VII Semester

Sr No	Course Code	Course Title	Hours per Week			Credits	Maximum Marks			No. of Hrs for ESE
			L	T	P		Continual Assessment	End Sem Examination	Total	
1	22ET701T	Microwave Engineering	3	-	-	3	30	70	100	3
2	22ET701P	Microwave Engineering lab	-	-	2	1	25	25	50	-
3	22ET702T	Digital Signal Processors and Architecture	3	-	-	3	30	70	100	3
4	22ET702P	Digital Signal Processors and Architecture Lab	-	-	2	1	25	25	50	-
5	22ET703T	Program Elective - IV	3	-	-	3	30	70	100	3
6	22ET704T	Program Elective - V	3	-	-	3	30	70	100	3
7	22ET761O	Open Elective-III	3	-	-	3	30	70	100	3
8	22ET705P	Project -II	-	-	8	4	50	50	100	`
9	22ET706P	* Summer / Winter Internship	-	-	-	2	50	-	50	
10	22ET707P	Capstone Course II**	-	-	2	1	50	-	50	-
		Total	15	-	14	24	350	450	800	

*Summer / Winter Internship (Evaluation of Four weeks Internship Completion till 6th Semester)

** Capstone Course – II (Comprehensive knowledge gained in Electronics & Telecommunication)

Professional Elective – IV	
22ET703T(i)	CMOS VLSI Design
22ET703T(ii)	Digital Image Processing
Professional Elective – V	
22ET704T(i)	VLSI Signal Processing
22ET704T(ii)	Bio Signal Processing
Open Elective – III	
ET761O(i)	Design of Solar Photovoltaic Systems

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22ET701T	Microwave Engineering	3	-	-	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	After completion of the course students are able to, 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. Illustrates fundamentals of RADAR and its types

UNIT- I: Microwave Liner beam tubes	**[9 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	**[9 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	**[9 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	**[9 Hrs]**
Microwave measurement: Microwave power measurement, Frequency measurement, VSWR measurement, Attenuation measurement, Impedance and Q factor measurement.	
Unit -V: Applications of Microwave Engineering	**9 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
22ET701P	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.	After completion of the course students are able to, 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

Minimum 8 practical based on the syllabus.

List of Practical

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

Text 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

Reference Book: Lab Manual

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22ET702T	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	After completion of the course students are able to, 1. Distinguish between the architectural features of General-purpose processors and DSP processors. 2. Describe the architectural details of programmable Digital Signal Processors TMS320C54x. 3. Describe the architectural details of advanced Digital Signal Processors TMS320C6x. 4. Illustrate various addressing modes of DSP TMS320C54x. 5. Apply the knowledge of mnemonics to determine various operations performed by processor.

UNIT- I: FUNDAMENTALS OF PROGRAMMABLE DSPs	**[10 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	**[8 Hrs]**
Architecture of TMS320C54X, Bus Structure & memory, CPU, ALU, Multiplier, CSSU.	
Unit -III ADVANCED DIGITAL SIGNAL PROCESSOR	**[8 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	**[9 Hrs]**
Addressing modes: Immediate, Absolute, Accumulator, Direct, Indirect, Memory mapped and Stack addressing, Pipelining.	
Unit -V: PROGRAMMING TMS320C54X	**10 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
22ET702P	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 understand different processors architectures and apply them in system design.	After completion of the course students are able to, 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 syllabus.

Sr.No.	List of the experiment
1	To Compare architectures of TMS320C54XX & TMS320C6X Experiment
2	To generate basic signals using TMS320C54XX
3	Write an ALP using instruction of TMS processors to add two numbers.
4	Write ALP to subtract two numbers.
5	Write an ALP to multiply two numbers of unsigned 32 bit data.
6	Write an ALP to divide 16 –bit data by an eight bit data.
7	Implementation of FFT using code Composer studio.
8	To implement Interpolation filter by Matlab.
9	To implement Decimation filter by Matlab.
10	To design FIR filter using MATLAB and find finite word length effect & cross verify using DSP processor.
11	To design IIR filter using MATLAB and find finite word length effect & cross verify using DSP Processor

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 Book: Lab Manual

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22ET703T(i)	Professional Elective – IV (CMOS VLSI Design	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To learn CMOS device parameters and short-channel effects. 2. To learn and design combinational and sequential circuits using CMOS, PTL, and TGL. 3. To explore CMOS processing technologies including FinFET devices. 4. To learn physical design of logic gates including low power and dynamic logic design strategies.	On completion of the course students will be able to, 1. Design PMOS, NMOS, and FinFET devices for scaled CMOS technology. 2. Implement combinational and sequential logic circuits using CMOS, PTL, and dynamic logic. 3. Design Pass-Transistor Logic (PTL) and Transmission Gate Logic (TGL), Multiplexers 4. Analyse circuit characterization and performance Estimation 5. Interpret CMOS processing technologies and design layout for various circuits.

Unit I : MOS TRANSISTORS	**[10 Hrs]**
nMOS enhancement and pMOS enhancement transistor, Threshold voltage, body effect, MOS effect, MOS device equations, Introduction to Short Channel Effects in Deep Submicron MOSFETs.	
Unit II : CMOS INVERTER:	**[10 Hrs]**
Principle of operation, DC characteristics, transient characteristics, n/p ratio, noise margin, Low Power Design Techniques (Sub-threshold Operation, Power Gating), Transmission gate, Introduction to Bi-CMOS inverter	
Unit III: Study of CMOS LOGIC	**[9 Hrs]**
Study of combinational logic, Gates, Pass-Transistor Logic (PTL) and Transmission Gate Logic (TGL), Multiplexers and memory elements using CMOS technology.	
Unit IV: Circuit Characterization and Performance Estimation	**[8 Hrs]**
Resistance and capacitance estimation, Switching characteristics, Power dissipation, Introduction to Dynamic Logic Families (Domino Logic, NP Domino)	
Unit V : VLSI DESIGN:	**[8 Hrs]**
VLSI processing integration, Layout design rules and stick diagram representation, MOS circuits and logic design, Transistor sizing, fan-in, fan-out, Physical design of simple logic Gates, MOS logic structures and clocking strategies, Basics of FinFET Technology and Multigate Devices	

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.	3rd Edition	Oxford University
3	VLSI Design Techniques for Analog and Digital	Randall L. Geiger, Phillip E.	1st Edition	McGraw-Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22ET703T(ii)	Professional Elective – IV Digital Image Processing	3	-	-	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	On completion of the course students will be able to, 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 coding 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	**[9 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: Image Enhancement	**[10 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	**[8Hrs]**
Image Coding Fundamentals, - redundancy: coding, interpixel, psychovisual, fidelity criteria, Basic compression methods, Error Free Compression - variable length, bit plane	
Unit IV Image Compression	**9 Hrs]**
Image Compression Model, fundamentals, LZW arithmetic Lossless Predictive, Lossy Compression- Lossy Predictive.Fundamentals of JPEG, MPEG, fractals.	
Unit V Image Analysis	**[8 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, Morphologic al 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

Reference Books

S.N	Title	Authors	Edit	Publisher
1	Digital Image Processing	Pratt William		John Wiley & Sons
2	Image Processing, Analysis and Machine	Milan Sonka, Vaclav Hlavac and Roger Boyle	2	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
22ET704T(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 Minimize power of VLSI design. 3. To understand folding & unfolding techniques in multirate system 4. To address folding techniques used to design time multiplexed architecture.	On completion of the course students will be able to, 1. Demonstrate various methodologies to optimize power of VLSI design. 2. Optimize delay of VLSI design using retiming 3. Design real time processing system using unfolding techniques. 4. Design real time processing systems using folding techniques. 5. Design & analyze fast and iterated convolution techniques.

Unit 1: **Pipeline and Parallel Processing**	**[10 Hrs]**
Introduction, pipeling of FIR Digital filters Parallel processing, Pipelining and parallel processing for low power.	
Unit **II: Retiming**	**[9Hrs]**
Introduction, Definition and properties, solving system of inequalities, retiming techniques	
Unit **III: Unfolding**	**[10 Hrs]**
Introduction, algorithms for unfolding, Properties of unfolding, Critical path, unfolding and retiming Application of unfolding.	
Unit **IV:Folding**	**[9Hrs]**
Introduction Folding Transformation, Register minimization in folded architectures, Folding in Multirate systems	
Unit **V: Fast Convolution**	**[7 Hrs]**
Introduction, Cook- Toom algorithm, Winogard algorithm, Cyclic Convolution, Iterated 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	Keshab. Parthi		Wiley

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22ET704T(ii)	Professional Elective – V Bio Signal Processing	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. Compare the basic concepts of signals and analyse 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	On completion of the course students will be able to, 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 Sigal Analysis& Time-**	**[10 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	**[8 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	**[8 Hrs]**
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	**[7 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
22ET761O	Open Elective – III Design of Solar Photovoltaic Systems	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To explain the concept ofSolar PV systems 2. To explain the componentsof Solar PV systems 3. To understand the conceptof solar PV systems designing through different applications	On completion of the course students will be able to, 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 5) To design Solar PV small projects through project activity.

UNIT- I: Photovoltaic Systems	**[10 Hrs]**
Pv cells, series and parallel interconnection, solar modules, solar arrays, power and energy output from solar PV systems, sizingPV 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	**[10 Hrs]**
Energy from sun, solar radiation, incident energy estimation, sun geometry, sun TRACKING, one axis tracking, two axestracking, estimating solar RADIATION empirically, measurement OF solar radiation	
Unit -III Maximum Power Point Tracking	**[9 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	**[8Hrs]**
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 hybridsystem PV and Water pumping, Peltier Cooling, PV Grid interface, Simple payback period, Life Cycle Costing	
Unit V:- Solar PV system Design projects	**[8 Hrs]**
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 andapplications	Dr. Chetan Singh Solanki	2nd	PHI
2	Photovoltaic Systems: Analysis and Design	Mukerjee A. K., Nivedita		PHI

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Solar Cells from B to Advanced Systems	Chenming, H.		McGraw Hill Book