

**FIFTH SEMESTER**
**Common to EC/TE**

Subject Code	Title	Teaching Department	Teaching hours/week		Examination			
			Theory	Practical	Duration	I. A	Theory/ Practical	Total Marks
06AL - 51	Management & Entrepreneurshi	EC	04		03	25	100	125
06EC- 52	Digital signal Processing	EC	04		03	25	100	125
06EC 53	Analog Communication	EC	04		03	25	100	125
06EC - 54	Microwaves and Radar	EC	04		03	25	100	125
06EC-55	Digital Switching Systems	EC	04		03	25	100	125
06EC - 56	Fundamentals of CMOS VLSI	EC	04		03	25	100	125
06ECL - 57	DSP Lab	EC		03	03	25	50	75
06ECL - 58	Analog Communication Lab + LIC Lab	EC		03	03	25	50	75
		<b>Total</b>	<b>24</b>	<b>06</b>	<b>24</b>	<b>200</b>	<b>700</b>	<b>900</b>

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**SIXTH SEMESTER**
**for EC Branch**

Subject Code	Title	Teaching Department	Teaching hours/week		Examination			
			Theory	Practical	Duration	I. A	Theory/ Practical	Total Marks
06EC - 61	Digital Communication	EC	04		03	25	100	125
06EC - 62	Microprocessors	EC	04		03	25	100	125
06EC - 63	Analog and Mixed mode VLSI Design	EC	04		03	25	100	125
06EC - 64	Antennas and Propagation	EC	04		03	25	100	125
06EC - 65	Information theory and coding	EC	04		03	25	100	125
06EC - 66X	Elective-(Group-A)	EC	04		03	25	100	125
06ECL - 67	Advanced Communication Lab	EC		03	03	25	50	75
06ECL - 68	Microprocessors Lab	EC		03	03	25	50	75
		<b>Total</b>	<b>24</b>	<b>06</b>	<b>24</b>	<b>200</b>	<b>700</b>	<b>900</b>

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## Electives -1(Group A)

06EC661	Programming in C ++	06EC664	Adaptive Signal Processing
06EC662	Satellite Communications	06EC665	Low Power VLSI Design
06EC663	Random Processes	06EC666	Modern Control theory
		06EC667	Digital System Design Using VHDL

## SEVENTH SEMESTER

for EC Branch

Subject Code	Title	Teaching Department	Teaching hours/week		Examination			
			Theory	Practical	Duration	I. A	Theory/ Practical	Total Marks
06EC-71	Computer communication Network	EC	04		03	25	100	125
06EC- 72	Optical Fiber Communication	EC	04		03	25	100	125
06EC – 73	Power Electronics	EC	04		03	25	100	125
06EC - 74	DSP Algorithms & Architecture	EC	04		03	25	100	125
06TC -75X	Elective -2 (Group B)		04		03	25	100	125
06TC – 76X	Elective-3 (Group C)		04		03	25	100	125
06TCL – 77	VLSI Lab			03	03	25	50	75
06TCL - 78	Power Electronics Lab			03	03	25	50	75
		Total	24	06	24	200	700	900

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## Electives -2(Group B)

06EC751	Operating Systems	06EC755	ATM Networks
06EC752	Pattern Recognition	06EC756	Image Processing
06EC753	Artificial Neural Network	06EC757	Video Engineering
06EC754	CAD For VLSI	06EC758	Smart Materials and MEMS

## Electives -3(Group C)

06EC761	Data Structures using C++	06EC764	Wavelet Transforms
06TC762	Real Time Systems	06EC765	Modeling & Simulation of Data Networks
		06EC766	Speech Processing
06EC763	Radio Frequency Integrated Circuits	06EC767	H R Management

## EIGHTH SEMESTER

for EC Branch

Subject Code	Title	Teaching Department	Teaching hours/week		Examination			
			Theory	Practical	Duration	I. A	Theory/ Practical	Total Marks
06EC-81	Wireless Communication	EC	04		03	25	100	125
06EC- 82	Embedded System Design	EC	04		03	25	100	125
06EC - 83X	Elective -4 (Group D)	EC	04		03	25	100	125
06EC – 84X	Elective- 5 (Group E)	EC	04		03	25	100	125

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06EC – 85	Project Work	EC	-	06	03	50	100	150
06EC - 86	Seminar	EC	-	-	-	50	-	50
		<b>Total</b>	<b>16</b>	<b>06</b>	<b>24</b>	<b>200</b>	<b>500</b>	<b>700</b>

Electives -4(Group D)

06EC831	Distributed Systems	06EC834	Biomedical Signal Processing
06EC832	Network Security	06EC835	High performance computer networks
06EC833	Internet Engineering	06EC836	Fuzzy Logic

Electives -5(Group E)

06EC841	Multimedia Communication	06EC844	GSM
06TC7842	Real Time Operating Systems	06EC845	Adhoc Wireless Networks
06EC843	Optical Networks	06EC846	Optical Computing

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## V SEMESTER

### MANAGEMENT & ENTREPRENEURSHIP

<b>Sub Code</b>	<b>: 06AL51</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hours</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

#### Part A Management

##### Unit 1 7 Hours

Introduction – Meaning - nature and characteristics of Management, Scope and functional areas of management – Management as a science, art or profession, - Management & Administration – Roles of management, Levels of Management, Development of Management Thought - early management approaches – Modern management approaches.

##### Unit 2 Planning 6 Hours

Nature, importance and purpose of planning process – Objectives – Types of plans (Meaning only) – decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans.

##### Unit 3 Organising and Staffing 6 Hours

Nature and purpose of organization – Principles of organization – Types of organization – Departmentation – Span of control – MBO and MBE (meaning only) Nature and importance of Staffing – Processes of Selection & Recruitment (in brief).

##### Unit 4 Directing & Controlling 7 Hours

Meaning and Nature of directing – Leadership styles, Motivation, Theories, Communication – Meaning and importance – Co-ordination, meaning and importance and Techniques of co-ordination.  
Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).

#### Part B Entrepreneurship

##### Unit 5 Entrepreneur 6 Hours

Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur .- an emerging Class, Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in Economic Development, Entrepreneurship in India; Entrepreneurship – its Barriers

**Unit 6 Small Scale Industry** **7 Hours**  
 Definition, Characteristics: Need and rationale, Objective; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start an SSI – Government policy towards SSI; Different Policies of SSI; Government support for SSI, during 5 year plans. Impact of Liberalization, Privatisation, Globalization on SSI. Effects of WTO/GATT supporting agencies of Government for SSI, Meaning and Nature of support, Objectives; Functions; Types of help, Ancillary Industry and Tiny Industry (Definition only).

**Unit 7 Institutional support** **6 Hours**  
 Different Schemes, TECKSOK, KIADB; KSSIDC; DIC Single Window agency; SISI, NSIC, SIDBI, KSFC.

**Unit 8 Preparation of Project** **6 Hours**  
 Meaning of Project; Project Identification, Project Selection, Project Report, Need and Significance of Report, Contents, formulation, Guidelines by Planning Commission for Project report, Network Analysis, Errors of Project Report, Project appraisal, Identification of Business Opportunities: Market feasibility study, Technical feasibility study, Financial feasibility study and Social feasibility study.

**TEXT BOOKS:**

1. P. C. Tripathi, P.N. Reddy; Principles of Management, Tata McGraw Hill,
2. Vasant Desai, Dynamics of Entrepreneurial Development & Management, Himalaya Pub. House, - (
3. Poornima M Charantimath, Entrepreneurship Development – Small Business Enterprises, Pearson Education – 2006

**REFERENCE BOOKS:**

1. Robert Lusier, Management Fundamentals – Concepts, Applications, Skill Development, Thompson,
2. S S Khanka, Entrepreneurship Development, S Chand & Co.,
3. Stephen Robbins, Management, Pearson Education/PHI, 17<sup>th</sup> Ed, 2003

**DIGITAL SIGNAL PROCESSING**

**Sub Code** : 06EC-52 **IA Marks** :25  
**Hours /Week** :04 **Exam Hours** :3  
**Total Hours** :52 **Exam Marks** :100

**PART A**

**Unit 1** **7 Hours**  
 Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms.

**Unit 2** **6 Hours**  
 Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.

**Unit 3** **8 Hours**  
 Fast-Fourier-Transform(FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT ( FFT algorithms).

**Unit 4** **6 Hours**  
 Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform

**PART B**

**Unit 5** **6 Hours**  
 IIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters., analog to analog frequency transformations

**Unit 6** **6 Hours**  
 FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique

**Unit 7** **7 Hours**  
 Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (backward difference and bilinear transformation) method, Matched z transforms, Verification for stability and linearity during mapping

**Unit 8** **6 Hours**  
 Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form I and direct form II systems, cascade, lattice and parallel realization.

**TEXT BOOK:**

1. Proakis & Monalakis, Digital signal processing – Principles Algorithms & Applications, Pearson education, 4<sup>th</sup> Edition, New Delhi, 2007.

**REFERENCE BOOKS:**

1. Oppenheim & Schaffer, Discrete Time Signal Processing, PHI, 2003.
2. S. K. Mitra, Digital Signal Processing, Tata Mc-Graw Hill, 2<sup>nd</sup> Edition, 2004.
3. Lee Tan: Digital signal processing, Elsevier publications, 2007

**ANALOG COMMUNICATION**

<b>Sub Code</b>	<b>: 06EC-53</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**PART A**

**Unit 1:** **7 Hours**  
 Random process: Random variables: Several random variables. Statistical averages: Function of Random variables, moments, Mean, Correlation and Covariance function: Principles of autocorrelation function, cross – correlation functions. Central limit theorem, Properties of Gaussian process.

**Unit 2:** **7 Hours**  
**Amplitude Modulation:** Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

**Unit 3:** **6 Hours**  
**Single Side-Band Modulation (SSB):** Quadrature carrier multiplexing, Hilbert transform, properties of Hilbert transform, Pre-envelope, Canonical representation of band pass signals, Single side-band modulation, Frequency-Domain description of SSB wave, Time-Domain description. Phase discrimination method for generating an SSB modulated wave, Time-Domain description. Phase discrimination method for generating an SSB modulated wave. Demodulation of SSB waves.

**Unit 4:** **6 Hours**  
**Vestigial Side-Band Modulation ( VSB):** Frequency – Domain description, Generation of VSB modulated wave, Time - Domain description, Envelop detection of VSB wave plus carrier, Comparison of amplitude modulation techniques, Frequency translation, Frequency division multiplexing, Application: Radio broadcasting, AM radio.

**PART B**

**Unit 5:** **6 Hours**  
**Angle Modulation (FM):** Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM.

**Unit 6:** **6 Hours**  
**Angle Modulation (FM):** Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems

**Unit 7:** **6 Hours**  
**Noise:** Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Narrow bandwidth, Noise Figure, Equivalent noise temperature, cascade connection of two-port networks.

**Unit 8:** **8 Hours**  
**Noise in Continuous wave modulation systems:** Introduction, Receiver model, Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM,

**TEXT BOOKS:**

1. Simon Haykins, Communication Systems, 3<sup>rd</sup> Edition, John Willey, 1996
2. Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley, 2003



**Unit 2:** **4 Hours**  
Evolution of Switching Systems: Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronic switching, Digital switching systems

Digital Switching Systems: Fundamentals : Purpose of analysis, Basic central office linkages, Outside plant venous inside plant, Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, Basic call processing.

**4 Hours**

**Unit 3:** **6 Hours**  
Telecommunications Traffic: Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, Lost call systems, Queuing systems.

**Unit 4:** **6 Hours**  
Switching Systems: Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems

## PART-B

**Unit 5:** **4 Hours**  
Time Division Switching : Introduction, space and time switching, Time switching networks, Synchronisation.

Text 1: Chapter 6

**Unit 6:** **6 Hours**  
Switching System Software: Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1 control, Software architecture for level 2 control, Software architecture for level 3 control, Digital switching system software classification, Call models, Connect sequence, Software linkages during call, Call features, Feature flow diagram, Feature interaction.

Text 2: Chapter 5

**Unit 7:** **8 Hours**  
Maintenance of Digital Switching System: Introduction, Scope, Software maintenance, Interface of a typical digital switching system central office, System outage and its impact on digital switching system reliability, Impact of software patches on digital switching system maintainability, Embedded patcher concept, Growth of digital switching system central office, Generic program upgrade, A methodology for proper maintenance of digital switching system, Effect of firmware deployment on digital switching

system, Firmware-software coupling, Switching system maintainability metrics, Upgrade process success rate, Number of patches applied per year, Diagnostic resolution rate, Reported critical and major faults corrected, A strategy improving software quality, Program for software process improvement, Software processes improvement, Software processes, Metrics, Defect analysis, Defect analysis.

**Unit 8:** **6 Hours**  
A Generic Digital Switching System Model: Introduction, Scope, Hardware architecture, Software architecture, Recovery strategy, Simple call through a digital system, Common characteristics of digital switching systems. Analysis report. Reliability analysis.

### TEXT BOOKS:

1. J E Flood: Telecommunication and Switching, Traffic and Networks. Pearson Education, 2002
2. Syed R. Ali, Digital Switching Systems, TMH Ed 2002.

### REFERENCE BOOK:

1. John C Bellamy: Digital Telephony Wiley India 3<sup>rd</sup> Ed, 2000

## FUNDAMENTALS OF CMOS VLSI

<b>Sub Code</b>	<b>: 06EC-56</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

## PART A

**Unit 1:** **4Hours**  
**Basic MOS technology:** Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. Thermal aspects of processing. BiCMOS technology. Production of E-beam masks.

**4Hours**  
**MOS Transistor Theory:** Introduction, MOS Device Design Equations, The Complementary CMOS Inverter – DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, Tristate Inverter

**Unit 2:** **4Hours**

**Circuit design processes:** MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams. Tutorial exercises.

Basic Physical Design of Simple logic gates

**3Hours**

**Unit 3**

**6 Hours**

**CMOS logic structures :** CMOS Complementary Logic, Bi CMOS Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic Cascaded Voltage Switch Logic (CVSL).

**Unit 4:**

**4 Hours**

**Basic circuit concepts:** Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances. Tutorial exercises.

**Scaling of MOS circuits:** Scaling models and factors. Limits on scaling. Limits due to current density and noise. **3Hours**

**Unit 5:**

**4 Hours**

**CMOS subsystem design:** Architectural issues. Switch logic. Gate logic. Design examples – combinational logic. Clocked circuits. Other system considerations.

Clocking Strategies

**4 Hours**

**Unit 6:**

**6 Hours**

**CMOS subsystem design processes:** General considerations. Process illustration. ALU subsystem. Adders. Multipliers.

**Unit 7:**

**5 Hours**

**Memory, registers, and clock:** Timing considerations. Memory elements. Memory cell arrays.

**Unit 8:**

**5 Hours**

**Testability:** Performance parameters. Layout issues. I/O pads. Real estate. System delays. Ground rules for design. Test and testability.

**TEXT BOOKS:**

1. Douglas A. Pucknell & Kamran Eshraghian, “Basic VLSI Design” PHI 3<sup>rd</sup> Edition (original Edition – 1994), 2005.
2. Neil H. E. Weste and K. Eshragian,” Principles of CMOS VLSI Design: A Systems Perspective,” 2<sup>nd</sup> edition, Pearson Education (Asia) Pvt. Ltd., 2000.

**REFERENCE BOOKS:**

1. M. K. Achuthan and K. N. Bhat, “Fundamentals of Semiconductor Devices”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
2. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
3. D.A Hodges, H.G Jackson and R.A Saleh. “Analysis and Design of Digital Integrated Circuits”- 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

**DIGITAL SIGNAL PROCESSING LABORATORY**

**Sub Code : 06ECL-57**

**IA Marks : 25**

**Hours /Week :3**

**Exam Hours : 3**

**Total Hour : 42**

**Exam Marks :50**

**A LIST OF EXPERIMENTS USING MATLAB/SCILAB/OCTAVE/WAB**

1. Verification of Sampling theorem.
2. Impulse response of a given system
3. Linear convolution of two given sequences.
4. Circular convolution of two given sequences
5. Autocorrelation of a given sequence and verification of its properties.
6. Cross correlation of given sequences and verification of its properties.
7. Solving a given difference equation.
8. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
9. Linear convolution of two sequences using DFT and IDFT.
10. Circular convolution of two given sequences using DFT and IDFT
11. Design and implementation of FIR filter to meet given specifications.
12. Design and implementation of IIR filter to meet given specifications.

**B. LIST OF EXPERIMENTS USING DSP PROCESSOR**

**(Note: Experiments no: 1, 2, 3 & 7 may be performed on CCS)**

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N- Point DFT of a given sequence
4. Realization of an FIR filter (any type) to meet given specifications .The input can be a signal from function generator / speech signal .
5. Audio applications such as to plot time and frequency (Spectrum) display of Microphone output plus a cosine using DSP. Read a wav file

- and match with their respective spectrograms
6. Noise: Add noise above 3kHz and then remove; Interference suppression using 400 Hz tone.
  7. Impulse response of first order and second order system

**REFERENCE BOOKS:**

1. Sanjeet Mitra, Digital signal processing using MATLAB, TMH, 2001
2. J.G.Proakis & Ingale, Digital signal processing using MATLAB, MGH, 2000
3. B.Venkataramani and Bhaskar, Digital signal processors, TMH, 2002

**ANALOG COMMUNICATION LAB + LIC LAB**

<b>Sub Code</b>	<b>: 06ECL-58</b>	<b>IA Marks</b>	<b>:25</b>
<b>Hours /Week</b>	<b>:3</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>:50</b>

**EXPERIMENTS**

1. Second order active LPF and HPF
2. Second order active BPF and BE
3. Schmitt Trigger Design and test a Schmitt trigger circuit for the given values of UTP and LTP
4. Frequency synthesis using PLL.
5. Design and test R-2R DAC using op-amp
6. Design and test the following circuits using IC 555
  - a. Astable multivibrator for given frequency and duty cycle
  - b. Monostable multivibrator for given pulse width W
7. Class C Single tuned amplifier
8. Amplitude modulation using transistor/FET (Generation and detection)
9. Pulse amplitude modulation and detection
10. PWM and PPM
11. Frequency modulation using 8038/2206
12. Precision rectifiers – both Full Wave and Half Wave.

**VI SEMESTER  
DIGITAL COMMUNICATION**

<b>Sub Code</b>	<b>: 06EC-61</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**PART A**

**Unit 1:** **07 Hours**

Basic signal processing operations in digital communication. Sampling Principles: Sampling Theorem, Quadrature sampling of Band pass signal, Practical aspects of sampling and signal recovery.

**Unit2:** **07 Hours**

PAM, TDM. Waveform Coding Techniques, PCM, Quantization noise and SNR, robust quantization.

**Unit3:** **06 Hours**

DPCM, DM, applications. Base-Band Shaping for Data Transmission, Discrete PAM signals, power spectra of discrete PAM signals.

**Unit4:** **06 Hours**

ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission.

**PART B**

**Unit 5** **07 Hours**

Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation techniques.

**Unit 6:** **06 Hours**

Detection and estimation, Model of DCS, Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input.

**Unit 7:** **06 Hours**

Detection of known signals in noise, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise,

**Unit 8** **07 Hours**

Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency

hop spread spectrum, applications.

**TEXT BOOK:**

1. Simon Haykin, Digital communications, JohnWiley,2003.

**REFERENCE BOOKS:**

1. K.Sam Shanmugam, Digital and analog communication systems, John Wiley, 1996. 2.Simon Haykin, An introduction to Analog and Digital Communication, John Wiley, 2003
2. Bernard Sklar: Digital communications Pearson education 2007

**MICROPROCESSOR**

<b>Sub Code</b>	<b>: 06EC-62</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**Part A**

**Unit 1** **07 Hours**  
*The 8086/8088 Processors:* Historical background, The microprocessor-based personal computer system, 8086 CPU Architecture, Machine language instructions, Instruction execution timing, The 8088

**Unit 2** **07 Hours**  
*Instruction Set of 8086/8088:* Assembler instruction format, data transfer and arithmetic, branch type, loop, NOP & HALT, flag manipulation, logical and shift and rotate instructions. Illustration of these instructions with example programs, Directives and operators

**Unit 3** **06 Hours**  
*Byte and String Manipulation:* String instructions, REP Prefix, Table translation, Number format conversions, Procedures, Macros, Programming using keyboard and video display

**Unit 4** **06 Hours**  
*8086 Interrupts:* 8086 Interrupts and interrupt responses, Hardware interrupt applications, Software interrupt applications, Interrupt examples

**PART B**

**Unit 5** **06 Hours**  
*8086 Interfacing:* Interfacing microprocessor to keyboard (keyboard types, keyboard circuit connections and interfacing, software keyboard interfacing, keyboard interfacing with hardware), Interfacing to alphanumeric displays (interfacing LED displays to microcomputer), Interfacing a microcomputer to a stepper motor

**Unit 6** **06 Hours**  
*8086/8088 based Multiprocessing Systems:* Coprocessor configurations, The 8087 numeric data processor: data types, processor architecture, instruction set and examples

**Unit 7** **07 Hours**  
*System Bus Structure:* Basic 8086/8088 configurations: minimum mode, maximum mode, Bus Interface: peripheral component interconnect (PCI) bus, the parallel printer interface (LTP), The universal serial bus (USB)

**Unit 8** **07 Hours**  
*80386, 80486 And Pentium Processors:* Introduction to the 80386 microprocessor, Special 80386 registers, Introduction to the 80486 microprocessor, Introduction to the Pentium microprocessor.

**TEXT BOOKS:**

1. Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu and G. A. Gibson, 2E PHI -2003
2. The Intel Microprocessor, Architecture, Programming and Interfacing- Barry B. Brey, 6e, Pearson Education / PHI, 2003

**REFERENCE BOOKS:**

1. Microprocessor and Interfacing- Programming & Hardware, Douglas hall, 2e TMH, 1991
2. Advanced Microprocessors and Peripherals - A.K. Ray and K.M. Bhurchandi, TMH, 2001
3. 8088 and 8086 Microprocessors - Programming, Interfacing, Software, Hardware & Applications - Triebel and Avtar Singh, 4e, Pearson Education, 2003

## ANALOG AND MIXED MODE VLSI DESIGN

<b>Sub Code</b>	<b>: 06EC-63</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

### PART A

**Unit 1:** **12 Hours**  
Sampling and Aliasing: Impulse Sampling, Sample and Hold, SPICE models for DACs and ADCs, Quantization noise, Spectral density of quantization noise.

**Unit 2:** **12 Hours**  
Data Converter SNR: Effective number of bits Clock jitter, spectral density, Using averaging to improve SNR, Decimating filters for ADCs, Interpolating filters for DACs, Band pass and High pass Sync filters, Using feedback to improve SNR.

### PART B

**Unit 3:** **12 Hours**  
Sub-Micron CMOS circuit design: Process flow, capacitors and resistors, SPICE MOSFET models, MOSFET Switch, Delay and Adder elements, Analog circuits – MOSFET Biasing, Op-Amp design, Circuit Noise.

**Unit 4:** **08 Hours**  
Implementing Data converters: Current Mode and Voltage mode R-2R DAC, Using Op-Amps in data converters, Implementing ADCs, Cyclic ADC.

**Unit 5:** **08 Hours**  
Integrator Based CMOS Filters: Integrator Building Blocks, Low pass and Active R-C filters, MOSFET-C integrators, Bilinear and Biquadratic transfer functions – Active R-C, Transconductor-C and Switched Capacitor implementations both transfer functions, Canonic form of a digital filter.

### TEXT BOOK:

1.R. Jacob Baker, CMOS – Mixed signal circuit design (Vol II of CMOS: Circuit design, layout and simulation), IEEE Press and Wiley Interscience, 2002

### REFERENCE BOOKS:

1.Design of Analog CMOS Integrated Circuits, B Razavi, First Edition, McGraw Hill,2001  
2.CMOS Analog Circuit Design, P E Allen and D R Holberg, Second Edition, Oxford University Press,2002

## ANTENNAS AND PROPAGATION

<b>Sub Code</b>	<b>: 06EC-64</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

### PART A

**Unit 1** **08 Hours**  
Antenna Basics: Introduction, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna field zones.

**Unit 2** **10 Hours**  
Point Sources and Arrays: Introduction, point sources, power patterns, power theorem, radiation intensity, field patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, examples of pattern synthesis by pattern multiplication, non-isotropic point sources, broad side array with non uni polar amplitude distribution, broad side versus end fire array, direction of maxima fire arrays of n isotropic point sources of equal amplitude and spacing.

**Unit 3** **06 Hours**  
Electric dipoles and thin linear antennas: Introduction, short electric dipole, fields of a short dipole, radiation resistance of short dipole, radiation resistances of  $\lambda/2$  Antenna, thin linear antenna, micro strip arrays, low side lobe arrays, long wire antenna, folded dipole antennas.

### PART B

**Unit 4 and 5** **10 Hours**  
Loop, slot, patch and horn antenna: Introduction, small loop, comparison of far fields of small loop and short dipole, loop antenna general case, far field patterns of circular loop, radiation resistance, directivity, slot antenna, Balinet's principle and complementary antennas, impedance of complementary and slot antennas, patch antennas, horn antennas, rectangular horn antennas.

**Unit 6** **06 Hours**  
 Antenna Types: Helical Antenna, Yagi-Uda array, corner reflectors, parabolic reflectors, log periodic antenna, lens antenna, antenna for special applications – sleeve antenna, turnstile antenna, omni directional antennas, antennas for satellite antennas for ground penetrating radars, embedded antennas, ultra wide band antennas, plasma antenna.

**Unit 7 and 8** **12 Hours**  
 Radio Wave Propagation: Introduction, Ground wave propagation, free space propagation, ground reflection, surface wave, diffraction.  
 Troposphere Wave Propagation: troposcopic scatter, Ionosphere propagation, electrical properties of the ionosphere, effects of earth's magnetic field.

**TEXT BOOK:**

1. John D.Krauss, Antennas, III (SEI) edition, McGraw-Hill International edition, 2006
2. Harish and Sachidananda: Antennas and Wave Propagation Oxford Press 2007

**REFERENCE BOOKS:**

1. C A Balanis, Antenna Theory Analysis and Design 2<sup>nd</sup> ED, John Wiley, 1997
2. Sineon R Saunders, Antennas and Propagation for Wireless Communication Systems, John Wiley, 2003.
3. G SN Raju: Antennas and wave propagation , Pearson Education 2005  
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**INFORMATION THEORY AND CODING**

<b>Sub Code</b>	<b>: 06EC-65</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>:100</b>

**PART –A**

**Unit 1:** **06 Hours**  
 Information Theory: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source

**Unit 2 :** **06 Hours**  
 Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.

**Unit 3 :** **06 Hours**  
 Fundamental Limits on Performance: Source coding theorem,, Huffman coding, Discrete memory less Channels, Mutual information, Channel Capacity.

**Unit 4 :** **06 Hours**  
 Channel coding theorem , Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem .

**PART-B**

**Unit 5 :** **07 Hours**  
 Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

**Unit 6 :** **07 Hours**  
 Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes.

**Unit 7 :** **07 Hours**  
 RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes..

**Unit 8:** **07 Hours**  
 Convolution Codes, Time domain approach. Transform domain appra

**TEXT BOOKS:**

1. K. Sam Shanmugam, Digital and analog communication systems, John Wiley, 1996.
2. Simon Haykin, Digital communication, John Wiley, 2003.

**REFERENCE BOOK:**

1. Ranjan Bose, ITC and Cryptography, TMH, II edition, 2007
2. Glover and Grant; Digital Communications Pearson Ed. 2<sup>nd</sup> Ed 2008

## ADVANCED COMMUNICATION LAB

<b>Sub Code</b>	<b>: 06EC-67</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:3</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>:50</b>

### LIST OF EXPERIMENTS

1. TDM of two band limited signals.
2. ASK and FSK generation and detection
3. PSK generation and detection
4. DPSK generation and detection
5. QPSK generation and detection
6. PCM generation and detection using a CODEC Chip
7. Measurement of losses in a given optical fiber ( propagation loss, bending loss) and numerical aperture
8. Analog and Digital (with TDM) communication link using optical fiber.
9. Measurement of frequency, guide wavelength , power, VSWR and attenuation in a microwave test bench
10. Measurement of directivity and gain of antennas: Standard dipole (or printed dipole), microstrip patch antenna and Yagi antenna(printed).
11. Determination of coupling and isolation characteristics of a stripline (or microstrip) directional coupler
12. (a) Measurement of resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate.  
(b) Measurement of power division and isolation characteristics of a microstrip 3 dB power divider.

### 06ECL-68: Microprocessor Lab

- I) Programs involving
- 1) Data transfer instructions like:
    - i] Byte and word data transfer in different addressing modes.
    - ii] Block move (with and without overlap)
    - iii] Block interchange
  - 2) Arithmetic & logical operations like:
    - i] Addition and Subtraction of multi precision nos.
    - ii] Multiplication and Division of signed and unsigned Hexadecimal nos.
    - iii] ASCII adjustment instructions
    - iv] Code conversions
    - v] Arithmetic programs to find square cube, LCM, GCD, factorial
  - 3)Bit manipulation instructions like checking:
    - i] Whether given data is positive or negative
    - ii] Whether given data is odd or even
    - iii]Logical 1's and 0's in a given data
    - iv] 2 out 5 code

- v] Bit wise and nibble wise palindrome
- 4)Branch/Loop instructions like:
- i] Arrays: addition/subtraction of N nos.  
Finding largest and smallest nos.  
Ascending and descending order
  - ii] Near and Far Conditional and Unconditional jumps, Calls and Returns
- 5) Programs on String manipulation like string transfer, string reversing, searching for a string, etc.
- 6) Programs involving Software interrupts  
Programs to use DOS interrupt INT 21h Function calls for Reading a Character from keyboard, Buffered Keyboard input, Display of character/ String on console
- II) Experiments on interfacing 8086 with the following interfacing modules through
- DIO (Digital Input/Output-PCI bus compatible) card
- a) Matrix keyboard interfacing
  - b) Seven segment display interface
  - c) Logical controller interface
  - d) Stepper motor interface
- III) Other Interfacing Programs
- a) Interfacing a printer to an X86 microcomputer
  - b) PC to PC Communication

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## ELECTIVE GROUP-A

### PROGRAMMING IN C++

<b>Sub Code</b>	<b>: 06EC-661</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

### PART A

- Unit 1** **06 Hours**
- C++, An Overview: Getting started, the C++ program, Preprocessor Directives,  
The Built-In Array Data Type, Dynamic Memory Allocation and Pointers, An Object – based Design, An Object-Oriented Design, An Exception – based Design, An array.

**Unit 2** **06 Hours**  
 The basic language: Literal Constant, Variables, Pointer Type, String Types, const  
 Qualifier, Reference Types, the bool type, Enumeration types, Array types.  
 The vector container type. Text 1: Chap 3: 3.1 to 3.10

**Unit 3** **10 Hours**  
 Operators: Arithmetic Operators, Equality, Relational and Logical operators, Assignment operators, Increment and Decrement operator, The conditional Operator, Bitwise operator, bitset operations. Statements: if, switch, for Loop, while, break, goto, continue statements.

**Unit 4** **04 Hours**  
 Functions: Prototype, Argument passing, Recursion and linear function.

**PART B**

**Unit 5** **06 Hours**  
 Exception Handling: Throwing an Exception, Catching an exception, Execution Specification and Exceptions and Design Issues.

**Unit 6** **07 Hours**  
 Classes : Definition, Class Objects, Class Initialization, Class constructor, The class destructor, Class Object Arrays and Vectors.

**Unit 7** **07 Hours**  
 Overload Operators, Operators ++ and --, Operators new and delete.

**Unit 8** **06 Hours**  
 Multiple Inheritance, public, private & protected inheritance, Class scope under Inheritance.

**TEXT BOOKS:**

1. S. B. Lippman & J. Lajoie, C++ Primer, 3rd Edition, Addison Wesley, 2000.

**REFERENCE BOOKS:**

1. C++ Program Design: An Introduction to Programming and Object-Oriented Design. Cohoon and Davidson, 3<sup>rd</sup> Edn. TMH publication. 2004.  
 2. R. Lafore, Object Oriented Programming using C++, Galgotia Publications, 2004.

**SATELLITE COMMUNICATION**

**Sub Code** : 06EC-662 **IA Marks** : 25  
**Hours /Week** :4 **Exam Hours** : 3  
**Total Hour** : 52 **Exam Marks** :100

**PART A**

**Unit 1** **03 Hours**  
 Over view of Satellite Systems: Introduction, frequency allocation, INTEL Sat.

**Unit 2** **10 Hours**  
 Orbits: Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits, Geostationary orbit: Introduction, antenna, look angles, polar mix antenna, limits of visibility, earth eclipse of satellite, sun transit outage, leandrag orbits.

**Unit 3** **08 Hours**  
 Propagation impairments and space link: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.  
 Space link: Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR.

**Unit 4** **06 Hours**  
 Space Segment: Introduction, power supply units, altitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem.

**Unit 5 and 6** **03 Hours**  
 Earth Segemnt: Introduction, receive only home TV system, out door unit, indoor unit, MATV, CATV, Tx – Rx earth station.

Interference and Satellite access: Introduction, interference between satellite circuits, satellite access, single access, pre-assigned FDMA, SCPC (spade system), TDMA, pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA. **08 Hours**

**Unit 7 and 8** **1 0 Hours**

DBS, Satellite mobile and specialized services: Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for

digital TV, satellite mobile services, USAT, RadarSat, GPS, orb communication and iridium.

**TEXT BOOK:**

1. Dennis Roddy, Satellite Communications, 4<sup>th</sup> Edition, McGraw-Hill International edition, 2006

**REFERENCES:**

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, Satellite Communications, 2<sup>nd</sup> Edition, John Wiley & Sons, 2003  
 2.W.L. Pitchand, H.L. Suyderhoud, R.A. Nelson, Satellite Communication Systems engineering, 2<sup>nd</sup> Ed., Pearson Education., 2007

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**RANDOM PROCESSES**

<b>Sub Code</b>	<b>: 06EC-663</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**Part A**

**Unit 1:** **07 Hours**  
 Introduction to Probability Theory: Experiments. sample space, Events, Axioms, Assigning probabilities, Joint and conditional probabilities,. Baye’s Theorem, Independence, Discrete Random Variables, Engg Example.

**Unit 2 :** **06 Hours**  
 Random Variables, Distributions, Density Functions: CDF, PDF, Gaussian random variable, Uniform Exponential ,Laplace, Gamma, Erlang, Chi-Square, Raleigh, Rician and Cauchy types of random variables

**Unit 3:** **06 Hours**  
 Operations on a Single R V: Expected value, EV of Random variables, EV of functions of Random variables, Central Moments, Conditional expected values.

**Unit 4:** **06 Hours**  
 Characteristic functions, Probability generating functions, Moment generating functions, Engg applications, Scalar quantization, entropy and source coding.

**PART B**

**Unit 5:** **07 Hours**  
 Pairs of Random variables, Joint CDF, joint PDF, Joint probability mass functions, Conditional Distribution, density and mass functions, EV involving pairs of Random variables, Independent Random variables, Complex Random variables, Engg Application

**Unit 6 :** **07 Hours**  
 Multiple Random Variables: Joint and conditional PMF, CDF, PDF,.EV involving multiple Random variables, Gaussian Random variable in multiple dimension, Engg application, linear prediction.

**Unit 7 :** **06 Hours**  
 Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, Properties of ACF.

**Unit 8 :** **06 Hours**  
 Example Processes: Markov processes, Gaussian Processes, Poisson Processes, Engg application, Computer networks, Telephone networks.

**TEXT BOOK:**

1. S L Miller and D C Childers: Probability and random processes: application to Signal processing and communication Academic Press/ Elsevier 2004

**REFERENCE BOOKS:**

1. A. Papoullis and S U Pillai: Probability, Random variables and stochastic processes McGraw Hill 2002  
 2. Peyton Z Peebles: Probability, Random variables and Random signal principles TMH 4<sup>th</sup> Edition 2007  
 3. H Stark and Woods: Probability, random processes and applications PHI 2001

**ADAPTIVE SIGNAL PROCESSING**

<b>Sub Code</b>	<b>: 06EC-664</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**PART-A**

**Unit 1** **04 Hours**  
 Adaptive Systems: Definition and characteristics, Areas of application, General properties, Open-and closed-loop adaptation, Applications of closed-

loop adaptation, Example of an adaptive system.

**Unit 2** **06 Hours**  
The Adaptive Linear Combiner: General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components.

**Unit 3** **08 Hours**  
Properties Of The Quadratic Performance Surface: Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values, a second example.

**Unit 4** **07 Hours**  
Searching The Performance Surface: Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, Gradient search by Newton’s method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves.

**PART-B**

**Unit 5** **08 Hours**  
Gradient Estimation And Its Effects On Adaptation: Gradient component estimation by derivate measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution, excess mean-square error and time constants, mis adjustment, comparative performance of Newton’s and steepest-descent methods, Total mis adjustment and other practical considerations.

**Unit 6** **05 Hours**  
The LMS Algorithm: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, misadjustment, performance.

**Unit 7** **05 Hours**  
Adaptive Modeling And System Identification: General description, Adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, Adaptive modeling in FIR digital filter synthesis.

**Unit 8** **07 Hours**  
Adaptive Interfacing Canceling: The concept of adaptive noise canceling, stationary noise-canceling solutions, effects of signal components in the reference input, The adaptive interference canceller as a notch filter, The

adaptive interface canceller as a high-pass filter, Effects of finite length and causality, multiple-reference noise canceling.

**TEXT BOOK:**  
1. Bernard Widrow and Samuel D. Stearns, Adaptive Signal Processing, Pearson Education Asia, 2001.

**REFERENCE BOOKS:**  
1. Simon Haykin, Adaptive filter Theory , 4e, Pearson Education Asia, 2002  
2. Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, Theory and Design of Adaptive Filters, Pearson education,/PHI 2002.  
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**LOW POWER VLSI DESIGN**

**Sub Code** : 06EC-665 **IA Marks** : 25  
**Hours /Week** :04 **Exam Hours** : 3  
**Total Hour** : 52 **Exam Marks** :100

**PART A**

**Unit 1:** **06 Hours**  
Introduction, Sources of power dissipation, designing for low power. Physics of power dissipation in MOSFET devices – MIS Structure, Long channel and sub-micron MOSFET, Gate induced Drain leakage.

**Unit 2:** **08 Hours**  
Power dissipation in CMOS – Short circuit dissipation, dynamic dissipation, Load capacitance. Low power design limits - Principles of low power design, Hierarchy of limits, fundamental limits, Material, device, circuit and system limits.

**Unit 3:** **12 Hours**  
Synthesis for Low power: Behavioral, Logic and Circuit level approaches, Algorithm level transforms, Power-constrained Least squares optimization for adaptive and non-adaptive filters, Circuit activity driven architectural transformations, voltage scaling, operation reduction and substitution, pre-computation, FSM and Combinational logic, Transistor sizing.

**PART B**

**Unit 4:** **12 Hours**  
Design and Test of Low-Voltage CMOS Circuits: Introduction, Design style, Leakage current in Deep sub-micron transistors, device design issues, minimizing short channel effect, Low voltage design techniques using reverse  $V_{gs}$ , steep sub threshold swing and multiple threshold voltages, Testing with elevated intrinsic leakage, multiple supply voltages.

**Unit 5:** **8 Hours**  
 Low energy computing: Energy dissipation in transistor channel, Energy recovery circuit design, designs with reversible and partially reversible logic, energy recovery in adiabatic logic and SRAM core, Design of peripheral circuits – address decoder, level shifter and I/O Buffer, supply clock generation.

**Unit 6:** **4 Hours**  
 Software design for low power: Introduction, sources of power dissipation, power estimation and optimization.

**TEXT BOOK:**

1. Kaushik Roy and Sharat C Prasad, Low-Power CMOS VLSI Circuit Design, Wiley Inter science, 2000

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**MODERN CONTROL THEORY**

<b>Sub Code</b>	<b>: 06EC-666</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hours /Week</b>	<b>:4</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total Hour</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>:100</b>

**PART-A**

**Unit 1:** **07 Hours**  
 Linear Spaces and Linear Operators.  
 Introduction, Fields, Vectors and Vector Spaces, Linear Combinations and Bases, Linear Transformations and Matrices, Scalar Product and Norms, Solution of Linear Algebraic Equations, Eigen values, Eigen vectors and a Canonical-Form, Functions of a Square Matrix.

**Unit 2:** **05 Hours**  
 State Variable Descriptions. Introduction, The Concept of State, State Equations for Dynamic Systems, Time-Invariance and Linearity, Non uniqueness and State Model, State diagrams.

**Unit 3:** **06 Hours**  
 Physical Systems and State Assignment:  
 Introduction, Linear Continuous-Time Models, Linear Discrete-Time Models, Nonlinear Models, Local Linearization of Nonlinear Models, Plant Models of some Illustrative Control Systems.

**Unit 4:** **06 Hours**  
 Solutions of State Equations: Introduction, Existence and Uniqueness of Solutions to Continuous –Time State Equations, Solution of Nonlinear Continuous-Time Equations, Solution of Linear Time-Varying Continuous –

Time State Equations, Solution of Linear Time- Invariant continuous-Time State Equations, Solution of Linear Discrete-Time State Equations, State Equations of Sampled –Data Systems.

**PART-B**

**Unit 5:** **07 Hours**  
 Controllability and Observability: Introduction, General Concept of Controllability, General Concept of Observability, Controllability Tests for Continuous-Time Systems, Observability Tests for Continuous- Time Systems, Controllability and Observability of Discrete-Time Systems, Controllability and Observability of State Model in Jordan Canonical Form, Loss of Controllability and Observability due to Sampling, Controllability and Observability, Canonical Forms of State Model.

**Unit 6:** **05 Hours**  
 Relationship between State Variable and Input-Output Descriptions: Introduction, Input-output Maps from State Models, Output Controllability, Reducibility, State models from Input-Output Maps.

**Unit 7:** **06 Hours**  
 Stability : Introduction, Stability Concepts and Definitions, Stability of Linear Time- Invariant Systems, Equilibrium Stability of Nonlinear Continuous-Time Autonomous Systems, The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems, Aids to Finding Lyapunov Functions for Nonlinear Continuous-Time Autonomous Systems, Use of Lyapunov Functions to Estimate Transients, The Direct Method of Lyapunov and the Discrete-Time Autonomous Systems.

**Unit 8:** **06 Hours**  
 Model Control: Introduction, Controllable and Observable Companion Forms, The effect of State Feedback on Controllability and Observability, Pole Placement by State Feedback, Full-Order Observers, Reduced-Order Observers, Deadbeat Control by State Feedback, Deadbeat Observers

**TEXT BOOK:**

1. M. Gopal : Modern Control System Theory –; 2nd Edition; New Age Int (P) Ltd. 2007

**REFERENCE BOOKS:**

1. Richard Dorf & Robert Bishop Modern Control System –, Pearson Education/ PHI.
2. K. Ogata Modern Control Engineering- - Pearson Education / PHI

