
Experiment 2: To generate basic signals using TMS320C54XX
Experiment 3: Write an ALP using instruction of TMS processors to add two numbers.
Experiment 4 : Write ALP to subtract two numbers.
Experiment 5: Write an ALP to multiply two numbers of unsigned 32 bit data.
Experiment 6: Write an ALP to divide 16 –bit data by an eight bit data.
Experiment 7: Implementation of FFT using code Composer studio.
Experiment 8: To implement Interpolation filter by Matlab.
Experiment 9: To implement Decimation filter by Matlab.
Experiment 10: To design FIR filter using MATLAB and find finite word length effect & cross verify using DSP processor.
Experiment 11. To design IIR filter using MATLAB and find finite word length effect & cross verify using DSP Processor.

Reference: Lab Manual

Reference Books

S.N	Title	Authors	Edition	Publisher
1	DSP Processor Fundamentals,	Lapsley et al.	-	S. Chand & Co
2	Digital signal processing	Jonathen Stein	-	Wiley
3	Digital Signal Processing	S.K. Mitra	-	Tata McGraw-Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET703T(i)	Professional Elective – IV (CMOS VLSI Design	3	0	0	3	30	70	100

Course Objectives	Course Outcomes
1. To learn CMOS device parameters and characteristics. 2. To learn and design combinational and sequential circuits using CMOS. 3. To explore CMOS processing technology 4. To learn physical design of logic gates.	On completion of the course students will be able to, 1. Design PMOS and NMOS transistor 2. Implementation different combinational logic circuits. 3. Design CMOS transistor 4. Design CMOS combinational and sequential logic design 5. Design layout for various circuits.

Unit I : MOS TRANSISTORS	**[8 Hrs]**
nMOS enhancement and pMOS enhancement transistor, threshold voltage, body effect, MOS effect, MOS device equations, small signal model for MOS transistor.	
Unit II : CMOS INVERTER:	**[8 Hrs]**
Principle of operation, dc characteristics, transient characteristics, n/p ration, noise margin, static load MOS inverter, transmission gate, introduction to Bi-CMOS inverter.	
Unit III: Study of CMOS LOGIC	**[7 Hrs]**
Study of combinational logic, gates, compound gates, multiplexers, and memory elements using CMOS technology.	
Unit IV: Circuit Characterization and Performance Estimation	**[6 Hrs]**
Resistance and capacitance estimation, switching characteristics, power dissipation, charge sharing.	
Unit V : VLSI DESIGN:	**[6 Hrs]**
VLSI processing integration, layout design rules, and stick diagram representation latch up, CMOS circuits and logic design: transistor sizing, fan-in, fan-out and physical design of simple logic gates, CMOS logic structures and clocking strategies.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	CMOS VLSI Design: A Circuits and Systems Perspective	Neil H.E. Weste, David Harris	4th Edition	Addison-Wesley
2	Design of Analog CMOS Integrated Circuits	Behzad Razavi	2nd Edition	McGraw-Hill
3	Digital Integrated Circuits	Jan M. Rabaey	2nd Edition	Prentice Hall

Reference Books

S.N	Title	Authors	Edition	Publisher
1	CMOS Digital Integrated Circuits: Analysis and Design	Sung-Mo Kang, Yusuf Leblebici	2nd Edition	McGraw-Hill
2	CMOS Analog Circuit Design	Phillip E. Allen, Douglas R. Holberg	3rd Edition	Oxford University Press
3	VLSI Design Techniques for Analog and Digital Circuits	Randall L. Geiger, Phillip E. Allen, Noel R. Strader	1st Edition	McGraw-Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET703T(ii)	Professional Elective – IV (Digital Image Processing	3	0	0	3	30	70	100

Course Objectives	Course Outcomes
1) Provide the student with the fundamentals of digital image processing. 2) Introduce the students to some advanced topics in digital image processing. 3) Give the students a useful skill base that would allow them to carry out further study in the field of image processing.	1) Demonstrate understanding of the basic concepts of two-dimensional signal acquisition, sampling, and quantization. 2) Demonstrate understanding of the fundamental image enhancement histogram algorithms and spatial filtering techniques, including linear and nonlinear methods. 3) Describe redundancy and implementation various redundancy codimg algorithms. 4) Demonstrate understanding of the fundamentals of lossy and lossless image compression models 5) Classify and represent discontinuity, boundary and edge using concepts of Image segmentation.

Unit I Digital Image Fundamentals	**[6 Hrs]**
Components of Image Processing System. , Image Sensing and Acquisition, Image Sampling & Quantization, Spatial and Gray Level Resolution, Basic Relationships between Pixels. Statistical parameters, Measures and their significance, Mean, standard deviation, variance, SNR, PSNR, Color models	
Unit II Unit2: Image Enhancement	**[8 Hrs]**
Enhancement in Spatial Domain: basic gray level transformations, histogram processing, equalization, Arithmetic and logical operations between images, Basics of spatial filtering, smoothening and sharpening spatial filters, Image Enhancement in frequency Domain: smoothening and sharpening frequency domain filters, 2D-DFT, FFT	
Unit III Image Coding	**[8 Hrs]**
Image Coding Fundamentals, - redundancy: coding, interpixel, psychovisual, fidelity criteria, Basic compression methods Error Free Compression - variable length, bit plane,	
Unit IV Image Compression	**[7 Hrs]**
Image Compression Model, fundamentals, LZW arithmetic Lossless Predictive, Lossy Compression- Lossy Predictive. Fundamentals of JPEG, MPEG, fractals.	
Unit V Image Analysis	**[7 Hrs]**
Segmentation: Point, line, Hough Transform, Edge detection, Boundary detection and Thresholding, Region Based segmentation. Representation & Description: Boundary representation by chain codes, signature & skeleton Boundary descriptors, shape number, Fourier descriptors, Basics of Regional descriptor, boundary representation by chain codes and B splines, Morphological Image Processing: Dilation, Erosion, Opening, Closing on Binary Images.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Digital Image Processing	Gonzalez and Woods	-	Pearson Education
2	Fundamentals of Digital Intake	Arthur Weeks Jr	-	PHI
3	Digital Image Processing	S Jayaraman	-	Tata McGraw Hill
4	Fundamentals of Digital Image	A. K. Jain		Pearson Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Digital Image Processing	Pratt William		John Wiley & Sons
2	Image Processing, Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac and Roger Boyle	Second Edition	Thomson Learning
3	Image Processing analysis & Machine Vision	Milan Sonka, Vaclav		Cenage Learning

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET704T(i)	Professional Elective – V (VLSI Signal Processing)	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To learn pipelining & parallel processing techniques 2. To understand folding & unfolding techniques in multirate s ystem 3. To address folding techniques used to design time multiplex ed architecture.	1. To demonstrate various methodologies to opti mize power of VLSI design. 2. To demonstrate various methodologies to opti mize power of VLSI design. 3. To design Real Time processing system using Unfolding (loop unrolling) techniques. 4. To design Real Time processing system using folding (time multiplexing) techniques. 5. To design & analyze fast and iterated convolution techniques.

Unit 1: **Pipeline and Parallel Processing**	**[7 Hrs]**
Introduction, pipeling of FIR Digital filters Parallel processing, Pipelining and parallel processing for low power.	
Unit **II: Retiming**	**7 Hrs]**
Introduction, Definition and properties, solving system of inequalities, retiming techniques.	
Unit **III: Unfolding**	**[7 Hrs]**
Introduction, algorithms for unfolding, Properties of unfolding, Critical path, unfolding and retiming Application of unfolding.	
Unit **IV:Folding**	**[7 Hrs]**
Introduction Folding Transformation, Register minimization in folded architectures, Folding in Multirate systems.	
Unit **V: Fast Convolution**	**[8 Hrs]**
Introduction, Cook- Toom algorithm, Winogard algorithm, Cyclic Convolution	

Text Books

S.N	Title	Authors	Edition	Publisher
1	VLSI Digital Signal Processing Systems	Keshab K. Parhi	2	Wiley-
2	Analog VLSI signal and information processing	Mohammed Ismail		McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	VLSI Digital signal processing system Design and implementation	Keshab. Parthi		Wiley

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET704T(ii)	Professional Elective – V (Bio Signal Processing)	3	0	0	3	30	70	100

Course Objectives	Course Outcomes
1) Compare the basic concepts of signals and analyze time and frequency based transforms. 2) To brush the basics of digital filters. 3) Students have to investigate the events in the signals. 4) Interpret the basic architecture of the DSP processor TMS 320 and its implementation, applications	1) Analyse the signals in different statistical methods. 2) Apply the filters in bio signal 3) Illustrate the transforms enactments on bio signal. Categorize the digital signal processor with its application aspects 4) Organize the operation of processors and its special applications

Unit1: **Introduction to Biomedical Signal Analysis& Time-**	**[7 hrs]**
Introduction to signals - Time domain - Statistical and information theoretic analysis, Fourier spectrum of bio signals, Hilbert transform and its applications - Empirical mode decomposition and empirical wavelet transform - correlation analysis and power spectral estimation.	
Unit 2:Digital Filters	**[7 hrs]**
Types of artefacts and noise, Time domain filters, frequency domain filters, notch and comb filters, optimal filtering, adaptive filters, Signal decomposition based filtering	
Unit 3: Event Detection and Feature Extraction Techniques	
Signal segmentation - Envelop extraction and analysis, temporal, spectral, statistical, information theoretic and cross spectral features - Waveform complexity.	
Unit 4: **Digital Signal Processors**	**[7 hrs]**
General purpose DSP processors, architecture, hardware configuration, software development tools - Implementation considerations, fixed point DSP processors, floating point DSP processors.	
Unit 5: TMS320 Family of DSP processors Architecture	**[8 hrs]**
- Functional units - Pipelining-Registers - Linear and Circular addressing - Types of instructions - Sample Programs - Real Time Implementation on DSP processors - Overview of Black Fin Processors, Estimation of heart rate in ECG - Auto-regressive model - Estimation of spectrum of thoughts in EEG	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Biomedical Signal Analysis	Rangaraj M.	2	Wiley-IEEE Press
2	Real Time Signal Processing Based on	Nasser Kehtarnavaz	2	Elsevier

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Digital Signal Processing and Applications with the C6713 and C6416 DSK	Rulph Chassaing	1	Wiley

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ET761O	Open Elective – III (Design of Solar Photovoltaic Systems)	3	0	-	3	30	70	100

Course Objectives	Course Outcomes
1) To explain the concept of Solar PV systems 2) To explain the components of Solar PV systems 3) To understand the concept of solar PV systems designing through different applications	1) To understand the basics of solar PV cells, modules, arrays and systems with balance of components. 2) To analyze sun geometry and impact of sun position on performance of PV systems. 3) To explain the concept of maximum power point tracking system for best performance of solar PV systems. 4) To analyze the concept of designing solar PV systems by different design examples like PV water pumping, DC fan running, Peltier cooling, Grid connected systems with simple pay back and life cycle costing 5) To design Solar PV small projects through project activity.

UNIT- I: Photovoltaic Systems	**[8Hrs]**
Pv cells, series and parallel interconnection, solar modules, solar arrays, power and energy output from solar PV systems, sizing PV balance of solar PV systems, lead acid battery, Lithium Ion battery, lithium phosphate battery PV -battery interfaces, dc-ac converters(inverters), inverter types, standalone PV systems, grid connected pv systems, hybrid PV systems	
Unit -II All about sun	**[8 Hrs]**
Energy from sun, solar radiation, incident energy estimation, sun geometry ,sun TRACKING, one axis tracking, two axes tracking, estimating solar RADIATION empirically, measurement OF solar radiation	
Unit -III Maximum Power Point Tracking	**[8 Hrs]**
Concept of MPPT, MPPT algorithms, MPP charging, DC-DC converters, switching techniques, buck converter, boost converter, buck boost converter, soft switching concept, efficiency calculations	
UNIT- IV: Design methodology of Solar PV systems and applications	**[8 Hrs]**
Design of unregulated and regulated standalone PV system with DC load, Wire sizing in PV systems, Precise sizing, regulated standalone system with battery and DC load, Regulated standalone system with battery and AC and DC load, Regulated hybrid system PV and Water pumping, Peltier Cooling, PV Grid interface, Simple payback period, Life Cycle Costing	
Unit V:- Solar PV system Design projects	**4Hrs.**
PV powered DC fan without battery, Regulated standalone system with DC load using MPPT, Design of PV powered DC pump, Solar mobile charging system, solar powered Reverse osmosis water purifier system, Solar powered EV battery charger	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Solar Photovoltaics:- Fundamentals, Technologies and applications	Dr. Chetan Singh Solanki	2nd	PHI
2	Photovoltaic Systems: Analysis and Design	Mukerjee A. K., Nivedita		PHI
3	Solar Cells from B to Advanced Systems	Chenming, H. and White,		McGraw Hill Book

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Solar Cell Array Design	Ruschenbach, HS		