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SRI VASAVI ENGINEERING COLLEGE (AUTONOMOUS)
(Sponsored by Sri Vasavi Educational Society)
(Approved by **AICTE**, New Delhi & Recognized by **UGC** under section **2(f) & 12(B)**)
(Permanently affiliated to JNTUK, Kakinada, Accredited by **NBA** and **NAAC** with '**A**' Grade)
Pedatadepalli, **TADEPALLIGUDEM – 534 101.**W.G.Dist**. (A.P)**
Department of Electronics and Communication Engineering

Date: 27.07.2022

Minutes of the 6th meeting of BOS
(Held on 25.07.2022)

The ECE Department 6th meeting of Board of Studies (BOS) was conducted through online mode on 25.7.2022 at 02.00 P.M using ZOOM Application with following given link address.
https://us02web.zoom.us/j/89973827779

Following external members have attended the meeting along with internal faculty members. The ECE HOD, Dr E. Kusuma Kumari, BOS Chairman headed the meeting.

S.No.	Name of the BOS Member	Position	Address
1.	Dr.E. KusumaKumari	Chair person	Professor & Head, ECE, SVEC
2.	Prof. B.T. Krishna	University Nominee	Prof.& HoD in ECE Dept., University College of Engg., JNTUK, Kakinada
3.	Prof. NVSN. Sarma	Subject Expert	Director, IIIT Trichy Tiruchirapalli, Tamilnadu.
4.	Prof. M. VenugopalaRao	Subject Expert	Prof., ECE Dept., K.L.University, Vijayawada.
5.	Sri.Sunkavalli Siva Kumar	Alumni Nominee	Sr.Engineer,Qualcomm, Bangalore.
6.	All Faculty Members in Dept.	Members	ECE Dept., SVEC

The following are the key points discussed in the meeting.

- **Item No.1: Chairperson, BOS has welcomed all the members and given the Opening Remarks.**
- **Item No.2: Approval of Proposed course structure and Syllabi for V, VI, VII & VIII semesters of B. Tech ECE & ECT under V20 Regulations.**

BOS members Reviewed the Course Structure and given Following Suggestions

Prof. NVSN. Sarma (Academic Expert)		
Regulation	**Suggestions Given**	**Remarks**
B. Tech V20-Regulation	Microwave and Optical Communication Course should be separated	This course is seperated as Microwave Engg and Optical Communication Networks
	Revise the Antenna and Wave Propagation Course syllabus	Skywave Propagation concepts were removed. Space wave Propagation was included.
	Include the PIN Diode and Schotky Diode concepts in Micrwave Engg course.	Mentioned Topics were included
	Embedded Systems & IOT Lab : Change the Lab name to IOT lab only	Lab name was changed.
	Include courses like wireless Sensor Networks, computer Networks, Optical Networks, Industrial IOT.	Suggested Courses were added in the Syllabus.

Dr. B. T. Krishna (University Nominee)		
Regulation	**Suggestions Given**	**Remarks**
B. Tech V20-Regulation	Reference books in VLSI Design course (V20ECT10) to be added	Reference books were Added
	Analog Circuits (V20ECT12) Syllabus is to be Revised	Syllabus was revised
	For Every Course no. of. Text Books and no. of Reference books are to be same.	No. of Books kept same.
	Text book Titles should be in same format	Kept in Same format.
	Radar Engg (V20ECT24) Text book and Reference book is to be interchanged	Books Interchanged

Prof. M. Venu Gopala Rao, (Academic Expert)		
Regulation	**Suggestions Given**	**Remarks**
B. Tech V20-Regulation	Ensure the Courses CO levels and Blooms Taxonomy Levels are to be properly defined	Made the necessary Changes and COs & BTL Levels are Properly Defined.
	Make the Analog Circuits (V20ECT12) course as compulsory course	Analog Circuits course was made as Compulsory course and AWP course was kept in Professional Elective course.
	Reduce the Digital signal Processing Course (V20ECT15) Syllabus.	DSP Processors topics are removed.
	DSP Lab (V20ECL08)Part-B , DIP experiments are included, which the students are not studied DIP	While doing the DIP experiments, a complete DEMO will be given to students though DIP Course was in VII Sem. DIP Experiments are essential while students are doing their Final Yr Projects.
	Reduce the Digital Image Processing (V20ECT20) Course Syllabus	Syllabus was reduced.
	In the course of VLSI Design, Design concepts should be include with revised Knowledge levels	Design concepts included with revised Knowledge levels

BOS members Approved course structure and Syllabi for V, VI, VII & VIII semesters of B. Tech ECE & ECT under V20 Regulations was given in **Annexure-1**

- **Item No.3: Approval of list of courses and Syllabi offered under Job Oriented courses for B. Tech ECE & ECT under V20 Regulation.**

BOS Members reviewed the list of courses and syllabi and suggested to include CSE relevant courses in the pool of Job Oriented Elective Courses. Hence, we included the courses Deep Learning & Machine Learning in Job Oriented Elective Courses.
Approved list of course and syllabi given in **Annexure-2**

- **Item No.4: Approval of Course structure & List of Courses for Honors Degree in B. Tech ECE in two streams ie., Communication & Signal Processing, VLSI & Embedded Systems & Minors Degree in ECE (VLSI & ES).**

BOS Members reviewed the list of courses and syllabi and suggested that At least minimum three course should be taught in conventional mode for Honors/Minors Degree and approved the same.
Details given in **Annexure-3**

- **Item No.5: Approval of list of courses and Syllabi offered under Open Elective courses for B. Tech under V20 Regulation for all other branches.**
  BOS Members reviewed the list of courses and syllabi and approved list of Open Elective Courses are given in **Annexure-4**

Finally, the chairperson thanked all the BOS members and faculty. The meeting was ended at 3.00 P.M

Dr. E. Kusuma Kumari,
Chairperson, BOS

Approved Course Structure & Syllabus

for

(V, VI, VII, VIII Semesters)

(V20 Regulation)

V- Semester

S. No	Course Code	Course Name	L	T	P	Course-Category	Credits
1	V20ECT10	VLSI Design	3	0	0	Professional Core	3
2	V20ECT11	Microprocessors & Microcontrollers	3	0	0	Professional Core	3
3	V20ECT12	Analog Circuits	3	0	0	Professional Core	3
4	V20ECT13 V20ECT14	**Professional Elective-I** Antenna &Wave Propagation Information Theory & Coding	3	0	0	Professional Elective	3
5		**Open Elective-I / Job Oriented Elective**	3	0	0	Open Elective	3
6	V20ECL06	VLSI Design Lab	0	0	3	Professional Core Lab	1.5
7	V20ECL07	Microprocessor & Microcontrollers Lab	0	0	3	Professional Core Lab	1.5
8	V20ECSOC03	Skill Oriented Course	1	0	2	Skill Oriented Course	2
9	V20ENT04	Professional Comm. skills(Eng+ aptitude) –III (BOS of English)	2	0	0	Mandatory & Non Credit	0
10		Summer Internship- Mandatory after Second Year to be Evaluated during V Semester	0	0	0	Mandatory	1.5
		TOTAL	**18**	**0**	**08**		**21.5**

VI- Semester

S. No	Course Code	Course Name	L	T	P	Course-Category	Credits
1	V20ECT15	Digital Signal Processing	3	1	0	Professional Core	3
2	V20ECT16	Microwave Engineering	3	0	0	Professional Core	3
3	V20ECT17	Internet of Things: Use Cases	3	0	0	Professional Core	3
4	V20ECT18 V20ECT19	**Professional Elective-II** Embedded Systems System Design Through Verilog	3	0	0	Professional Elective	3
5		Management Science	3	0	0	Humanities & Social Science Elective	3
6	V20ECL08	Digital Signal Processing Lab	0	0	3	Professional Core Lab	1.5
7	V20ECL09	IoT Lab	0	0	3	Professional Core Lab	1.5
8	V20ECL10	Microwave Engg. Lab	0	0	3	Professional Core Lab	1.5
9	V20ENT05	Professional Comm. Skills (Eng+ aptitude) (MNC)- IV	2	0	0	Mandatory & Non Credit	0
10	V20ECSOC04	Skill Advanced Course / Soft Skill Course	1	0	2	Skill Advanced Course / Soft Skill Course	2
		TOTAL	**17**	**1**	**13**		**21.5**

VII Semester

Sl. No.	Course Code	Course Title	Hours per week			Category	Credits
			L	T	P		C
1	V20ECT20 V20ECT21	**Prof. Elective III:** • Digital Image Processing • Computer Networks	3	0	0	Prof. Elective Course	3
2	V20ECT22 V20ECT23	**Prof. Elective IV:** • Cellular Mobile Communication • Low Power VLSI Design	3	0	0	Prof. Elective Course	3
3	V20ECT24 V20ECT25	**Prof. Elective V:** • Radar Engineering • CMOS Digital IC Design	3	0	0	Prof. Elective Course	3
4		**Open Elective-II/ Job Oriented Elective**	2	0	2	Open Elective Course	3
5		**Open Elective-III / Job Oriented Elective**	2	0	2	Open Elective Course	3
6		**Open Elective-IV / Job Oriented Elective**	2	0	2	Open Elective	3
7	V20ECSOC05	Skill Advanced Course	1	0	2	Skill Advanced Course	2
8		Industrial Internship-Mandatory after Third Year to be Evaluated during VII Semester	0	0	0	Mandatory	3
		Total	**18**	**0**	**6**		**23**

VIII Semester

Sl. No.	Course Code	Course Title	Hours per week			Category	Credits
			L	T	P		C
1	V20ECP01	Project Work, Seminar and Internship in Industry	0	0	0	Major Project	12
		Total	**0**	**0**	**0**		**12**

V-Semester Syllabus

(V20 Regulation)

V Sem.	VLSI Design	Course Code	L	T	P	C
		V20ECT10	3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Understand different IC technologies. **(K2)**
CO-2: Explain basic electrical properties of MOS, CMOS and Bi-CMOS Circuits. **(K2)**
CO-3: Develop layouts for MOS & Bi-CMOS circuits using design rules. **(K3)**
CO-4: Compute the parameters of MOS circuits and assess the effects of scaling **(K3)**
CO-5: Design Combinational circuits and Subsystems. **(K4)**

UNIT-I:
Review of Microelectronics and An Introduction to MOS technology: Introduction to IC technology, Basic MOS transistors, Enhancement mode MOS transistor Action, Depletion mode MOS transistor Action, NMOS, PMOS fabrication, CMOS fabrication and Bi-CMOS technology, Comparison between CMOS and Bi-CMOS technology.

UNIT-II:
Basic Electrical Properties of MOS and BICMOS Circuits: Ids versus Vds relationships, Aspects of MOS transistor threshold voltage Vt, Trans conductance gm, Output conductance gds and Figure of merit, NMOS inverter, Pull-up to pulldown ratio for NMOS inverter driven by another NMOS inverter and through one or more pass transistors, Alternative forms of pull-up, CMOS inverter, BICMOS inverters, Latch-up in CMOS circuits.

UNIT-III:
MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2μm Double Metal, Double Poly, CMOS/Bi-CMOS rules, 1.2μm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams- Translation to Mask Form.

UNIT-IV:
Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, some area Capacitance Calculations, The Delay Unit, Inverter Delays, driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers. Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling.

UNIT-V:
Subsystem Design and Layout: Architectural issues, Switch logic, Gate Logic Examples of Structured Design (Combinational Logic): A Parity Generator, Bus Arbitration Logic for n-line-Bus an Illustration of Design Process: Multiplier, Design of an ALU Subsystem, Ripple Carry Adder, and Carry look ahead adder.

Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005Edition.

References:

1. "CMOS Digital Integrated Circuits, Analysis And Design", Sung – Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw Hill, 3rd Edition, 2003.
2. "VLSI Technology", S.M. Sze, 2nd edition, Tata McGraw Hill, 2003.

V Sem.	Microprocessors & Microcontrollers	Course Code V20ECT11	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe the basic architecture and Modes of 8086 microprocessor (**K2)**
CO-2: Construct assembly language programs for arithmetic and Logical Operations (**K3).**
CO-3: Describe the basic peripherals interfacing and its programming techniques**(K2)**

CO-4: Illustrate the Architecture and features of Intel 8051 Microcontroller **(K3)**

CO-5: Explain the Architecture and features of PIC microcontroller **(K2)**

UNIT-1: **Introduction to Microprocessors**: Evolution of Microprocessors, features, Intel Microprocessor families, Architecture of 8086 microprocessor, pin/signal description, Physical address formation, Description of Minimum and maximum mode pins, Timing diagrams.
Interrupts, Available interrupts, Interrupt Cycle, ISR (Interrupt service Routine).

UNIT-II: **Programming with 8086 Microprocessor**: Various addressing modes of 8086, Instruction set and Classification, Assembler Directives of 8086, writing Assembly language programs using various types of instructions.

UNIT – III: **Interfacing with Basic Peripherals**: Semiconductor memories interfacing (RAM, ROM), Interfacing Microprocessor to keyboards, interfacing to ADC/DAC, Interfacing, 8255(PPI-Parallel I/O port), 8259(Programmable interrupt controller), 8251(serial communication UART), Stepper motor interfacing and programming.

UNIT – IV:**8051 Microcontroller**: Intel 8051 Microcontroller, Microprocessor vs. Microcontroller, 8051 Microcontroller Architecture, Microcontroller 8051 pin diagram, Internal and External Memory, Counters and Timers, Serial Communication in 8051, interrupts in 8051, Addressing Modes, Instruction set, simple programs using microcontroller 8051.

UNIT – V: PIC Microcontroller: Introduction, characteristics of PIC microcontroller, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.

TEXT BOOKS:

1. Advanced microprocessor and Peripherals by A.K.Ray and K.M.Bhurchandi, TMH, 2000.
2. Microprocessors and Interfacing by Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGrawHill Education Private Limited, 3rd Edition.

REFERENCE BOOKS:

1. The Intel Microprocessors-Architecture, Programming, and Interfacing by Barry B.Brey,Pearson, Eighth Edition-2012.

V Sem.	Analog Circuits	Course Code V20ECT12	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Demonstrate Linear wave shaping circuits for various applications. **(K2)**
CO-2: Explain Non-Linear wave shaping circuits for various applications. **(K2)**
CO-3: Explain the operation of non sinusoidal oscillators & Illustrate Op-Amp Characteristics **(K2)**
CO-4: Demonstrate circuits for different applications using ICs. **(K2)**
CO-5: Discuss the operation of Active filters and Data Converters. **(K2)**

Unit I
Linear Wave shaping circuits: Response of high pass and low pass RC circuits to step, pulse inputs. High pass RC circuit as differentiator, low pass RC circuit as integrator.

Unit II
Non Linear Wave Shaping Circuits: Introduction to Clippers, Series and Shunt Clippers, Clippers with reference voltages, Clipping at two independent levels, Series and Shunt Noise Clippers, Positive and Negative Clampers, Clamping Circuits, Clamping Circuit Theorem.

Unit III
Non-sinusoidal oscillators & Introduction to Op-amp: Bistable, Monostable and Astable Multivibrators using BJT . Op-amp Block Diagram, Ideal Op-amp, Equivalent Circuit, Op Amp Characteristics.

Unit IV
Integrated Circuits and applications: open loop op-amp configurations. Inverting and non-inverting amplifier, OP Amp Applicationsr, 555 IC functional block diagram, 555 IC as Astable and Monostable multivibrators.

Unit V
Active filters and Data Converters: First order Low pass, high pass, band pass and band stop filters, All pass filter design guidelines. Weighted resistor DAC, R-2R ladder DAC. Dual slope ADC, Successive approximation ADC, flash ADC.

Text Books:
1. Integrated Electronics- J. Millman and C.C. Halkias, TMH

2. Electronic Devices and Circuits- Salivahanan, N.Suresh Kumar, A. Vallavaraj, TMH

3. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, TMH

References :

1. Pulse and Digital Circuits – A. Anand Kumar, PHI

2. Linear Integrated Circuits – D. Roy Choudhury, 4th edition, New Age International (p) Ltd.

3. Op-Amps & Linear Integrated Circuits - Ramakanth A. Gayakwad,3rd edition, PHI.

V Sem.	Antenna &Wave Propagation (Professional Elective-I)	Course Code V20ECT13	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Understand the radiation mechanism and fundamental parameters of antenna **(K2)**
CO-2: Solve the field components of dipole (or quarter monopole), loop antenna and their characteristics. **(K3)**
CO-3: Solve array factor for N element linear array and directivity & Design the Microwave antennas. **(K3)**
CO-4: Demonstrate the measurement procedure for antenna parameters, develop the rectangular Microstrip antenna and understand the concepts of modern antennas. **(K3)**
CO-5: Explain the concept of propagation methods and fading in wave propagation. **(K2)**

UNIT I

ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – single wire, two wires, Dipoles, Current Distribution on a thin wire antenna. Antenna Parameters –Near and far field regions, Radiation Patterns, Patterns in Principal Planes, Main Lobe and Side Lobes, Beam width, Polarization, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, Reciprocity Theorem applicable to antennas, Simple Problems.

UNIT II

WIRE ANTENNAS: Retarded Potentials, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Evaluation of Electric and magnetic Field Components, Radiation Resistance, Beam-width, Directivity.

Loop Antennas: Small Loops - Concept of short magnetic dipole - Field Components, Comparison of far fields of small loop and short dipole, Helical Antennas – Significance, Geometry, basic properties.

UNIT III

ANTENNA ARRAYS: Two element arrays, N element Uniform Linear Arrays – Broadside Array, End-fire Array, Array factor, Derivation of their characteristics and comparison, Principle of Pattern Multiplication, Non Uniform arrays- Binomial arrays, Phased Arrays concept - Beam scanning, Applications.

MICROWAVE ANTENNAS: Parabolic Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds & Cassegrain Feeds. Horn Antennas – Types, design Characteristics of Pyramidal Horns.

UNIT IV

ANTENNA MEASUREMENTS – Block diagram of radiation pattern measurement setup and measurement procedure, Distance Criterion, Indoor and outdoor measurement- Far field measurement, Advantages. Gain Measurements and measurement procedure (Comparison of Absolute and 3-Antenna Methods).

MODERN ANTENNAS: Microstrip Antennas - Geometry, Features, Advantages and Limitations, Rectangular MSA Design, Radiation mechanism, Simple design problems. Smart antennas - Block diagram, concept, switched beam and adaptive array concept & MIMO antennas.

UNIT V

WAVE PROPAGATION AND TRENDS IN WIRELESS COMMUNICATION: Concepts of Propagation - frequency ranges and types of propagations. Ground Wave-Propagation characteristics, Fundamental Equation for Free - Space Propagation, Basic Transmission Loss Calculations, Space Wave Propagation - Mechanism, LOS and Radio Horizon, Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations. Fading - Types of fading, Multipath propagation.

TEXT BOOKS

1. Antennas for All Applications by John D. Kraus and Ronald J. Marhefka, 3rd Edition, TMH, 2003.
2. Electromagnetic Waves and Radiating Systems by E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
3. Broadband Microstrip Antenna by Girish Kumar, Artech house Publishers

REFERENCES

1. Antenna Theory by C.A. Balanis, John Wiley and Sons, 2nd Edition, 2001.
2. Antennas and Wave Propagation by K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.
3. Antennas and Wave Propagation by Sisir K Das and Annapurna Das – Tata McGraw Hill.

V Sem.	Information Theory & Coding (Professional Elective-I)	Course Code V20ECT14	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1. Analyze the properties of Information theory **[K4]**
CO2. Evaluate Source coding efficiencies for different discrete sources **[K4]**
CO3. Apply various source coding techniques for data compression **[K3]**
CO4. Analyze linear block code encoding and decoding techniques **[K4]**
CO5. Analyze cyclic and convolutional code encoding and decoding techniques **[K4]**

UNIT I

INFORMATION THEORY : Introduction, Types of Information sources, Discrete messages, Concept of amount of information and its properties, Average information, Entropy and its properties, Information rate, Mutual information and its properties, Classification of Channels-Binary symmetric Channel, Binary Erasure Channel, Channel Matrices for different Channels.

UNIT II

CHANNEL CAPACITY & SOURCE CODING : Shannon-Hartley Theorem, Channel capacity of analog and discrete Channels, Capacity of a Gaussian channels, bandwidth –S/N trade off, Introduction to source coding, Shannon's source coding theorem, Prefix, Variable, & Fixed-Length Codes, Shanon-Fano coding, Huffman coding, Non-binary Huffman coding, Coding efficiency calculations.

UNIT III

DATA COMPRESSION : Basic Concepts of data compression, Run Length Coding, Block Sorting Compression, Dictionary Coding- Lempel Ziv algorithm, Statistical Compression, Prediction by Partial Matching, Arithmetic Coding, Adaptive Huffman Coding, Comparison of Huffman coding and Adaptive Huffman Coding.

UNIT IV

LINEAR BLOCK CODES : Introduction to channel coding, Classification of channel coding techniques-Error detection and correction codes, Systematic and Nonsystematic codes, Matrix description of Linear Block codes, Encoding using Generator Matrix, Syndrome Calculation, Decoding of linear block codes, Error detection and error correction capabilities of linear block codes.

UNIT V

BINARY CYCLIC CODES: Introduction, Polynomial Representation of Code words, Generator Polynomial, Systematic cyclic codes, Encoder design, Syndrome Calculation, Error Detection, Decoder design, and Limitations of Cyclic Codes.

CONVOLUTIONAL CODES: Introduction, Encoder Design, Encoding-Time Domain, Graphical approach: state, tree and trellis diagram, Decoding of Convolutional Codes-Viterbi algorithm, Sequential Decoding, Advantages and Limitations of Convolutional codes.

TEXT BOOKS:

T1. John G Proakis, “Digital Communications”, Mc Graw-Hill, 4th ed, 2000.

T2. Carlson A. Bruce, “Communication Systems”, 4th Edition, Mc. Graw Hill Publishers, 2002.

REFERENCES:

R1. Roberto Togneri, Christopher J.S. Desilva, “Fundamentals of Information Theory and Coding Design”, CRC Press, Taylor & Francis, 2006.

R2. Taub &Schilling, “Principles of Communication Systems”, 2nd Edition, McGrawHill Publishing Company.

V Sem.	VLSI Design Lab	Course Code	L	T	P	C
		V20ECL06	0	0	3	1.5

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Explain the VLSI Design Methodologies using Mentor Graphics Tools **(K2)**
CO-2: Demonstrate significance of various CMOS Analog and Digital circuits in Full-custom IC Design flow **(K2)**
CO-3: Explain the Physical Verification in Layout Design **(K2)**
CO-4: Design and analyse of Analog and mixed signal simulation **(K3)**
CO-5: Analyse the Significance of Pre-Layout Simulation and Post-Layout Simulation. **(K4)**

PART-A List of Experiments: Design the following experiments using 250nm CMOS technology and extract parasitic.

1. CMOS Inverter
2. Universal Logic gates
3. Full Adder
4. RS-Latch & D- latch
5. JK-Flip Flop
6. Ripple Carry Adder
7. Asynchronous Counter
8. Ring Oscillator
9. R-2R Ladder Type DAC
10. Differential Amplifier
11. 2–3-week Mini Project. Lab Requirements: Software: Mentor Graphics – Pyxis Schematic, IC Station, Calibre, ELDO Simulator

V Sem.	Microprocessor & Microcontrollers Lab	Course Code	L	T	P	C
		V20ECL07	0	0	3	1.5

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Develop algorithm and logic for different operations using 8086 Instructions. **(K3)**
CO-2: Construct simple programs for 8086 using Assembler directives (MASM)/Machine control Instructions. **(K3)**
CO-3: Develop ALP to perform arithmetic and logical operations using various instructions. **(K3)**
CO-4: Develop ALP to perform conversions, finding squares of a numbers by using Loop, Jump instructions. **(K3)**
CO-5: Develop Assembly language programs for 8051 Micro controller. **(K3)**

LIST OF EXPERIMENTS

PART- A:
8086 Assembly Language Programming using Assembler Directives
Introduction to MASM/TASM

1. Basic Arithmetical operations – Unsigned Addition, Subtraction, Multiplication and Division.
2. Multi byte addition/subtraction
3. Sorting of given array of elements (Ascending order /descending order)
4. Sum of squares/cubes of a given n-numbers
5. Shift and rotate operations for given number.

PART- B: 8051 Assembly Language Programming

6. Assembly Language program to find average of n numbers by 8051 microcontrollers.
7. Assembly Language program to find the no of 1's and 0's in a given number by 8051 Microcontroller.
8. Assembly language program in 8051 micro controllers for Counter 0 in Mode 2 to count the number of pulses and display the count value on port P2 and external memory location 0FFC1H.
9. Assembly language program for serial transmission and serial reception with an baud rate of 9600bps.
10. Assembly Language program to interface stepper motor to 8051 microcontroller (Both directions)

VI-Semester Syllabus

(V20 Regulation)

VI Sem.	Digital Signal Processing	Course Code V20ECT15	L	T	P	C
			3	1	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Classify Discrete Time Signals & systems, Compute DFT for discrete Time signals. **(K3)**
CO-2: Compute DFT for discrete Time signals using FFT Algorithm **(K3)**
CO-3: Describe the various implementations of digital filter structures **(K2)**
CO-4: Analyze and design a Digital filter (FIR&IIR) from the given specifications **(K4)**
CO-5: Use the Multi-rate Processing concepts in various applications **(K3)**

UNIT I INTRODUCTION & DISCRETE FOURIER TRANSFORMS: Classification of Discrete time signals & Systems, stability of LTI systems. Introduction to DTFT**,** Discrete Fourier transforms, Properties of DFT.

UNIT II INTRODUCTION & FAST FOURIER TRANSFORMS Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

UNIT III REALIZATION OF DIGITAL FILTER: Review of Z-transform, digital filters, Block diagram representation of linear constant coefficient difference equations, Basic structures of IIR systems, Transposed forms. Basic structures of FIR systems.

UNIT IV DESIGN OF IIR and FIR DIGITAL FILTERS: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from Analog filters, Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters**,** Applications – Sub-band Coding of Speech Signals, Introduction to architecture of TMS320C5X DSP processors.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications by John G. Proakis, Dimitris G.Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing by A.V.Oppenheim and R.W. Schaffer, PHI
3. Digital Signal Processing by Ramesh babu, Sci Tech publications

Reference Books:

1. Digital Signal Processing by MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.
2. Digital Signal Processing by Alan V. Oppenheim, Ronald W. Schafer, PHI Ed., 2006
3. Digital Signal Processing by A.Nagoor Kani, RBA Publications.

VI Sem.	Microwave Engineering	Course Code: V18ECT16	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Solve the TE/TM modes and characteristics of Rectangular waveguide **(K2)**
CO2: Illustrate the construction, operation, Power output and efficiency of two cavity Klystron Amplifier and Reflex klystron Oscillator **(K3)**
CO3: Examine the construction, operational details of travelling wave tube Amplifier & cylindrical cavity Magnetron Oscillator **(K4)**
CO4: Construct the various passive waveguide components based on the Scattering matrix **(K3)**
CO5: Explain the operation of Microwave Solid State Devices & the procedure for measuring various microwave parameters using a Microwave test bench **(K2)**

UNIT I

MICROWAVE TRANSMISSION LINES: Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides (RWG) – Solution of TE and TM wave equation in RWG - Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations & Characteristics, Cavity resonators – Rectangular cavity resonator – Dominant mode – Resonant frequency – related problems.

UNIT II

MICROWAVE TUBES (O type): Limitations and Losses of conventional tubes at microwave frequencies. Re-entrant cavities, Microwave tubes – O type and M type classifications. O-type tubes: 2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory –Expressions for o/p Power and Efficiency, Applications, Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Bunching Process, Power Output, Efficiency, Applications, Related Problems.

UNIT III

HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Suppression of Oscillations, Nature of the four Propagation Constants.

M-type Tubes Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – operation, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics.

UNIT IV MICROWAVE PASSIVE COMPONENTS: Waveguide Attenuators- Waveguide phase shifters. Scattering Matrix – Significance - Formulation and Properties. E plane Tee - H plane Tee – Magic Tee - Directional coupler operation and Scattering Matrix Calculation. Ferrite Components- Faraday rotation - Isolator and Circulator.

UNIT V

MICROWAVE SOLID STATE DEVICES: TEDs – Introduction, Gunn Diode – Principle - RWH Theory – Characteristics - Basic Modes of Operation - Oscillation Modes. Avalanche Transit Time Devices – IMPATT Diode – Principle of Operation and characteristics. Detector Diode, PIN Diode characteristics and applications.

MICROWAVE MEASUREMENTS: Description of Microwave Bench – Different Blocks and their Features, Precautions. Microwave Power Measurement using Bolometer Method. Measurement of Attenuation, VSWR and Impedance.

TEXT BOOKS:

1. Microwave Devices and Circuits by Samuel Y. Liao, PHI, 3rd Edition, 1994.
2. Foundations for Microwave Engineering by R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
3. "Microwave Engineering" by David M.Pozar, Fourth Edition, Wiley, India 2012.

REFERENCES:

1. Microwave and Radar Engineering by M.Kulkarni, Umesh Publications, 3rd Edition.
2. Microwave Engineering by G S N Raju, I K International
3. Microwave and Radar Engineering by G Sasibhushan Rao Pearson

VI Sem.	Internet of Things: Use Cases	Course Code V20ECT17	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe M2M and IOT Technologies. **[K2]**
CO2: Explain the layers and protocols in IOT. **[K2]**
CO3: Describe various communication technologies used in IOT. **[K2]**
CO4: Illustrate various hardware components required for IOT applications. **[K2]**
CO5: Discuss the cloud technologies and their services and explain the IoT Applications. **[K2]**

UNIT I – INTRODUCTION [1]
Introduction from M2M to IoT - An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, M2M and IoT Technology Fundamentals - Devices and gateways.

UNIT II – IOT PROTOCOLS [2]
Functionality of Layers in IoT –Study of protocols - Wireless HART, Z-Wave, 6LoWPAN, RPL, CoAP, MQTT.

UNIT III - COMMUNICATION TECHNOLOGIES IN IOT [2, 4]
IoT Connectivity – IEEE 802.15.4, Zigbee, LPWAN, Wi-Fi, Bluetooth, 5G Era.

UNIT IV - SYSTEM HARDWARE [3, 4]
Sensors, Actuators, Radio Frequency Identification, Introduction to Embedded Devices for IoT - RASPBERRY PI, Beaglebone black.

UNIT V – Cloud Computing [3, 4]
Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/ Services. Use Cases - Smart and Connected Cities, Agriculture, and Healthcare.

TEXTBOOKS:
1. "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, 1st Edition, Academic Press, 2014.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Cisco Press 800 East 96th Street Indianapolis, Indiana 46240 USA.
3. "Internet of Things (A Hands-on- Approach)", Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014.
Internet of Things - By Raj Kamal, McGraw-Hill Education. Copyright.

REFERENCE BOOKS:

1. From Internet of Things to Smart Cities: Enabling Technologies - edited by Hongjian Sun, Chao Wang, Bashar I. Ahmad, CRC Press -2018.
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT, David Etter.

VI Sem.	Embedded Systems (Professional Elective-II)	Course Code V20ECT18	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe the Basic Concepts of Embedded Systems- **(K2).**
CO2: Describe the characteristics of Application & Domain-Specific Embedded Systems – **(K2)**
CO3: Discuss various hardware design approaches in embedded environment- **(K2)**
CO4: Describe various Embedded firmware design approaches on Embedded environment. **(K2)**
CO5: Illustrate the development, implementation & testing of Embedded System. **(K3)**

UNIT-I:
INTRODUCTION: Embedded System -Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, List of Communication Interface.

UNIT-II:
Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-III:
EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-IV:
EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-V:
EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, Deassembler/De-compiler, Simulators, Emulators and Debugging, Target hardware debugging, Embedded Software development process and tools, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

Text Books:

1.Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2.Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

References:

1.Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2.Embedded Systems-Lyla B.Das-Pearson Publications,2013.

VI Sem.	SYSTEM DESIGN THROUGH VERILOG (Professional Elective-II)	Course Code	L	T	P	C
		V20ECT19	3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Outline basic concepts, constructs and conventions of VERILOG. **(K2)**
CO2: Develop Verilog codes for combinational and sequential logic cirucits at gate and data flow level. **(K3)**
CO3: Develop Verilog codes for combinational and sequential logic circuits at behavioral level. **(K3)**
CO4: Develop Verilog codes for CMOS circuits at switch level and outline the concepts of task, function and complier directives. **(K3)**
CO5: Explain Synthesize of Combinational and Sequential Circuits. **(K2)**

UNIT-I

INTRODUCTION TO VERILOG:
Verilog as HDL, Levels of design description, concurrency, module, simulation and synthesis, test bench, functional verification, programming language interface (PLI), simulation and synthesis tools.
LANGUAGE CONSTRUCTS AND CONVENTIONS:
Introduction, keywords, identifiers, whitespace characters, comments, numbers, strings, logic values, data types, scalars and vectors, parameters, memory, operators.

UNIT-II
GATE LEVEL MODELLING:
Introduction, AND gate primitive, module structure, other gate primitives, illustrative examples, tristate gates, array of instances of primitives, design of Flip flops with gate primitives, delays, strengths and contention resolution, net types, design of basic circuits.
DATA FLOW LEVEL MODELLING
Introduction, continuous assignment structures, delays and continuous assignments, assignment to vectors, design of basic circuits.
.

UNIT-III
BEHAVIORAL MODELLING:
Introduction, operations and assignments, initial construct, always construct, examples, assignments with delays, wait construct, multiple always blocks, blocking and non-blocking assignments, the case statement, if and if else constructs, assign-De assign construct, repeat construct, FOR loop, the disable construct, While loop, Forever loop, parallel blocks, force-release construct, event.

UNIT-IV
SWITCH LEVEL MODELLING
Basic transistor switches, CMOS switch, Bidirectional gates and time delays with switch primitives, instantiations with strengths and delays, strength contention with trireg nets, switch level modeling for NAND, NOR and XOR.

SYSTEM TASKS, FUNCTIONS, AND COMPILER DIRECTIVES:
Introduction, System Tasks and Functions, File based Tasks and Functions, Compiler Directives, Hierarchical Directives, User-defined Primitives (UDP).

UNIT-V

SYNTHESIS OF COMBINATIONAL AND SEQUENTIAL LOGIC USING VERILOG:
Synthesis of combinational logic: Net list of structured primitives, a set of continuous assignment statements and level sensitive cyclic behavior with examples, Synthesis of priority structures, Exploiting logic don't care conditions. Synthesis of sequential logic with latches: Accidental synthesis of latches and Intentional synthesis of latches, Synthesis of sequential logic with flip-flops, Synthesis of explicit state machines.

TEXT BOOKS:
1. Design through Verilog HDL — T.R. Padmanabhan and B. Bala Tripura Sundari, WSE, IEEE Press, 2004.
2. Advanced Digital Design with Verilog HDL — Michael D. Ciletti, PHI, 2005.

REFERENCES:
1. Fundamentals of Logic Design with Verilog — Stephen. Brown and Zvonko Vranesic, TMH, 2005.
2. A Verilog Primier — J. Bhasker, BSP, 2003.

VI Sem.	Digital Signal Processing Lab	Course Code	L	T	P	C
		V20ECL08	0	0	3	1.5

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe the generation and convolution of discrete time signals **(K2)**
CO-2: Compute the DFT using FFT **(K3)**
CO-3: Design Digital IIR and FIR filter **(K4)**
CO-4: Develop Interpolator and Decimator **(K3)**
CO-5: Apply DSP algorithms for audio and Image processing applications **(K3)**
CO-6: Develop DSP algorithms on TMS320C6713 DSP processor Kit **(K3)**

List of Experiments (Any 6 Experiment from PART-A and PART-B):

PART – A

1. Generate the varies discrete time signals.
2. Perform linear & circular convolution of given sequences
3. Obtain a 4-point and 8-point DFT of a givensequence.
4. Determine the 4-point and 8-point DFT using FFT.
5. Design and Simulate Infinite Impulse Response (IIR) filters using butter worth and Chebyshev filters.
6. Design and simulate Finite Impulse Response (FIR) filters using windowing techniques.
7. Compute Interpolation and Decimation of given signal and find their spectrum.

PART – B (DSP Applications)

1. Read a .wav file and plot time domain waveform of a speech signal
2. Compute the histogram of the given image.
3. Compute the edge of an image using spatial filters.
4. Compute the two-level Decomposition of Discrete Wavelet transforms and Reconstruct image using inverse Discrete Wavelet transform
5. Obtain linear & circular convolution of two signals using TMS320C6713 DSP processor.
6. Obtain Power Spectral Density of a periodic signal using TMS320C6713 DSP processor.
7. Design and simulate Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters using TMS320C6713 DSP processor.

VI Sem.	IoT Lab	Course Code V20ECL09	L	T	P	C
			0	0	3	1.5

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:
CO1: Develop Embedded C Program to interface sensors & actuators. **(K3)**
CO2: Develop Embedded C Program to send the sensor data to cloud. **(K3)**
CO3: Develop Wireless Module Interface with Embedded device. **(K3)**
CO4: Develop street light control system, security system, home automation system. **(K4)**
CO5: Develop mobile application to interface with Embedded device. **(K3)**

List of Experiments (any 10 Experiments)

1. Write an Embedded C Program to interface the following with Arduino Uno with IR Sensor, Temperature Sensor, Ultrasonic Sensor
2. Write an Embedded C Program to Interface DC Motor, Servo/stepper Motor with Arduino Uno.
3. Write an Embedded C Program to Interface LCD with Arduino Uno.
4. Develop an Application to Interface GPS with Arduino and Identify Latitude and Longitude
5. Wireless Module Interface – Bluetooth with Arduino Uno.
6. Wireless Module Interface – Zigbee with Arduino Uno as transceiver.
7. Write an Embedded C Program to monitor temperature and humidity and store in cloud using Wi-Fi Module.
8. Read data from sensor and send it to a requesting client using socket communication. Note: The client and server should be connected to same local area network.
9. Home security System using Raspberry-pi and PIR Sensor.
10. LED Control and LDR interfacing with Raspberry-pi.
11. Uploading sensor Data to cloud With MQTT protocol.
12. Interfacing Raspberry-pi with the smart phone for enabling home automation.

REFERENCE BOOKS:

1. From Internet of Things to Smart Cities: Enabling Technologies - edited by Hongjian Sun, Chao Wang, Bashar I. Ahmad, CRC Press -2018.
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT, David Etter.
4. “Internet of Things (A Hands-on- Approach)”, Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014.

VI Sem.	Microwave Engineering Lab	Course Code V20ECL10	L	T	P	C
			0	0	3	1.5

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Sketch the characteristics of various Microwave & Optical sources **(K3)**

CO2: Compute the various Parameters of Microwave & Optical Components **(K3)**

CO3: Measure the radiation pattern of Horn antenna and reflector antenna. **(K5)**

CO4: Analyze a rectangular micro strip patch antenna using HFSS software **(K4)**

Minimum Twelve Experiments to be conducted:

Part – A (Any 7 Experiments):

1. Reflex Klystron Characteristics.
2. Gunn-Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. Frequency and Waveguide Parameters Measurement.
6. Impedance and Measurement.
7. Scattering parameters of Magic Tee.
8. Scattering parameters of Circulator.
9. Radiation Pattern of Horn and Parabolic Antennas.
10. Synthesis of Microstrip antennas (Rectangular Structure) Using HFSS.

Part – B (Any 5 Experiments):

11. Characterization of LED.
12. Characterization of Laser Diode.
13. Intensity modulation of Laser output through an optical fiber.
14. Measurement of Data rate for Digital Optical link.
15. Measurement of NA.
16. Measurement of losses for Analog Optical link.

VII-Semester Syllabus

(V20 Regulation)

VII Sem.	Digital Image Processing (Professional Elective-III)	Course Code	L	T	P	C
		V20ECT20	3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1. Explain image fundaments and the different image Transforms Techniques **(K2)**
CO2. Describe Spatial and frequency domain filtering like smoothing and sharpening operations on Images **(K2)**
CO3. Describe Restoration operations/techniques on Images **(K3)**
CO4. Describe the Image compression Techniques and Image segmentation **(K3)**
CO5. Explain the different color models and color image processing techniques **(K2)**

UNIT-I

Introduction: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing.

Image Transforms: Need for image transforms, Discrete Fourier transform (DFT) of two variables, Walsh Transform. Hadamard transform, Haar Transform, Slant transform, Discrete Cosine transform.

UNIT-II

Intensity Transformations and Spatial Filtering: Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, and sharpening spatial filters.

Filtering in the Frequency Domain:, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters and Selective filtering.

UNIT-III

Image Restoration and Reconstruction: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Estimating the image degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering, geometric mean filter.

UNIT-IV

Image compression : Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding,Image pyramids and subband coding.

Image segmentation: Fundamentals, point, line, edge detection, thresholding, region based segmentation and .simple morphological operations Erosion and dilation,opening and closing.

UNIT-V

Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color.

Text Books

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.

Reference Books

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

VII Sem.	Computer networks (Professional Elective-III)	Course Code V20ECT21	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Discuss fundamentals of network concepts, Reference Models and physical layer. **(K2)**
CO2: Demonstrate Error control and protocols. **(K3)**
CO3: Apply Routing algorithms and congestion control algorithms. **(K3)**
CO4: Discuss Transport layer services and protocols. **(K2)**
CO5: Describe Application layer protocols. **(K2)**

UNIT-I:

Introduction: Reference models: The OSI Reference Model- the TCP/IP Reference Model, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

Physical Layer: Transmission Media, Multiplexing: FDM, WDM and TDM- LAN Technologies, introduction to switching: Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

UNIT–II:

Data link layer: Design issues, Framing, Flow control, error control, error detection and correction, CRC, Checksum: idea, one's complement internet checksum, MAC: ALOHA, CSMA. Elementary Data Link Layer protocols: simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocol: One bit, go back N, Selective repeat-Stop and wait protocol, HDLC, point to point protocol (PPP).Piggybacking.

UNIT-III:

Network Layer :Network layer design issues- Algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast Routing algorithms Congestion control and algorithms, Internet Protocol (IP) Addresses, Subnet masking

UNIT–IV:

Transport Layer: Services, Primitives and sockets, Elements of transport protocols, Internet Transport protocols(TCP,UDP,RPC,RTTP/RTP,RTCP) Segment headers, Primitives, Control, Congestion control, Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT–V:

Application Layer: DNS, SMTP, POP, & FTP HTTP Presentation formatting. Network security: Introduction to Cryptography, Authentication, Basics of Public key and private key cryptography, digital signatures and certificates firewalls and wireless security.

TEXT BOOKS:

1. Computer Networks by Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
2. Data Communications and Networks by Behrouz A. Forouzan.Third Edition TMH

REFERENCES:

1. An Engineering Approach to Computer Networks by S.Keshav, 2nd Edition, Pearson Education
2. Understanding Communications and Networks, 3rd Edition by W.A. Shay, Thomson

VII Sem.	Cellular Mobile Communication (Professional Elective-IV)	Course Code V20ECT22	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Demonstrate the limitations of conventional mobile telephone systems; Understand the concepts of cellular systems. **[K2]**
CO2: Illustrate the concept of frequency Reuse channels, deduce Co- channel Interference reduction factor **[K2]**
CO3: Understand the frequency management, channel assignment strategies and Antennas in cellular systems.**[K2]**
CO4: Discuss the concepts of Handoff, dropped calls and cell splitting, Intersystem Handoff. **[K2]**
CO5: Explain the knowledge about different multipleacess schemes, GSM architecture and higher generation cellular standards,.**[K2]**

UNIT-I
CELLULAR MOBILE RADIO SYSTEMS: Introduction to Cellular Mobile System, uniqueness of mobile radio environment, operation of cellular systems, consideration of the components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems.
CELLULAR CONCEPTS: Evolution of Cellular systems, Concept of frequency reuse, frequency reuse ratio, Number of channels in a cellular system, Cellular traffic: trunking and blocking, Grade of Service; Cellular structures: macro, micro, pico and femto cells; Cell splitting, Cell sectoring.

UNIT-II
INTERFERENCE: Types of interferences, Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, design of Antenna system, antenna parameters and their effects, diversity receiver, non-cochannel interference-different types.

UNIT-III
FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units: fixed channel and non-fixed channel assignment, channel sharing and borrowing, overlaid cells. CELL COVERAGE FOR SIGNAL AND TRAFFIC: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, straight line path loss slope, and general formula for mobile propagation over water and flat open area, near and long distance propagation, antenna height gain, form of a point to point model.

UNIT-IV
HANDOFF STRATEGIES Concept of Handoff, types of handoff, handoff initiation, delaying handoff, forced handoff, mobile assigned handoff, intersystem handoff, vehicle locating methods, dropped call rates and their evaluation.

UNIT-V

DIGITAL CELLULAR NETWORKS: GSM architecture, GSM channels, multiple access schemes; FDMA, TDMA, CDMA, OFDMA;

HIGHER GENERATION CELLULAR STANDARDS: 3G System architecture (UMTS) enhancements in 4G standard, Architecture and representative protocols, introduction to 5G.

TEXTBOOKS:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn,2006.
2. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2007.

REFERENCES:

1. Wireless Communications – Theodore. S. Rapport, Pearson education, 2nd Edn, 2002.
2. Wireless and Mobile Communications – Lee McGraw Hills, 3rd Edition, 2006. 3. Mobile Cellular Communication – G Sasibhushana Rao Pearson
3. Wireless Communication and Networking – Jon W. Mark and WeihuaZhqung, PHI, 2005.

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VII Sem.	Low Power VLSI Design (Professional Elective-IV)	Course Code V20ECT23	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Illustrate the importance of low power design, sources of power dissipation and the factors affecting them. **[K3]**
CO2: Describe various power reduction techniques possible for Low-Power Design at different levels. **[K2]**
CO3: Analyze various adder structures for low power applications. **[K4]**
CO4: Analyze various multipliers and multiplication algorithms for low voltage and low power environment. **[K4]**
CO5: Discuss the techniques for attaining the low power consumption in memories. **[K2]**

UNIT-I:
Fundamentals of Low Power VLSI Design: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-II:
Low-Power Design Approaches:
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.
Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT-III:
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT-IV:
Low-Voltage Low-Power Multipliers Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT-V:
Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Text Books:

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

Reference Books:

1. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
2. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.

VII Sem.	Radar Engineering (Professional Elective-V)	Course Code V20ECT24	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Demonstrate the factors which affecting the radar performance using Radar Equation. **[K2]**

CO2: Describe the operation of CW and FMCW Radar systems. **[K2]**

CO3: Illustrate the principle of each and every block of MTI Radar **[K2]**

CO4: Distinguish the different methods used for tracking targets. **[K2]**

CO5: Illustrate the basic principle and the importance of Matched Filter Receivers in Radars **[K2]**

UNIT–I:

Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications.

Radar Equation : Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, SNR, Probability of Detection, Probability of False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, PRF and Range Ambiguities, System Losses.

UNIT–II:

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.

FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FMCW altimeter, Multiple Frequency CW Radar.

UNIT-III:

MTI Radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation and Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance.

UNIT –IV:

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns.

UNIT –V:

Detection of Radar Signals in Noise: Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Detection and Cross-correlation Receiver, Matched Filter with Non-white Noise, Noise Figure and Noise Temperature.

Radar Receivers: Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers.

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Edition,2007.
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
3. Radar Engineering – GSN Raju, IK International.

REFERENCE BOOKS:

1. Introduction to Radar Systems, 3rd edition – M.I. Skolnik, TMH Ed., 2005.
2. Microwave & Radar Engineering – M. Kulkarni, Umesh Publications, 3rd edition
3. Microwave & Radar Engineering – G. SasibhushanaRao, Pearson Publications

VII Sem.	CMOS DIGITAL IC DESIGN (Professional Elective-V)	Course Code	L	T	P	C
		V20ECT25	3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Analyze the concepts of MOS Design. **[K2]**
CO2: Design and analysis of Combinational MOS Circuits. **[K2]**
CO3: Design and analysis of Sequential MOS Circuits. **[K2]**
CO4: Construct Dynamic Logic Circuits Using Various Logic Styles. **[K2]**
CO5: Describe the Concepts of Semiconductor Memories, Flash Memory, RAM array organization **[K2]**

UNIT-I

MOS Design:

Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II

Combinational MOS Logic Circuits:

MOS logic circuits with NMOS loads, Primitive CMOS logic gates NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT-III

Sequential MOS Logic Circuits:

Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT-IV

Dynamic Logic Circuits:

Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT-V

Semiconductor Memories:

Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory, NOR flash and NAND flash.

TEXT BOOKS:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

REFERENCE BOOKS:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.

Job Oriented Elective Courses

(V20 Regulation)

List of Advanced/ Job Oriented Elective Courses for ECE Students

S. No	Course Code	Name of the Course	Department Offered
1	V20ECTJOC01	FPGA Architecture	Electronics & Communication Engineering
2	V20ECTJOC02	Optical Communications & Networks	
3	V20ECTJOC03	Industrial IOT	
4	V20ECTJOC04	Modern Satellite Communication	
5	V20ECTJOC05	Wireless Sensor Networks	
6	V20ECTJOC06	Digital Signal Processors and Applications	
7	V20ECTJOC07	Modern Wireless Communication Systems	
8	V20ECTJOC08	CMOS Analog IC Design	
9	V20ECTJOC09	Bio Medical Instrumentation	
10	V20ECTJOC10	Speech Signal Processing	
11	V20ECTJOC11	Electronic Instrumentation	
12	V20ECTJOC12	Sensors & Applications	
13	V20ECTJOC13	Deep Learning	
14	V20ECTJOC14	Machine learning	

Sem.	FPGA Architecture (Job Oriented Elective)	Course Code: V20ECTJOC01	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1 Describe Low end programmable devices and FPGA basics. **[K2]**
CO-2 Describe Spartan 6 basics. **[K2]**
CO-3 Use Virtex 5 clock sources and FIFO. Comprehend various I/O standards. **[K3]**
CO-4 Use Memory, DSP blocks in complex designs. Comprehend SerDes. **[K3]**
CO-5 Distinguish RISC based Soft processors from Xilinx, Aletra. **[K3]**

UNIT-I
DESIGNING WITH PROGRAMMABLE LOGIC DEVICES:
Read only Memories, Programmable logic Arrays (PLA), Programmable Array logic (PAL), Programmable logic Devices (PLD). Skew, setup, hold time.
DESIGNING WITH FPGA:
Logic implementation options, Technology trends, Simple SRAM programmable FPGA architecture, Xilinx 3000 series FPGAs, Programmable interconnects, Xilinx 4000 series FPGAs, Programming the FPGA.

UNIT-II
SPARTAN 6 ARCHITECUTUTE:
Spartan 6 Device features- 6 input LUT, Slice, Single Port RAM, Dual Port RAM, ROM, Distributed RAM, 32 x 6, 64 x 1, 128 x 1, Distributed RAM timings, Shift Registers, Multiplexers, Interconnect, PLL, DCM, DSP Slice.

UNIT-III
VIRTEX 5 ARCHITECTURE:
Clock resources-Global clocks, regional clocks, Clock buffer, Clock Gating. Clock Tree, Clock De-skew, True Dual port RAM. Write modes, FIFO architecture, empty flags, almost empty flags, almost fill flags, full flag, cascading FIFOS, connecting FIFOs in parallel, designing Large multiplexer 4xl, 8xl, 16xl. Control impedance, I/O primitives. I/O supported standards, LVDS.

UNIT-IV
STARATIX V ARCHITECTURE:
ALM Block diagram, ALM operating modes, ALM in Arithmetic mode, Types of embedded memory, Control clocking, Memory features, Memory modes, DSP block features, operational modes, DSP block architecture in 27 X 27 mode, independent complex multiplier mode, I/O features mixing voltage referenced and non voltage referenced standard I/O features standards. Dynamic OCT.LVDS Serdes block diagram and features, Differential Receiver Block diagram and features.

UNIT-V

SOFT PROCESSORS:

JTAG, programming through JTAG, IEEE 1149.1 Boundary scan testing, programmable power technology, Feratures of Soft processors, Nios-II, Microblaze.

TEXT BOOKS:

1. Charles H Roth Jr“ Digital System Design using VHDL”, second edition, 2008.
2. Spartan 6 family overview.
3. Virtex 5- User Guide.

REFERENCES:

1. J. Old Field,R.Dorf, “Field Programmable Gate Arrays”, John Wiley & Sons, New York, 1995.
2. S. Trimberger, Edr.“Field Programmable Gate Arrays Technology”, Kluwer Academic Publications, 1994.
3. Bob Zeidman, “ Designing with FPGAs & CPLDs”, CMP Books, 2002.

Sem.	Optical Communication & Networks (Job Oriented Elective)	Course Code: V20ECTJOC02	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:
CO1. Describe the overview of optical fiber communication, ray theory transmission and concepts of modes. **[K2]**
CO2. Explain the Transmission characteristics of fiber and optical fiber Connectors. **[K2]**
CO3. Describe the operation of optical sources, photo detectors and optical Receiver. **[K2]**
CO4. Explain WDM Concepts and Components. **[K2]**
CO5. Explain the Optical switching networks. **[K2]**

UNIT I
Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cut-off wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers.**(Text 2)**

UNIT II
Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.
Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber connectors: Cylindrical ferrule connectors, Duplex and Multiple fiber connectors, Fiber couplers: three and four port couplers, star couplers, Optical Isolators and Circulators**.(Text 2)**

UNIT III
Optical sources: Light emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies.
Photodetectors: Physical principles of Photodiodes, Photo detector noise, Detector responsetime.
Optical Receiver: Optical Receiver Operation: Error sources, Front End Amplifiers,Receiver sensitivity, Quantum Limit.**(Text1)**

UNIT IV
WDM Concepts and Components: Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer, Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Introduction to Optical amplifiers: Basic application and Types. **(Text 1)**

UNIT V
Optical Networks: Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol, Wavelength routing networks: Routing and wavelength assignment,

Optical switching networks: Optical circuit switched networks, packet switched networks,Multiprotocol Label Switching, Optical burst switching networks.**(Text 2)**

TEXT BOOKS:

1. Optical Fiber Communications – Gerd Keiser, McGraw-Hill International edition, 5th Edition, 2015.
2. Optical Fiber Communications – John M. Senior, PHI, 3rd Edition, 2010.

RERFERENCES :

1. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
2. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

Sem.	Industrial IoT (Job Oriented Elective)	Course Code: V20ECTJOC03	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe the key techniques and theory behind Industrial Internet of Things **[K2]**
CO2: Explain the key techniques and theory behind Industrial Internet of Things **[K2]**
CO3: Explain the integration of Cloud and IoT, Edge and Fog Computing **[K2]**
CO4: Apply effectively the various enabling technologies (both hardware and software) for IIoT **[K3]**
CO5: Illustrate and build IIoT system for different Use cases **[K3]**

Unit – 1 – Introduction to IoT

Overview of Internet of Things, Introduction, IoT Architecture, Application-based IoT Protocols - Infrastructure-based protocols, Data protocols, Transport protocols; Cloud Computing - Types of cloud, Business aspects of cloud, Virtualization: Key aspect of cloud computing, Mobile cloud computing; Fog Computing - Applications of Fog computing; Sensor Cloud - Applications of Sensor Cloud; Big Data.

Unit -2 - Introduction to IIoT

Industry 4.0, Introduction IIoT, Design requirement of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of Industry, Smart Business perspective, Cybersecurity, Impacts of Industry 4.0, Industrial Internet Systems, Industrial Sensing, Industrial Process.

Unit – 3- IIoT Technologies

Business Model of IIoT, Reference Architecture of IIoT, Off-site Technologies – cloud computing & Fog Computing, On-site Technologies –Augmented Reality, Virtual Reality, Big Data & Advance Analytics, Smart factories.

Unit -4 Sensors, Actuators & Data Transmission

Sensors – Thermal, Mechanical, Electrical, optical; Actuators – Thermal, Hydraulic, Electromechanical; Industrial Data Transmission – Profibus, Modbus, CAN, NB-IoT, IEEE 802.11AH.

Unit – 5 Case Studies

Introduction, Manufacturing Industry; Automotive Industry; Mining Industry.

Textbooks:

1. SudipMisra, Chandana Roy, Anandarup Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0”.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”.

References:

1. Antonio Capasso, GiacomoVeneri, "Hands-On Industrial Internet of Things", Packt Publishing.
2. Chen, Fulong, Luo, Yonglong, “Industrial IoT Technologies and Applications”, LNICST Series.

Sem.	Modern Satellite Communication (Job Oriented Elective)	Course Code V20ECTJOC04	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Describe the basic concepts and orbit mechanics of satellite communication. **[K2]**

CO2: Discuss the major subsystems of a satellite and satellite link design. **[K2]**

CO3: Describe the various sub-systems used in Earth stations and the different orbits. **[K2]**

CO4: Illustrate the various multiple access techniques. **[K2]**

CO5: Explain the Special purpose communication satellites and Global Positioning System. **[K2]**

UNIT I

INTRODUCTION: Origin of Satellite Communications, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

ORBITAL MECHANICS : Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbital effects in communication systems performance. Advanced payload systems and launch vehicles.

UNIT II

SATELLITE SUB SYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna.

SATELLITE LINK DESIGN: General Link equation, system noise temperature and G/T ratio, Design of down links, up link design.

UNIT III

EARTH STATION TECHNOLOGY: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Advanced ground sub systems.

LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations. Very high throughput satellites, Operational NGSO constellation Designs.

UNIT IV

Frequency division multiple access (FDMA), Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure. Satellite Switched TDMA Onboard processing, Code Division Multiple access (CDMA),Spread spectrum transmission and reception.

UNIT V

Special Purpose Satellites: Earth observation satellite,Satellite Television,Direct Broadcast Satellite-TV receiver, Very Small Aperture Terminal(VSAT),Mobile Communication Satellite system(MSAT), Search and Rescue satellites(SARSAT),GPS Systems, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, Differential GPS. Satellite Internet of Things.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.

2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.

2. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004

Sem.	Wireless Sensors And Networks (Job Oriented Elective)	Course Code: V20ECTJOC05	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Explain the concepts of Wireless Sensor Networks, it's Architecture. **[K2]**

CO2: Describe the Networking Technologies. **[K2]**

CO3: Explain the MAC Protocols. **[K2]**

CO4: Illustrate the Routing and Transport Layer Protocols. **[K2]**

CO5: Explain the Security Layer Protocols and Applications of WSN. **[K2]**

UNIT I - Overview of Wireless Sensor Networks:
Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints and challenges, Driving Applications, Enabling Technologies for Wireless Sensor Networks.Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, OperatingSystems and Execution Environments, Network Architecture -Sensor Network Scenarios, Gateway Concepts.

UNIT II - Networking Technologies:
Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hiddennode and exposed node problem, Topologies of PANs, MANETs, WANETs.

UNIT-III - MAC Protocols for Wireless Sensor Networks:
Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols - Contention - Based Protocols, with reservation Mechanisms, and with Scheduling Mechanisms.

UNIT-IV–Routing and Transport Layer Protocols:
Routing Protocols:, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks,Classification of Routing Protocols, Table–Driven Routing Protocols, On – Demand Routing Protocols.

Transport Layer Protocols: Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks.

UNIT- V - Security, Platforms & Applications:
Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning; Sensor Node Hardware – Berkeley Motes, Programming Challenges; Applications - Home Automation, Smart Metering.

TEXT BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Adhoc and Sensor Networks: Protocols, Performance and Control, JagannathanSarangapani, CRC Press.
3. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

REFERENCES:

1. Wireless Sensor Networks- Technology, Protocols, and Applications, KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007.
2. Wireless Sensor Networks- An Information Processing Approach,Feng Zhao & Leonidas J. Guibas, Elsevier, 2007.
3. Adhoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh,1st Ed., PearsonEducation.
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.
5. Wireless Sensor Networks – S Anandamurugan, Lakshmi Publications.

Sem.	Digital Signal Processors and Applications (Job Oriented Elective)	Course Code: V20ECTJOC06	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe the concepts of digital signal processing. **(K2)**
CO-2: Explain architectures used in programmable DSP's.**(K2)**
CO-3: Illustrate addressing modes and memory organization of TMS32OC54xx processor**. (K3)**
CO-4: Describe the Instruction set, peripheral devices and programming techniques**. (K2)**
CO-5: Illustrate the applications of DSP processor (**K3)**

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING:
A Digital Signal Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation, Number Formats for Signals and coefficients in DSP Systems.

UNIT II ARCHITECTURES FOR PROGRAMMABLE DIGITAL SIGNAL-PROCESSORS:
Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.

UNIT IIIPROGRAMMABLE DIGITAL SIGNAL PROCESSORS:
Commercial digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx, Memory Space of TMS32OC54xx Processors, Program Control.

UNIT IVINSTRUCTION SET AND PROGRAMMING: TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts, Pipeline Operation of TMS32OC54xx Processor.

UNIT V INTERFACING AND APPLICATIONS OF DSP PROCESSOR:
Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.

TEXT BOOKS:

1. Digital Signal Processing, Avatar Singh and S. Srinivasan, Thomson Learning, 2004.
2. Digital Signal Processing, Principles, Algorithms, and Applications by John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
3. Discrete Time Signal Processing by A.V.Oppenheim and R.W. Schaffer, PHI

Reference Books:

1. Digital Signal Processing by Andreas Antoniou, TATA McGraw Hill , 2006
2. Digital Signal Processing by MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.

Sem.	Modern Wireless Communication Systems (Job Oriented Elective)	Course Code: V20ECTJOC07	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe how to measure the performance of wireless system, in multipath Environment **[K2]**

CO2: Summarize about Wireless Channel. **[K2]**

CO3: Explain Principle and properties of CDMA. **[K2]**

CO4: Discuss the working and advantages of MIMO wireless communication systems **[K2]**

CO5: Explain the principle and advantages of OFDM system and various modern wireless communication technologies **[K2]**

Unit I: Introduction to Wireless Systems: Evolution of Wireless Communication Technologies, Modeling Wireless Channel, Wireless Fading Channel Model, Fading Channel Distribution , Rayleigh Fading Channel, Bit Error Rate (BER) Performance, Bit Error Rate (BER) of AWGN Channels.

Unit II: Performance in Fading wireless channels: Bit Error Rate of Rayleigh Fading Wireless Channel, Exact BER Expression for Rayleigh Fading Wireless Channel, Deep Fade Analysis of Wireless Communication, Principle of Diversity, Multiple Antenna Diversity, BER of Multiple Antenna Wireless Systems.

Wireless Channel Characterization : Delay Spread and Doppler,RMS Delay Spread, Delay Spread and Inter Symbol Interference, Coherence Bandwidth of Wireless Channel,Impact of Doppler Effect on Wireless Channel

Unit III: Principles of CDMA Wireless Communication: Introduction to Code Division Multiple Access (CDMA),Chip Time and Bandwidth Expansion in CDMA, Code Generation for CDMA,CDMA Codes: Properties of PN Sequences, BER of CDMA Systems

Unit IV: Principles of CDMA and MIMO Wireless Communication: Analysis of Multi-user CDMA, Multipath Diversity in CDMA Systems, Near-Far Problem in CDMA, Multiple Input Multiple Output (MIMO) Systems, Examples of MIMO Systems, MIMO Receivers, BER Performance of ZF Receiver, Alamouti Code and Space-Time Block Codes, BER of Alamouti Coded System, Singular Value Decomposition (SVD), SVD in MIMO

Unit V: Principles of OFDM Wireless Communication: Capacity of MIMO Wireless Systems, SVD based MIMO Transmission, Orthogonal Frequency Division Multiplexing (OFDM), Transmission in Multicarrier Systems, FFT/IFFT Processing in OFDM, Cyclic Prefix in OFDM Systems, Schematic Representation of OFDM Transmitter and Receiver, BER Performance of OFDM Systems.

Text Books:

1. Aditya K. Jagannatham, ―Principle of Modern Wireless Communication Systems: Theory and practice‖ 1st Edition, McGrawHill Publication
2. Theodore S. Rappaport, ―Wireless Communications: Principles and Practice‖ Second Edition, Pearson Education

Reference Books:

1. Simon Haykin, MichaleMoher, ―Modern Wireless Communications‖, Pearson.

2. Xiaodong Wang, H. Vincent Poor, ―Wireless Communication Systems: Advanced Techniques for Signal Reception.

Sem.	CMOS Analog IC Design (Job Oriented Elective)	Course Code: V20ECTJOC08	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe the concept of MOS device and modeling of MOS drain current for large and small signal analysis **(K2)**
CO-2: Design and analyze Analog CMOS Sub-Circuits **(K4)**
CO-3: Describe the large signal and small signal analysis of Inverters & differential amplifier **(K2)**
CO-4: Describe the large signal and small signal analysis of cascade amplifier & Current Amplifiers **(K2)**
CO-5: Illustrate the CMOS output Amplifiers **(K3)**

UNIT -I: MOS Devices and Modeling: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT -II: Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors Cascade current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT -III: CMOS Amplifiers-I: Inverters- Active load inverter, current source inverter, push-pull inverter, Differential Amplifiers- large signal analysis, small signal analysis, design of differential amplifier,

UNIT -IV: CMOS Amplifiers-II: Cascode Amplifiers- Large signal analysis, small signal analysis and frequency response, design of cascade amplifier, Current Amplifiers- single ended input current amplifier, differential input current amplifier,

UNIT-V: Output Amplifiers: class-a amplifier, source follower, push pull CS amplifier, High Gain Amplifiers Architectures.

TEXT BOOKS:

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.

REFERENCE BOOKS:

1. Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn, 2016.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewisand R. G. Meyer, Wiley India, Fifth Edition, 2010.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI

Sem.	Bio Medical Instrumentation (Job Oriented Elective)	Course Code: V20ECTJOC09	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Explain the basics concepts of Bio-Medical Instrumentation **(K2)**
CO2: Explain the concepts of electrode theory, classification of Electrodes and Transducers used in Bio-Medical Applications **(K2)**
CO3: Explain the Anatomy and Physiology of Cardiovascular system and Illustrate the application of Bio-Medical Instruments to measure the Physiological parameters of Cardiovascular System **(K2)**
CO4: Discuss the processing methods in elements used for Patient's Health care & monitoring.
CO5: Classify different types of monitors, discuss the principals of recorders and Illustrate the methods of accident preventions i.e. Shock Hazards from different Electrical Equipment. **(K2)**

UNIT-I:

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION: Age of Biomedical Engineering, Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body, Problems Encountered in Measuring a Living System, Sources of Bioelectric Potentials, Muscle, Bioelectric Potentials, Sources of Bioelectric Potentials, Resting and ActionPotentials,BioelectricPotentials-ECG,EEGandEMG,EnvokedResponses.

UNIT-II:

ELECTRODES AND TRANSDUCERS: Introduction, Electrode Theory, Bio potential Electrodes, Examples of Electrodes, Basic Transducer Principles ,The Transducer and Transduction Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications, Pulse Sensors, Respiration Sensor, Transducers with Digital Output.

UNIT-III:

CARDIOVASCULAR SYSTEM AND MEASUREMENTS: The Heart and Cardiovascular System, Electro Cardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart Sounds, Plethysmography.
MEASUREMENTS IN THE RESPIRATORYSYSTEM: The Physiology of The Respiratory System, Tests and Instrumentation for the Mechanics of Breathing, Respiratory Therapy Equipment.

UNIT-IV:

PATIENT CARE AND MONITORING: Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring Equipment, Other Instrumentation for Monitoring Patients, Organization of the Hospital for Patient-Care Monitoring, Pacemakers, Defibrillators.

UNIT-V:

MONITORS, RECORDERS AND SHOCK HAZARDS: Bio potential Amplifiers, Monitors, Recorders, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Isolated Power Distribution System.

Text Books:

1. "Bio-Medical Electronics and Instrumentation", Onkar N. Pandey, Rakesh Kumar, Katson Books.
2. "Bio-Medical Instrumentation", Cromewell, Wiebell, Pfeiffer

References:

1. "Hand Book of Bio-Medical Instrumentation", Khandapur. McGrawHill
2. "Introduction to Bio-Medical Equipment Technology", 4thEdition, Joseph J.Carr, John M.Brown, Pearson Publications.

Sem.	SPEECH SIGNAL PROCESSING (Job Oriented Elective)	Course Code: V20ECTJOC10	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO 1 Outline the basic characteristics of speech signal in relation to speech production and model the speech production system.(**K2)**
CO 2 List different speech parameters. **(K2)**
CO 3 Apply various algorithms for speech enhancement and speech coding. **(K3)**
CO 4 Design a simple system for speech recognition. **(K3)**
CO 5 Make use of different Speaker Recognition Techniques. **(K3)**

UNIT I Speech Production: Speech signal; Speech Production process: Lungs, Larynx and Vocal folds, Vocal tract; Acoustic Phonetics: Vowels, Diphthongs, Semi vowels, Nasals, Unvoiced fricatives, Voiced fricatives, Voiced and unvoiced stops; Acoustic theory of speech production; Digital models for speech signals.

UNIT II Speech Analysis: Time-Dependent processing of speech; Short-Time energy and average magnitude; Speech vs. Silence discrimination using energy and zero crossings; Short-Time autocorrelation; Short-Time average magnitude difference function; Pitch period estimation using autocorrelation function; Linear Predictive Coding (LPC) Analysis; Cepstral Analysis.

UNIT III Speech Enhancement: Nature of Interfering Sounds; Speech Enhancement (SE) Techniques: Basic principles of Spectral Subtraction; Wiener Filtering; Wiener filtering for noise reduction; Statistical-Model-based method: Maximum-likelihood estimator for speech enhancement; Applications of speech enhancement.

UNIT IV Speech Coding: Quantization; Speech redundancies; Time-Domain waveform coding: Basic Time-Adaptive Waveform Coding, Exploiting Properties of the Spectral Envelope; Linear predictive coding (LPC)-based coders: Adaptive delta modulation, Adaptive differential pulse code modulation, Code-excited linear prediction;

UNIT V Automatic Speech and Speaker Recognition: Introduction: ASR Search, Variability in Speech Signals, Speech recognition approaches - using HMMs and Deep Neural Networks, Speaker recognition using GMMs, I-Vector and Deep Learning

Text books:

1. Douglas O Shaughnessy, “Speech Communications Human and Machine” 2 nd Edition, IEEE Press, 2000.
2. Dr Shaila D Apte, “ Speech and Audio Processing , Wiley India, 1ST Edition 2012

Reference Books:

1. Philipos C. Loizou, “Speech Enhancement” 2 ndEdition, CRC Press, Taylor & Francis Group, 2013
2. Thomas F. Quatieri, “Discrete -Time Speech Signal Processing: Principles and Practice”, Pearson Education, 2002

Sem.	Electronic Instrumentation (Job Oriented Elective)	Course Code: V20ECTJOC11	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1. Select the instrument to be used based on the requirements**.[K2]**
CO2. Understand the design of oscilloscopes for different applications**.[K2]**
CO3. Explain different signal generators and analyzers**.[K2]**
CO4. Understand the design of different types of Bridge circuits for different Applications.**[K2]**
CO5. Explain and Design different types of transducers for different Applications and for measurement of Physical Parameters.**[K2]**

UNIT-I

Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters-Multi-range, Range extension/Solid state and differential voltmeters, AC voltmeters-multi
range, range extension, shunt. Thermocouple type RF ammeter, Ohmmeters series type, and shunt type, Multi-meter for Voltage, Current and resistance measurements.

UNIT-II

Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO, Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope, Lissajous method of frequency measurement.

UNIT-III

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

UNIT-IV

DC Bridges: Measurement of Resistance-Wheatstone's Bridge, Kelvin's Bridge. AC Bridges: Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson Bridge. Measurement of capacitance-Schering's Bridge. Measurement of Frequency-Wien Bridge, Errors and precautions in using bridges.

UNIT-V

Transducers- active & passive transducers : Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors.

Measurement of physical parameters- Force, Pressure, Velocity, Humidity, Moisture. Data acquisition systems.

TEXTBOOKS:

1. Electronic Instrumentation, second edition -. S. Kalsi, Tata Mc Graw Hill, 2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrickand W.D.Cooper, PHI, 5th Edition,2002.

REFERENCES:

1. Electronic Instrumentation & Measurements- David A. Bell, PHI, 2nd Edition, 2003.
2. Electronic Test Instruments, Analog and Digital Measurements- Robert A. Witte, Pearson Education, 2ndEdition, 2004.
3. ElectronicMeasurements & Instrumentations by K. Lal Kishore, Pearson Education-2005.
4. Electronic Measurements & Instrumentation by Uday A.Bakshi & Ajay V. Bakshi Technical Publications.

Sem.	Sensors & Applications (Job Oriented Elective)	Course Code: V20ECTJOC12	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe the sensors and theory behind **[K2]**
CO2: Explain the Sensors used in mechanical systems. **[K2]**
CO3: Explain the Thermal and electrical Sensors **[K2]**
CO4: Explain the Magnetic, Acoustic and High frequency sensors **[K2]**
CO5: Illustrate and build IoT or IIoT systems for different Use cases **[K3]**

UNIT – I

Introduction: transducer, Electrical sensor – need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors.General characteristics and specifications of sensors - Implications of specifications uses of sensors - measurement of stimuli - block diagram of sensor system. Brief description of each block.

UNIT– II

Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, anemometers, piezo electric, accelerometers, potentiometric sensors, LVDT.

UNIT– III

Thermal sensors – temperature – temperature difference – heat quantity. Thermometers for different situation – thermocouples thermistors – colorpyrometry.Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor, CCD, CMOS sensors.

Electrical sensors: conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors.

UNIT – IV

Magnetic sensors: magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids.

Acoustic or sonic sensors: Intensity of sound, frequency of sound in various media, various forms of microphones, piezo electric sensors.

High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors.

UNIT – V

Applications in IoT: Smart Cities and AgricultureApplications in IIoT: Manufacturing and Automotive Industries.

Textbooks:

1. Henry Bolte, “Sensors – A Comprehensive Sensors”, John Wiley
2. Doebelin, “Measurement Systems: Application and Design”, McGraw Hill.

References:

1. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim “Microsensors, MEMS and Smart Devices”, New York: Wiley
2. KouroshKalantar – Zadeh, Benjamin Fry, “Nanotechnology- Enabled Sensors”, Springer
3. Ramon Pallas-Areny, John G. Webster, “Sensors and signal conditioning” John Wiley & Sons.

Sem.	Deep Learning (Job Oriented Elective)	Course Code: V20ECTJOC13	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Describe the basics of learning algorithms. **(K2)**
CO2: Explain neural network and various parameters while training neural network. **(K2)**
CO3: Describe convolution neural network and its training. **(K2)**
CO4: Discuss various advanced neural network architectures. **(K2)**
CO5: Discuss various Deep Learning applications. **(K2)**

Unit-I

Introduction:

Introduction to Deep Learning, Bayesian Learning, Optimization Techniques, Gradient Descent, Batch Optimization. Bias and Variance, Maximum Likelihood Estimation,Supervised Learning Algorithms, Unsupervised Learning Algorithms.

Unit-II

Neural Networks

The Basic Architecture of Neural Networks- Single Computational Layer: The Perceptron, Multilayer Neural Networks; Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training-The Problem of Overfitting, The Vanishing and Exploding Gradient Problems, Unsupervised Learning with Deep Network, Autoencoders.

Unit-III

Convolution neural network and training

Introduction, The Basic Structure of a Convolutional Network- Padding, Strides, Typical Settings, The ReLU Layer, Pooling, Fully Connected Layers, The Interleaving Between Layers, **,** Transfer Learning

Gradient Descent, Momentum Optimizer, RMSProp, Adam , Transfer Learning ,Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

Unit-IV

Advanced Deep Learning Architectures

Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN , LSTM Networks, Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network.

Unit-V

Deep Learning applications

Applications of Convolutional Networks: Content-Based Image Retrieval, Object Localization, Object Detection, Natural Language and Sequence Learning; Application of Recurrent Neural Networks: Application to Automatic Image Captioning, Time-Series Forecasting and Prediction, End-to-End Speech Recognition, Handwriting Recognition.

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Text Books

1. “Deep Learning”, Ian Goodfellow, Yoshua Bengio, Aaron Courville, The MIT Press, 2016.
2. ”Neural Networks and Deep Learning”,Charu C. AggarwalSpringer.

Reference Books

1. Raúl Rojas ” Neural Networks: A Systematic Introduction,,Springer.
2.Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

Sem.	Machine Learning (Job Oriented Elective)	Course Code: V20ECTJOC14	L	T	P	C
			3	0	0	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Explain the principles and concepts of machine learning **(K2)**
CO2: Describe the different machine learning approaches and techniques **(K2)**
CO3: Explain the clustering techniques used in Data representation**. (K2)**
CO4: Explain the neural network concepts **(K2)**
CO5: Describe the regression and reinforcement learning and solve ML problems using Machine learning tools **(K2)**

UNIT I

Introduction: Machine learning: What and why? , Types of Machine Learning Supervised Learning ,Unsupervised Learning , The Curse of dimensionality, Over and under fitting , Model selection , Error analysis and validation , Parametric vs. non,parametric models.

UNIT II

Machine learning Types of Machine Learning , Supervised Learning, Classification models , Naïve Bayes Classifier , Decision trees , Support Vector Machines , KNN model , Dimensionality reduction , PCA.

UNIT III

Clustering Clustering approaches , Mean Shift clustering , Clustering data points and features , Bi-clustering , Multi,view clustering , K-Means clustering , K-medians clustering , Expectation Maximization (EM).

UNIT IV

Neural Networks Neural networks , Biological motivation for Neural Network, Neural network Representation , Perceptron , Feed forward networks , Multilayer Networks and Back Propagation Algorithms , Hidden layer representation , Application of neural network.

UNIT V

Applications and Tools Linear models for regression , Reinforcement Learning , Machine Learning Tools , Engineering applications.

Text Books:

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Ethem Alpaydin, “Introduction to Machine Learning”, Second Edition, Prentice Hall of India, 2010.

Reference Books:

1. Laurene Fausett, “Fundamentals of Neural Networks, Architectures, Algorithms and Applications”, Pearson Education, 2008.
2. Tom Mitchell, “Machine Learning”, McGraw,Hill, 1997.

The institution is offering Honors degree in ECE and Minors degree in ECE (VLSI & ES) under V20 regulation.

CURRICULAR FRAMEWORK FOR HONORS DEGREE PROGRAMME

i. B.Tech. (Hons.) is introduced in order to facilitate the students to choose additionally the specialized courses and build their competence in a specialized area.

ii. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

iii. A student shall be permitted to register for Honors program at the beginning of V semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 CGPA up to the end of III semester without any history of backlogs. An CGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Honors registration active.

iv. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.

v. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160/121 credits).

vi. 20 credits shall be earned by undergoing specified courses listed as pools. The credits must be acquired by studying either in MOOCs courses under Swayam platform or conventional type will be decided by the college at the time of registration for Honors degree.

vii. MOOCs courses shall be domain specific with a minimum duration of 8/12 weeks as recommended by the Head of the department concerned.

viii. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.

ix. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the academic council.

x. The concerned BOS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

xi. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a **"pass (P)"** grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

xii. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiii. Switching from honors degree to minor degree is not permitted.

xiv. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned Bachelor's Degree.

Course Structure for Honors Degree in ECE:

S. No	Name of the Course	Credits
1	NPTEL online course of Relevance (8/ 12 weeks)	3
2	NPTEL online course of Relevance (8/ 12 weeks)	3
3	NPTEL online course of Relevance (8/ 12 weeks)	3
4	NPTEL online course of Relevance (8/ 12 weeks)	3
5	NPTEL online course of Relevance (8/ 12 weeks)	3
6	NPTEL online course of Relevance (8/ 12 weeks)	3
7	Mini Project	2
	Total Credits	**20**

Honors (For ECE) Students:

Track-I : Communication & Signal Processing

1. Modern Digital Communication Techniques
2. Communication for 5G and Beyond
3. Modern CDMA/ MIMO/ OFDM Wireless Communications
4. Signal Processing Techniques And Its Applications
5. Broadband Networks: Concepts And Technology
6. Bio medical Image Processing
7. Cognitive Radio

Track-II : VLSI & Embedded Systems

1. Analog & Mixed Signal ICs
2. ASIC Design
3. C- Based VLSI Design
4. Fabrication Techniques for MEMS Based Sensors
5. Embedded System Design with ARM
6. MEMS & Micro Systems
7. EMC in Design

NOTE : List of Courses will be updated in every semester as per the courses offered by NPTEL.

CURRICULAR FRAMEWORK FOR MINOR DEGREE PROGRAMME:

i. a) Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects courses from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

ii. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE,CE,ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.

iii. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.

iv. There shall be no limit on the number of programs offered under Minor. The Institute can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

vi. A student shall be permitted to register for Minors program at the beginning of V semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 7.75 CGPA up to the end of III semester without any history of backlogs. An CGPA of 7.75 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

v. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160/121 credits).

vi. 20 credits shall be earned by undergoing specified courses listed as pools. The credits must be acquired by studying either in MOOCs courses under Swayam platform or conventional type will be decided by the college at the time of registration for Honors degree.

vii. MOOCs courses shall be domain specific with a minimum duration of 8/12 weeks as recommended by the Head of the department concerned.

viii. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.

ix. MOOCs courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the academic council.

x. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

xi. A committee shall be formed at the level of College/department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

xii. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a **"pass (P)"** grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

xiii. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiv. Switching from minor degree to honor degree is not permitted. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned Bachelor's Degree.

Course Structure for Minors in ECE (VLSI & ES) Degree for all other Branch Students

S. No	Name of the Course	Mode of Learning	No. of Weeks	Credits
1	Introduction to Semi Conductor Devices	NPTEL	12 weeks	3
2	Semiconductor Devices and Circuits	NPTEL	12 weeks	3
3	Digital Circuits	NPTEL	12 weeks	3
4	Digital IC Design	Conventional Teaching	8 weeks	2
5	Basics of VLSI Design	Conventional Teaching	12 weeks	3
6	System design through Verilog	NPTEL	8 weeks	2
7	CMOS Analog VLSI Design	Conventional Teaching	12 weeks	3
8	Introduction to Internet of Things	NPTEL	12 weeks	3
9	Microprocessors & Micro Controllers	NPTEL	8 weeks	2
10	Concepts of Embedded Systems	Conventional Teaching	8 weeks	2
11	Embedded system Design with ARM	NPTEL	8 weeks	2
12	Project work		16 weeks	4

Note: While registering for the course, the student have to take the approval from the department. Above list of courses is tentative.

Total Credits : 20

(16 Credits from the above list of courses + 4 Credits from Project work)

Annexure-04

Open Elective Courses

(V20 Regulation)

List of Open Elective Courses

Courses offfered to Other Branch Students

S. No	Course Code	Name of the Course	Department Offered
1	V20ECTOE01	Internet of Things	Electronics & Communication Engineering
2	V20ECTOE02	Communication Systems	
3	V20ECTOE03	Principles of Image Processing	
4	V20ECTOE04	Medical Electronics	
5	V20ECTOE05	Principles of Wireless Comm.	
6	V20ECTOE06	Basics of VLSI Design	
7	V20ECTOE07	Concepts of Embedded Systems	

Sem.	Internet of Things (Open Elective)	Course Code: V20ECTOE01	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe M2M and IOT Technologies. **(K2)**

CO-2: Identify the layers and protocols in IOT. **(K2)**

CO-3: Describe various communication technologies used in IOT**. (K2)**

CO-4: Demonstrate various hardware components required for IOT applications. **(K2)**

CO-5: Identify the cloud technologies & explain the applications of IoT**. (K2**)

UNIT I – INTRODUCTION

Introduction from M2M to IoT - An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, M2M and IoT Technology Fundamentals - Devices and gateways

UNIT II – IOT PROTOCOLS

Functionality of Layers in IoT –Study of protocols - Wireless HART, Z-Wave, 6LoWPAN, RPL, CoAP, MQTT.

UNIT III - COMMUNICATION TECHNOLOGIES IN IOT

IoT Connectivity – IEEE 802.15.4, Wi-Fi, Bluetooth, Zigbee, LPWAN, 5G Era.

UNIT IV - SYSTEM HARDWARE

Sensors, Actuators, Radio Frequency Identification, Introduction to Embedded Devices for IoT - RASPBERRY PI.

UNIT V – Cloud Computing & Case Studies

Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/Services. Real-time applications of IoT - Smart and Connected Cities, Agriculture.

TEXTBOOKS:

1. "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence" Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle , 1st Edition, Academic Press, 2014.
2. IOT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Cisco Press 800 East 96th Street Indianapolis, USA.
3. "Internet of Things (A Hands-on- Approach)", Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014.

REFERENCE BOOKS:

1. From Internet of Things to Smart Cities: Enabling Technologies - edited by Hongjian Sun, Chao Wang, Bashar I. Ahmad, CRC Press -2018.
2. “Architecting the Internet of Things”, Bernd Scholz-Reiter, Florian Michahelles, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT, David Etter.

Sem.	Communication Systems (Open Elective)	Course Code: V20ECTOE02	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Demonstrate the fundamentals of communication systems **(K2)**
CO-2: Compare the various analog modulation and demodulation schemes **(K2)**
CO-3: Compare the various digital modulation and demodulation schemes **(K2)**
CO-4: Explain the wireless communication system concepts **(K2)**
CO-5: Outline the satellite & Optical communication system principles **(K2)**

Unit-I

Fundamentals of Communication systems: Block diagram of communication system; types of communications-analog and digital; Noise–types of noise, sources of noise, and noise figure.

Unit-II

Fundamentals of Analog Communication: Need for modulation; Types of analog modulation techniques (AM, FM & PM). Sampling theorem, Nyquist criteria, introduction to PAM, PWM and PPM.

Unit-III

Fundamentals of Digital Communication: Advantages; Working principle of PCM; introduction to digital modulation techniques-ASK, FSK, &PSK.

UNIT-IV:

Fundamentals of Wireless Communication: Evolution of mobile communications, Mobile Radio System around the world, Comparison of Common wireless system, Concepts of 1G, 2G, 3G, 4G. , Introduction to 5G.

Unit-V

Fundamentals of Satellite & Optical communication: Brief history of Satellite systems; Principles, architecture. Fundamentals of Optical Communication: Evolution of fiber optic system, Elements of an Optical Fiber Transmission link and Reception link.

Textbooks:

1. Principles of Communications by H. Taub and D. Schilling, TMH, 2003.
2. Wireless Networks: Applications and Protocols by T. S. Rappaport, Pearson Education
3. Satellite Communications by Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
4. Optical Fiber Communication by Gerd Kaiser (TMH)

References:

1. Electronic Communication Systems by Kennedy and Davis, TMH, 4th edition, 2004.
2. Wireless Communication and Networks: 3G and Beyond by I. SahaMisra, TMH Education.
3. Satellite Communications: Design Principles by M. Richharia, B S publications, 2nd Edition, 2003.

Sem.	Principles of Image Processing (Open Elective)	Course Code: V20ECTOE03	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1. Understand the different Transforms Techniques & their use in Image Processing Applications. **(K2)**
CO2. Describe Spatial and frequency domain filtering like smoothing and sharpening operations on Images. **(K2)**
CO3. Describe Restoration operations/techniques on Images. **(K2)**
CO4. Describe the Image compression Techniques and Image segmentation. **(K2)**
CO5. Explain the different color Image Processing Techniques. **(K2)**

UNIT-1 Introduction
Introduction: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing.
Image Transforms: Discrete Fourier transform (DFT) and Discrete Cosine transform.

UNIT-2 Image Enhancement Techniques
Intensity Transformations and Spatial Filtering: Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters and sharpening spatial filters.
Filtering in the Frequency Domain:image smoothing using frequency domain filters, Image Sharpening using frequency domain filters.

UNIT-3 Image Restoration
Image Restoration : A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering. Estimating the image degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

UNIT-4 Image compression and Segmentation
Image compression: Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, LZW coding **a**nd subband coding.
Image segmentation: Fundamentals, point, line, edge detection, thresholding, based segmentation and simple morphological operations :Erosion and dilation, opening and closing

UNIT-5 Color image processing
Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening.

Text Books

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw Hill Education, 2011.

Reference Books

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Sem.	Medical Electronics (Open Elective)	Course Code: V20ECTOE04	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Explain the basics concepts of Bio-Medical Instrumentation. **(K2)**
CO2: Explain the concepts of electrode theory, classification of Electrodes and Transducers used in Bio-Medical Applications. **(K2)**
CO3: Explain the Anatomy and Physiology of Cardiovascular system and Illustrate the application of Bio-Medical Instruments to measure the Physiological parameters of Cardiovascular System **(K2)**
CO4: Discuss the elements used for Patient's Health care &monitoring. **(K2)**
CO5: Classify different types of monitors, discuss the principals of recorders and Illustrate the methods of accident preventions **(K2)**

UNIT-I:

INTRODUCTIONTOBIOMEDICALINSTRUMENTATION: AgeofBiomedicalEngineering,Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body, Problems Encountered in Measuring a Living System, Sources of Bioelectric Potentials, Muscle, Bioelectric Potentials, Sources of Bioelectric Potentials, Resting and Action Potentials, Bioelectric Potentials-ECG, EEG and EMG,

UNIT-II:

ELECTRODES AND TRANSDUCERS: Introduction, Electrode Theory, Bio potential Electrodes, Examples of Electrodes, Basic Transducer Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications, Pulse Sensors, Respiration Sensor, Transducers with Digital Output.

UNIT-III:

CARDIOVASCULAR SYSTEM AND MEASUREMENTS: The Heart and Cardiovascular System, Electrocardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart Sounds, Plethysmography.

UNIT-IV:

PATIENTCAREANDMONITORING: ElementsofIntensive-CareMonitoring,PatientMonitoringDisplays, Diagnosis, Calibration and Repair ability of Patient-Monitoring Equipment, Other Instrumentation for Monitoring Patients, Organization of the Hospital for Patient-Care Monitoring, Pacemakers, Defibrillators.

UNIT-V:

DIAGNOSTIC TECHNIQUES AND BIO-TELEMETRY: Principles of Ultrasonic Measurement, Ultrasonic Imaging, Ultrasonic Applications of Therapeutic Uses, Ultrasonic Diagnosis, X-Rayand Radio-Isotope Instrumentations, CAT Scan, Emission Computerized Tomography, MRI, Introduction to Biotelemetry, Physiological Parameters Adaptable to Biotelemetry, The Components of Biotelemetry System, Implantable Units, Telemetry for ECG Measurements during Exercise, Telemetry for Emergency Patient Monitoring

Text Books:

1. Bio-Medical Electronics and Instrumentation, OnkarN.Pandey, RakeshKumar, KatsonBooks.
2. Bio-Medical Instrumentation, Cromewell, Wiebell, Pfeiffer

References:

1. "Hand Book of Bio-Medical Instrumentation", Khandapur. McGrawHill
2. "Introduction to Bio- Medical Equipment Technology", 4th Edition, Joseph J.Carr, John M.Brown, Pearson Publications.

Sem.	Principles of Wireless Communication (Open Elective)	Course Code: V20ECTOE05	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1: Discuss the cellular system evolution of mobile radio systems **[K2]**
CO2: Illustrate the basic cellular concepts. **[K2]**
CO3: Explain the Various Propagation models. **[K2]**
CO4: Discuss the need of modulation, diversity and equalization in cellular & Mobile Communication. **[K2]**
CO5: Demonstrate the knowledge about GSM architecture, &upcoming technologies like 3G, 4G etc. **[K2]**

UNIT-I: Introduction of Wireless Communication History and evolution of mobile radio systems: Types of mobile wireless services/systems, WLL, Paging, Satellite systems.

UNIT-II: Cellular Concepts and System Design Fundamentals: Cellular concept and frequency reuse, channel assignment, handoff strategies, cell splitting,cell sectoring.

UNIT-III: Mobile radio Propagation Models: Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading.

UNIT-IV: Overview analog and digital modulation techniques Need For Modulation.

UNIT-V: Digital cellular networks: GSM architecture, GSM Services, multiple access schemes; FDMA, TDMA, CDMA, OFDMA;

Higher Generation Cellular Standards: 3G System architecture (UMTS), 4G System Architecture, Introduction to 5G.

Text Books

1. Theodore S. Rappaport, ―wireless communications Principles and Practices‖, PHI, 2005
2. Jochen Schiller, ―Mobile Communications‖, Pearson Education, second edition, 2009.

Reference Book

1. Lee W.C.Y, ―Mobile communication Engineering
2. Theory and Applications‖ , 2/e McGraw-Hill,New York, 2003
3. Andreas F. Molisch, ―Wideband Wireless Digital Communication‖ , Pearson Education 2001.

Sem.	Basic of VLSI Design (Open Elective)	Course Code: V20ECTOE06	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO1. Identify the CMOS layout levels, and the design layers used in the process sequence. **(K2)**
CO2. Describe the general steps required for processing of CMOS integrated circuits. **(K2)**
CO3. Outline static CMOS combinational and sequential logic at the transistor level. **(K1)**
CO4. Demonstrate different logic styles such as complementary CMOS logic, pass-Transistor Logic, dynamic logic, etc. **(K3)**
CO5. Interpret the need for testability and testing methods in VLSI. **(K3)**

UNIT-I:

Moore's law, speed power performance, n-MOS fabrication, CMOS fabrication: n-well, well processes, Bi-CMOS, Comparison of bipolar and CMOS. Basic Electrical Properties of MOS And Bi-CMOS Circuits: Drain to source current versus voltage characteristics, threshold voltage, trans conductance.

UNIT-II:

Basic Electrical Properties of MOS And Bi-CMOS Circuits: n-MOS inverter, Determination of pull up to pull down ratio: n-MOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, Bi-CMOS inverters, latch up.
Basic Circuit Concepts: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, super buffers, Bi-CMOS drivers.

UNIT-III:

MOS and Bi-CMOS Circuit Design Processes: MOS layers, stick diagrams, n-MOS design style, CMOS design style Design rules and layout & Scaling of MOS Circuits: λ - based design rules, scaling factors for device parameters

UNIT-IV:

Subsystem Design and Layout-1: Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo n-MOS, Dynamic CMOS Examples of structured design: Parity generator, Bus arbitration, multiplexers, logic function block, code converter.

UNIT-V:

Subsystem Design and Layout-2: Clocked sequential circuits, dynamic shift registers, bus lines, General considerations, 4-bit arithmetic processes, 4-bit shifter, Regularity-Definition & Computation Practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

Text Books:

1. “Basic VLSI Design”, Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.

References:

1. “CMOS Digital Integrated Circuits, Analysis And Design”, Sung – Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw Hill, 3rd Edition, 2003.
2. “VLSI Technology”, S.M. Sze, 2nd edition, Tata McGraw Hill, 2003.

Sem.	Concepts of Embedded Systems (Open Elective)	Course Code: V20ECTOE07	L	T	P	C
			2	0	2	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Describe the Basic Concepts of embedded systems- **(K2).**
CO-2: Describe the characteristics of Application & Domain-Specific Embedded Systems - **(K2)**
CO-3: Explain the various elements of embedded hardware and their design principles- **(K2)**
CO-4: Explain various software design approaches in embedded environment- **(K2)**
CO-5: Discuss various tools used for Embedded system implementation and testing - **(K2)**

UNIT I - INTRODUCTION TO EMBEDDED SYSTEMS:

Introduction to Embedded Systems, Classification of Embedded systems, Major application areas of embedded systems, Purpose of embedded Systems, The Typical embedded system - core of the embedded system, Difference between RISC and CISC, Types of Memories.

UNIT II - CHARACTERISTICS OF EMBEDDED SYSTEM:

Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT III - EMBEDDED HARDWARE DESIGN:

Analog Electronic Components, Digital electronic components, I/O types and examples, Serial communication devices (I2C, SPI, USB), GPRS, Watchdog timer, Real time Clock,Sensors and Actuators.

UNIT IV - EMBEDDED FIRMWARE DESIGN:

Embedded Firmware design approaches, Embedded Firmware development languages: Assembly level and High-level Programming Language, Advantages and Drawbacks of development languages, Concepts of C versus Embedded C and Compiler versusCross-compiler.

UNIT V - EMBEDDED SYSTEM IMPLEMENTATION AND TESTING:

The main software utility tools - IDE and CAD, Translation tools - Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

Text Books:

1. Embedded Systems Architecture- By Tammy Noergaard, ElsevierPublications,2013
2. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited,2013.

References:

1. Embedded Systems: Architecture, Programming and Design by Raj Kamal, Tata McGraw-Hill Education, 2011.
2. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications,2013.
3. Embedded/Real Time Systems by KVKK Prasad by Dreamtech Publication

V Sem.	Hardware Modelling using Verilog	Course Code	L	T	P	C
		V20HONECT02	3	-	-	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1: Describe VLSI design flow and standard cell based design. **[K2]**

CO2: Discuss various concepts of verilog, Simulation and Synthesis. **[K2]**

CO3: Develop digital systems using various modelling styles. **[K3]**

CO4: Synthesize Combinational and Sequential circuits. **[K6]**

CO5: Construct Memories and Processors using Verilog. **[K3]**

Unit 1: VLSI Design Process

Introduction to IC Technologies, Moore's law, VLSI design flow, Needfor CAD tools,HDLs, design representation, Y (wye) diagram, physical design, design style, FPGA, look up table, FPGA design flow, Gate Array

Standard Cell based Design: Characteristic of the Cells, Standard cell example, Floor plan for standard cell Design, Standard cell Layout, Full Custom Design.

Unit 2: Verilog Concepts and Conventions

Need of Verilog, Module, Simulation, Synthesis, Test Bench, Concepts of Verilog: Module, Data Types, Data Values and Signal Strengths, Scalars and Vectors, Multidimensional Arrays and Memories, Constants, Parameters. Some Recommended Practices: Naming Conventions, Comments, Coding Style, Module Partitioning, General Coding Techniques, General Guidelines for Synthesis.

Unit 3: Modelling Concepts

Switch Level Modelling: Introduction, Various Switch Primitives in Verilog, Various gate primitives in switch level, Strengths, Predefined Logic Gates in Verilog, The timescale directive, Specifying connectivity during Instantiation, Hardware Modelling Issues.

Behavioural representation, Structural representation, Physical representation with examples, Operators, Verilog modelling examples, Assignment statements : Continuous and Procedural Assignments, Blocking and Non – Blocking Assignments, Verilog Test bench, The Simulator Directives.

Unit 4: Modelling Combinational and Sequential Circuits

User Defined Primitives(UDP), Rules, Guidelines, Modelling Combinational Circuits, Modelling Sequential Circuits, Modelling Finite State machines: Introduction to FSM, Mealy and Moore Types, Data Path and Controller Design: Introduction, The Data Path, The Control Path, The Test bench for Data Path and Control path. **Synthesizable Verilog:**

Synthesis rules for combinational logic, Styles for synthesizable Combinational Logic : Gate Netlist, Using Continuous Assignments, Using Procedural blocking Assignments, Using Functions in Verilog, Using Tasks, Constructs to avoid for Combinational Synthesis, Synthesizable & Non – Synthesizable Verilog Constructs.

Unit 5: Memories and Processors

Guidelines to Model Memories, Initializing Memory: from a file, Single – port RAM with synchronous read / write, Single – port RAM with asynchronous read / write, A ROM / EPROM, Modelling Register Banks: Introduction, 4 × 32 Register Bank, 32 × 32 Register Bank, Basic Pipelining Concepts, Examples of Pipelining Modelling, Clocking Issue in Pipelining, Pipeline Implementation of a ProcessorMIPS32(Non – Pipelined & Pipelined), Verilog Implementation of MIPS32, Running Example Programs on the Processor.

TEXT BOOKS:

1. Design Through Verilog Hdl By T.R. Padmanabhan, B.Bala Tripura Sundari, 2008
2. Modeling, Synthesis, and Rapid Prototyping with the VERILOG (TM) HDL 1st Edition By Michael D. Ciletti

REFERENCE BOOKS:

1. Verilog HDL Synthesis, A Practical Primer By J. Bhasker · 2018
2. Verilog HDL A Guide to Digital Design and Synthesis · Volume 1 By Samir Palnitkar · 2003

V Sem.	Introduction to Semiconductor Devices	Course Code V20MINECT01	L	T	P	C
			3	-	-	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to

CO1: Explain the basic concepts of Semiconductor Physics. **(K2)**
CO2: Discuss the basic concepts of PN Junction Diode. **(K2)**
CO3: Interpret the Input & Output characteristics of BJT in different Configurations.(K2)
CO4: Explain the construction, principle of operation of J-FET Drain & Transfer characteristics.(K2)
CO5: Discuss the construction, principle of operation of Enhancement & Depletion MOSFET characteristics. (K2)

Unit 1: **Semiconductor Physics:** Semiconductors in daily life, Energy band formation, Band gap and Material classification-Conductors, Insulators & Semi- Conductors. Intrinsic & Extrinsic Semiconductors, Fermi level, Fermi level in Intrinsic & Extrinsic semiconductors.

Unit2: Junction Diode Characteristics: PN junction diode, Current components in PN junction Diode,Diode equation, V-I Characteristics, Diode resistance, Diode Capacitance,ZenerDiode,Breakdown mechanisms, LED, applications.

Unit3: **BJT Characteristics :** Junction transistor , transistor current components, transistor equation, Transistor Configurations & Regions of Operation, Characteristics of transistor in Common Base, Common Emitter and Common Collector configurations.

Unit4: **J-FET Characteristics**: FET Classification J-FET Construction, operation, Drain Characteristics, Transfer Characteristics and Parameters-Drain Resistance(r_d),Trans Conductance(g_m) and Amplification Factor(μ).

Unit 5: **MOSFET Characteristics**: MOSFET- types, Enhancement MOSFET: Construction, operation, Characteristics, DepletionMOSFET: Construction, operation, Characteristics.

Text Books

1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition
2. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition
3. Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, Second Edition
4. Electronic Devices and Circuits – R.L Boylestad and Louis Nashelsky, Pearson Publications

References

1. Integrated Electronics- Jacob Millman, C. Halkies, C.D.Parikh, Tata Mc-Graw Hill, 2009.
2. Electronic Devices and Circuits-K. Satya Prasad, VGS Book Links.
3. Electronic Devices and Circuits – Bell, Oxford
4. Electronic Devices and Circuits-A.PGodse, U.A.Bakshi,Technical publications

Minors	Principles of Digital Circuits	Course Code: V20MINECT02	L	T	P	C
			3	-	-	3

Syllabus Details

Course Outcomes: After Successful completion of this course, the students will be able to:

CO1 Discuss Boolean functions and various Combinational Circuits **[K2]**
CO2 Analyze various Sequential Circuits **[K3]**
CO3 Implement designs using Programmable Logic Devices**[K3]**
CO4 Discuss various Logic Families.**[K2]**
CO5 Discuss Semiconductor memories **[K2]**

UNIT-I
Boolean algebra and logic gates : Introduction to Boolean Algebra and Logic Gates, Simplification of Boolean Functions using Karnaugh map (4 variable), Combinational Circuits – Binary Adder-Subtractor, Decoders, Encoders, Multiplexers.

UNIT-II
Sequential Logic : Sequential Circuits: Latches, Flip-Flops, Basics of Counters and Shift Registers.

UNIT-III
Memory And Programmable Logic: RAM – Memory Decoding, ROM - Programmable Logic Array – Programmable Array Logic.

UNIT-IV
Logic Families : Introduction to TTL, ECL, MOS & CMOS, their operation and specifications.

UNIT-V
Semiconductor Memories: Introduction to – RAM, ROM, EPROM, EEROM, SRAM, DRAM.

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, ―Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog‖, 6th Edition, Pearson Education, 2017.
2. A. K. Maini, "Digital Electronics: Principles, Devices And Applications, Wiley, 2007.

REFERENCES:

1. G. K. Kharate, Digital Electronics, Oxford University Press, 2010
2. John F. Wakerly, Digital Design Principles and Practices, Fifth Edition, Pearson Education, 2017.
3. Charles H. Roth Jr, Larry L. Kinney, Fundamentals of Logic Design, Sixth Edition, CENGAGE Learning, 2013.

V Sem.	Synthesis of Digital systems	Course Code	L	T	P	C
		V20HONECT01	3	-	-	3

Syllabus Details

Course Outcomes: After Successful completion of the Course, the student will be able to:

CO-1: Discuss about digital systems modeling with VHDL. (K2)
CO-2: Describe High level synthesis and its processes (K2)
CO-3: Illustrate various Scheduling methods (K3)
CO-4: Analyze timing issues in High level synthesis and FSM encoding methods. (K4)
CO-5: Illustrate Retiming, optimization methods and timing. (K3)

UNIT-I:

Introduction to digital systems with VHDL: Outline what is synthesis, Chip design flow and hardware modeling, Introduction to Hardware Description Languages & VHDL Basics, VHDL: Modeling Timing - Events & Transaction, VHDL: Specifying Hardware Behaviour with Processes, Specifying Structure, Test Benches, Parameterisation, & Libraries

UNIT-II:

High level synthesis and its processes:

Introduction to High-level Synthesis, Language front-end Design Representation, Compiler Transformation in High Level Synthesis: Constant Folding, Memory Modeling & Compiler Transformation in High Level Synthesis, Compiler Transformations in High Level Synthesis: Loop Unrolling and Function Inlining

UNIT-III:

Hardware Transformations and Scheduling:

Hardware Transformations: Tree height reduction, Control flow to data flow, Flow graph flattening, Pattern Matching.

Scheduling: Importance of Scheduling, Basic Scheduling, Scheduling with unlimited resources: ASAP Scheduling Algorithm, ALAP Scheduling, Resource constrained Scheduling: List Scheduling, Time-constrained Scheduling, Force Directed Scheduling & Register Allocation

UNIT-IV:

High level synthesis and FSM analysis High Level Synthesis and Timing Issues, Finite State Machine Synthesis: Introduction to FSM Encoding, Finite State Machine Synthesis: Identifying Common Cubes & Graph Embedding,

UNIT-V:

Retiming, logic synthesis and optimization, timing analysis: The Retiming Problem, Efficient Solution to Retiming & Introduction to Logic Synthesis, Binary Decision Diagrams, Introduction to Logic Synthesis, Two-level Logic Optimisation, Multi-level Logic Synthesis: Technology Mapping, timing analysis and critical path.

Text Books:

Giovanni de Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill
High Level Synthesis Introduction to chip and system design edited by Daniel D Gajski

REFERENCE BOOKS:

Philippe Coussy, Adam Morawiec: High-level synthesis from Algorithm to digital circuit, Springer 2008.
The Synthesis Approach to Digital System Design Petra Michel, Ulrich lauther, Peter Duzy.