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UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics and Telecommunication Engineering

Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

Objectives:

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.

2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.

3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.

4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

Dr. Uttam D. Kolekar

Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC601	Microcontrollers & Applications	4	-	--	4	--	4
ECC602	Computer Communication Networks	4	-	-	4	-	4
ECC603	Antenna & Radio Wave Propagation	4	-	-	4	-	4
ECC604	Image Processing and Machine Vision	4	-	--	4	--	4
ECCDLO 602X	Department Level Optional Course II	4	-	-	4	-	4
ECL601	Microcontroller & Applications Lab	-	2	-	-	1	1
ECL602	Computer Communication Network Lab	-	2	-	-	1	1
ECL603	Antenna & Radio Wave Propagation Lab	-	2	-	-	1	1
ECL604	Image Processing and Machine Vision Lab	-	2	-	-	1	1
ECLDLO 602X	Department Level Optional Lab II	-	2	-	-	1	1
Total		**20**	**10**	**-**	**20**	**5**	**25**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC601	Microcontroller& Applications	20	20	20	80	03	--	--	100
ECC602	Computer Communication Network	20	20	20	80	03	--	--	100
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	03	--	--	100
ECC604	Image Processing and Machine Vision Lab	20	20	20	80	03	--	--	100
ECCDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ECL601	Microcontroller & Applications Lab	--	--	--	--	--	25	25	50
ECL602	Computer Communication Network Lab	--	--	--	--	--	25	25	50
ECL603	Antenna & Radio Wave Propagation Lab	--	--	--	--	--	25	25	50
ECL604	Image Processing and Machine Vision Lab	--	--	--	--	--	25	25	50
ECLDLO 602X	Department Level Optional Lab II	--	--	--	--	--	25	--	25
Total				**100**	**400**		**125**	**100**	**725**

Course Code	Department Level Optional Course II
ECCDLO 6021	Digital VLSI Design
ECCDLO 6022	Radar Engineering
ECCDLO 6023	Database Management System
ECCDLO 6024	Audio Processing

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC601	Microcontrollers & Applications	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC601	Microcontrollers & Applications	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge and core expertise in microcontrollers.
- To understand peripheral devices and their interfacing to microcontrollers.
- To write programs for microcontrollers and their applications in Assembly and Embedded C Language.

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed architecture of 8051 and ARM7 microcontroller.
- Study the in-depth working of the microcontrollers and their Instruction set.
- Interface various peripheral devices to the microcontrollers.
- Write Assembly language and Embedded C program for microcontrollers.

Module No.	Unit No.	Topics	Hrs.
1.0		**8051 Microcontroller**	**12**
	1.1	Comparison between Microprocessor and Microcontroller	
	1.2	Features, architecture and pin configurations	
	1.3	CPU timing and machine cycle	
	1.4	Input / Output ports	
	1.5	Memory organization	
	1.6	Counters and timers	
	1.7	Interrupts	
	1.8	Serial data input and output	
2.0		**8051 Programming**	**08**
	2.1	Instruction set	
	2.2	Addressing mode	
	2.3	Assembler Directives	
	2.4	**Programs related to**: arithmetic, logical, delay, input, output, timer, counters, port, serial communication, and interrupts	
3.0		**8051 Interfacing and Applications**	**06**
	3.1	Interfacing of Display: LED, LCD and Seven Segment display	
	3.2	Stepper Motor and Relay	
	3.3	UART	
4.0		**ARM7: A 32 bit Microcontroller**	**08**
	4.1	The RISC and the CISC design philosophy	
	4.2	Concept of Cortex-A, the Cortex-R and the Cortex-M	
	4.3	Features of ARM Microcontroller	
	4.4	Pipeline Architecture	
	4.5	Registers	
	4.6	Exceptions, Interrupt and Vector Table	
	4.7	Memory Management	
5.0		**ARM7 Programming**	**08**
	5.1	Data Processing Instructions	
	5.2	Conditional and Branching Instructions	
	5.3	ARM-THUMB Interworking	
	5.4	Single-Register Load-Store Instructions	
	5.5	Stack Instructions	
	5.6	Software Interrupt Instructions	
6.0		**ARM Programming with Embedded C**	**06**
	6.1	General Purpose Input Output	
	6.2	Timer Mode	
	6.3	Pulse –Width Modulator Configuration	
		Total	**48**

Text Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "*The 8051 Microcontroller & Embedded systems*", Pearson Publications, Second Edition 2006.
2. C. Kenneth J. Ayala and D. V. Gadre, "*The 8051 Microcontroller & Embedded system using assembly & 'C*' ", Cengage Learning, Edition 2010.
3. Satish Shah, "*The 8051 Microcontrollers",* Oxford publication first edition 2010.
4. Andrew Sloss, Dominic Symes, and Chris Wright, "*ARM System Developer's Guide*" Morgan Kaufmann Publishers, First Edition 2004.
5. Lyla Das, "*Embedded Systems: An Integrated Approach*", Pearson Publication, First Edition 2013
6. James A. Langbridge, "*Professional Embedded Arm Development*", Wrox, John Wiley Brand& Sons Inc., Edition 2014

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC602	Computer Communication Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC602	Computer Communication Networks	20	20	20	80	--	--	--	100

Course Pre requisite:

- Analog Communication

Course objectives:

- To introduce analysis and design of computer and communication networks.
- To design and configure a network for an organization. To implement client-server socket programs.
- To analyse the traffic flow and the contents of protocol frames.

Course outcomes:

After successful completion of the course student will be able to

- Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
- Perform basic configurations on routers and Ethernet switches.
- Demonstrate knowledge of programming for network communications.
- Learn to simulate computer networks and analyse the simulation results.
- Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model.
- Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Network Applications	
	1.2	Network Hardware	
	1.3	Network Software	
	1.4	Reference Models, overview of TCP/IP, layer Functions, services, sockets and ports, Encapsulation.	
2.0		**Introduction to Physical layer Services and System**	**08**
	2.1	Introduction to physical media, Coax, RJ 45 , fiber, twisted pair, DSL, HFC, WiMax, cellular, satellite, and telephone networks, bit transmission, frequency division multiplexing. time division multiplexing.	
3.0		**The Data Link Layer**	**08**
	3.1	Data link Layer Design Issues	
	3.2	Error Detection and Correction	
		Elementary Data Link Protocols, Sliding Window Protocols	
		Example Data Link Protocols: HDLC: High-Level Data Link Control, The Data Link Layer in The Internet.	
4.0		**The Medium Access Sub- Layer**	**06**
	4.1	Channel Allocation Problem.	
	4.2	Multiple Access Protocols.	
5.0		**The Network Layer**	**10**
	5.1	Network Layer Design Issues.	
	5.2	Routing Algorithms.	
	5.3	Congestion Control Algorithms, Quality of Service.	
	5.4	Internetworking.	
	5.5	The Network Layer In The Internet: The IP Protocol, IPv4 header, IP Addressesing, Subnetting.	
	5.6	Internet Control Protocols, The Interior Gateway Routing Protocol: OSPF, The Exterior Gateway Routing Protocol: BGP.	
6.0		**The Transport Layer**	**10**
	6.1	The Transport Service.	
	6.2	Elements of Transport Protocols.	
	6.3	The Internet Transport Protocol: UDP	
	6.4	The Internet Transport Protocol: TCP:-Introduction to TCP, The TCP Service Model, The TCP Protocol.	
	6.5	The TCP Segment Header.	
	6.6	TCP Connection Establishment, TCP Connection Release.	
	6.7	Modeling TCP Connection Management.	
	6.8	TCP Transmission Policy.	
	6.9	TCP Congestion Control.	
	6.10	TCP Timer Management, Transactional TCP.	

		Total	**48**

Text Books:

1. A. S. Tanenbaum,"Computer Networks", 4th edition, Prentice Hall
2. B. F. Ferouzan,"Data and Computer Communication", Tata McGraw Hill.

Reference Books:

1. Peterson & Davie, "Computer Networks", 2nd Edition, Morgan Kaufmann.
2. Kurose, Ross, "Computer Networking", Addison Wesley
3. S. Keshav, "An Engg, Approach To Computer Networking", Addison Wesley.
4. W. Richard Stevens, "TCP/IP Volume1, 2, 3", Addison Wesley.
5. D. E. Comer, "Computer Networks And Internets", Prentice Hall.
6. B. F. Ferouzan , "TCP/IP Protocol Suite", Tata McGraw Hill.

Internal Assessment:
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End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC603	Antenna & Radio Wave Propagation	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Field
- Two port network
- Transmission Line

Course objectives:

- To learn fundamental parameters of Antenna
- To learn about linear wire antenna elements and Antenna arrays
- To learn about Special types of Antennas
- To learn about Antenna measurements and radio wave propagation

Course outcomes:

After successful completion of the course student will be able to

- Define Basic antenna parameters like radiation pattern, directivity and gain.
- Derive the field equations for the basic radiating elements like linear wire antenna and loop antenna.
- Design of uniform linear and planar antenna arrays using isotropic and directional Sources.
- Implement special types of Antennas like microstrip antennas and reflectors.

Module No.	Unit No.	Topics	Hrs.
1.0		**Antenna Fundamentals**	**08**
	1.1	Introduction, Radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, Beamwidth, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, Antenna radiation efficiency, FRIIS transmission equation	
	1.2	Basic concepts of Maxwell's equation, vector potential, wave equation, near field and far field radiation, dual equations for electric and magnetic current sources.	
2.0		**Wire Elements: Dipoles, Monopoles, Loops and Helical**	**12**
	2.1	Infinitesimal dipole, radiation fields, radiation resistance, radiation sphere, near field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, Monopole antenna, Folded dipole. Design of dipole and monopole antenna	
	2.2	Loop Antenna: Small circular loop, comparison of small loop with short dipole, Ferrite loop, radiation patterns its parameters and their application.	
	2.3	Helical Antennas: Input impedance matching, Axial mode and normal mode propagation, Circular polarization using Helical Antenna	
3.0		**Arrays**	**12**
	3.1	Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, Phase scanning arrays, broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array.	
	3.2	Introduction to planner and circular arrays	
	3.3	Design of Yagi antenna and Log Periodic antenna	
4.0		**Aperture Antennas**	**06**
	4.1	Horn Antennas :E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn	
	4.2	Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector, Design considerations	
5.0		**Patch Antenna**	**04**
	5.1	Microstrip antenna (MSA): Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs	
6.0		**Antenna Measurements & Wave Propagation**	**06**

	6.1	**Antenna Measurements:** Measurement of Antenna parameters: Input Impedance, Radiation Pattern, Gain (Two and Three antenna method), Polarization.	
	6.2	**Ground Wave Propagation:** Ground waves, effect of Earth's Curvature on Ground wave propagation, impact of imperfect earth	
	6.3	**Sky Wave Propagation** Ionosphere and Earth magnetic field effect, Critical frequency, Angle of incidence, Maximum usable frequency, Skip distance, Virtual height, Variations in ionosphere and Attenuation and fading of waves in ionosphere	
	6.4	Space Wave Propagation	
		Total	**48**

Text Books:

1. C. A. Balanis, Antenna Theory: Analysis and Design (3rd eds.), John Wiley & Sons, Hoboken, NJ, 2005.
2. J. D. Kraus, R. J. Marhefka, A.S. Khan "Antennas & Wave Propagation", McGraw Hill Publications, 4th Edition, 2011
3. G. Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, 2002.

Reference Books:

1. Stutzman, Theile, " Antenna Theory and Design", John Wiley and Sons , 3rd Edition
2. R. E. Collin, "Antennas and Radio Wave Propagation", International Student Edition, McGraw Hill.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC604	Image Processing & Machine Vision	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC604	Image Processing & Machine Vision	20	20	20	80	--	--	--	100

Prerequisites:

- Signals and Systems
- Discrete Time Signal Processing

Course objectives:

- To cover the fundamentals and mathematical models in digital image processing and Machine Vision
- To develop time and frequency domain techniques for image enhancement.
- To expose the students to classification techniques in Machine Vision
- To develop Applications using image processing and Machine Vision

Course outcomes:

After successful completion of the course student will be able to

- Understand theory and models in image processing.
- Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.
- Apply quantitative models of image processing for segmentation and restoration for various applications.
- Find shape using various representation techniques and classify the object using different classification methods.

Module No.	Unit No.	Topics	Hrs.
1.0		**Digital Image Fundamentals**	**04**
	1.1	**Introduction** – Origin – Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and Acquisition, Image Sampling and Quantization – Relationships between pixels, Transformation: Orthogonal, Euclidean, Affine	
	1.2	**Color Image Processing**: Color Fundamentals Color models.	
2.0		**Image Transforms**	**06**
	2.1	1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT ,Walsh -Hadamard, Discrete Cosine Transform, Haar Transform	
3.0		**Image Enhancement**	**08**
	3.1	Image Negative, Log Transform, Power Law transform, Histogram equalization and Histogram Specification	
	3.2	**Spatial Domain**: Basics of Spatial Filtering, The Mechanics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering	
	3.3	**Frequency Domain**:, The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Laplacian, Unsharp Masking and Homomorphic filters	
4.0		**Morphological & Image Restoration**	**06**
	4.1	**Morphology**: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation.	
	4.2	**Restoration :**Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters	
5.0		**Patch Antenna**	**12**
	5.1	**Point, Line, and Edge Detection:** Detection of Isolated Points, Line detection, edge models, basic and advance edge detection, Edge linking and boundary detection , Canny's edge detection algorithm	
	5.2	**Thresholding** : Foundation, Role of illumination, Basic Global thresholding	
	5.3	**Region Based segmentation**: Region Growing, Region Splitting and merging	
	5.4	**Region Identification**, chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences, B-spline representation	
6.0		**Boundary Description & Object Recognition**	**12**

	6.1	**Texture:** Statistical Texture Description Methods- Methods based on spatial frequencies, co-occurrence matrices, edge frequency, primitive length, Law's texture energy measures	
	6.2	**Object Recognition** Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Support vector machine, cluster analysis	
		Total	**48**

Text Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Cengage Engineering, 3rd Edition, 2013
2. Gonzales and Woods, "Digital Image Processing", Pearson Education, India, Third Edition,

Reference books:

1. Anil K.Jain, "Fundamentals of Image Processing", Prentice Hall of India, First Edition, 1989.
2. W Pratt, "Digital Image Processing", Wiley Publication, 3rd Edition, 2002

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6021	Digital VLSI Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6021	Digital VLSI Design	20	20	20	80	--	--	--	100

Prerequisites:

- Digital System Design
- Microelectronics

Course objectives:

- To highlight the circuit design issues in the context of Digital VLSI technology
- A profound understanding of Digital VLSI design circuits using different design styles.
- To provides an exposure to RTL design and programming

Course outcomes:

After successful completion of the course student will be able to

- Understand the semiconductor technology, scaling and performance.
- Realize logic circuits with different design styles.
- To understand operation of memory, storage circuits and data path elements.
- Simulate and synthesize digital circuits using HDL language.
- Demonstrate an understanding of system level design issues such as protection, clocking, and routing.
- Learn the RTL design techniques and methodologies

Module No.	Unit No.	Topics	Hrs.
1.0		**MOS Circuit Design Styles**	**10**
	1.1	Static CMOS, Dynamic CMOS , Pseudo NMOS, Domino, C^2MOS, NORA logic, NP Domino logic	
	1.2	Realization of Multiplexer (upto 4:1 Mux) , Encoder, Decoder,SR Latch, JK FF, D FF, 1 Bit Shift Register with different design styles and their layouts	
2.0		**Memory and Storage circuits**	**08**
	2.1	ROM array, SRAM (operation, design strategy, leakage currents, read /write circuits), layout of SRAM	
	2.2	DRAM (Operation of 1T, 3T, operation modes, leakage currents, refresh operation, Input-Output circuits), layout of DRAM	
	2.3	Flash memory: NAND and NOR flash memory	
3.0		**Data path design**	**08**
	3.1	Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder	
	3.2	Array Multiplier	
	3.3	Barrel shifter	
4.0		**VLSI Clocking, Protection and Interconnect**	**06**
	4.1	CMOS clocking styles, pipelined systems, Clock generation, stabilization and distribution	
	4.2	ESD protection, Input circuits, Output circuits, power distribution scheme	
	4.3	Interconnect delay model, interconnect scaling and crosstalk	
5.0		**Design methods**	**08**
	5.1	Semicustom, Full custom design, ASIC	
	5.2	PLA, PLD, PAL, FPGA	
	5.3	System based and Data path design using HDL	
6.0		**RTL Design**	**08**
	6.1	High Level state machines, RTL design process	
	6.2	Soda dispenser machine, laser based distance measure, Sum of absolute	
	6.3	FIR filter design	
		Total	**48**

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.
2. P. Uyemura, "*Introduction to VLSI Circuits and Systems*", John Wiley & Sons.
3. Frank Vahid, " Digital Design with RTL design, VHDL and VERILOG", John Wiley and Sons Publisher 2011.

4. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.
5. Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis", PHI, Second Edition
6. Douglas L. Perry " VHDL: Programming by Example" , McGrawHill, 4th Edition

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition..
2. Volnei A. Pedroni ,"Circuit Design and Simulation with VHDL", MIT Press, 2nd Edition

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6022	Radar Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6022	Radar Engineering	20	20	20	80	--	--	--	100

Prerequisties:

- Communication Fundamentals
- Electromagnetic field
- Transmission Lines and Antenna

Course objectives:

- To interpret Radar equations
- To explain different types of radar
- To design RADAR transmitters and receivers for given conditions

Course outcomes:

After successful completion of the course student will be able to

- Explain generalized concept of RADAR.
- Solve problems using radar equations.
- Describe different types of radar for specific application.
- Explain concept of tracking radar.
- Evaluate the design constraints for transmitter.
- Evaluate the design constraints for receiver.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Radar**	**04**
	1.1	Basics Radar, Radar equation	
	1.2	Block Diagram, Radar Frequencies	
	1.3	Applications of Radar	
2.0		**Radar Equation**	**08**
	2.1	Detection of signal in noise	
	2.2	Receiver Noise and Signal-to-noise Ratio	
	2.3	Probability of detection and false alarm: Simple , complex Targets	
	2.4	Pulse Repetition Frequency	
3.0		**MTI and Pulse Doppler Radar**	**12**
	3.1	Introduction to Doppler and MTI radar, Doppler frequency shift	
	3.2	Simple CW Doppler radar, MTI radar block diagram	
	3.3	Delay line canceler	
	3.4	Moving-target-detection	
	3.5	Pulse Doppler radar	
4.0		**Tracking Radar**	**08**
	4.1	Monopulse tracking	
	4.2	Conical scan and sequential lobbing	
	4.3	Limitation of tracking accuracy	
	4.4	Low angle tracking	
5.0		**Radar Transmitters**	**10**
	5.1	Radar RF power sources: Klystron, Travelling wave tube	
	5.2	Solid state RF power source: low power transmitter, high power transmitter, Advantages of solid state RF power source	
	5.3	Magnetron: coaxial magnetron	
	5.4	Crossed field amplifiers: CFA operation, modulating a CFA, system implementation	
6.0		**Radar Receivers**	**06**
	6.1	Receiver noise figure	
	6.2	Superheterodyne Receiver	
	6.3	Radar Display: Types of displays	
		Total	**48**

Text Books:

1. Merill Skolnik, –Introduction to RADAR Systems, Tata McGraw Hill, Third Edition
2. Merill Skolnik, –Radar Handbook, TataMcgraw Hill, Second Edition

Reference books:

1. Mark A. Richards, James A. Scheer, William A. Holm, "Principles of Modern Radar Basic Principals", Scitech Publishing.
2. Simon Kingsley, Shaun Quegon, "Understanding Radar Systems", Scientech Publishing Inc.
3. G. S. N. Raju, "Radar Engineering and Fundamentals of Navigational Aids", I. K International publishing House Pvt. Ltd.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

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1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6023	Database Management System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6023	Database Management System	20	20	20	80	--	--	--	100

Prerequisites:

- Basic knowledge of programming

Course objectives:

- Learn and practice data modeling using the entity-relationship and developing database designs.
- Understand the use of Structured Query Language (SQL) and learn SQL syntax.
- Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access

Course outcomes:

After successful completion of the course student will be able to

- Understand the different issues involved in the design and implementation of a database system.
- Transform an information model into a relational database schema and to use a data definition language and/or utility to implement the schema using a DBMS.
- Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
- Understand the concepts of constraints, views, concurrency control, deadlock

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Databases and Transactions**	**02**
	1.1	Introduction to databases, History of database system, Benefits of Database system over file system, relational databases, database architecture, transaction management	
2.0		**Data Models**	**06**
	2.1	The importance of data models, Basic building blocks, Business rules, Evolution of data models (hierarchical, Network, Relational, Entity relationship and object model), Degrees of data abstraction.	
3.0		**Database Design, ER-Diagram and Unified Modeling Language**	**10**
	3.1	Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).	
4.0		**Relational Algebra and Calculus**	**10**
	4.1	Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	
5.0		**Constraints, Views and SQL**	**10**
	5.1	What is constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.	
6.0		**Transaction management and Concurrency control**	**10**
	6.1	Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	
		Total	**48**

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", Fifth Edition McGraw-Hill
2. Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", Seventh Edition, Person.
4. G. K. Gupta: "Database Management Systems", McGraw – Hill.

Reference Books:

1. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.
2. P.S. Deshpande, "SQL and PL/SQL for Oracle 11g, Black Book", Dreamtech Press
3. Mark L. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley
4. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH
5. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

E-Resources:

1. https://www.tutorialspoint.com/dbms/index.htm
2. https://www.studytonight.com/dbms/
3. https://beginnersbook.com/2015/04/dbms-tutorial/
4. https://www.w3schools.in/dbms/
5. https://www.tutorialcup.com/dbms

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

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1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6024	Audio Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6024	Audio Processing	20	20	20	80	--	--	--	100

Prerequisites

- Signal System

Course objectives:

- To understand basic concepts and methodologies for the analysis and modeling of speech signal.
- To characterize the speech signal as generated by a speech production model.
- To understand the mechanism of speech and audio perception.
- To understand the digital representation of the speech waveform.
- To perform the analysis of speech signal using STFT.
- To extract the information of the speech or audio signals.
- To provide a foundation for developing application in this field.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate advanced Knowledge in Digital model representation of speech signal.
- Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
- Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
- Formulate and design a system for speech recognition and speaker recognition.
- Acquired knowledge about audio and speech signal estimation and detection.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Review of digital signal and systems, Transforms representations of signal and systems, Sampling Theorem, Goertzel algorithm, Chirp algorithm.	
2.0		**Digital Models for Speech signals**	**06**
	2.1	Speech production and acoustic tube modeling, acoustic phonetics, anatomy, and physiology of the vocal tract and ear, hearing and perception.	
3.0		**Digital Representations of the Speech Waveform**	**08**
	3.1	Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, Direct digital code conversion.	
4.0		**Time Domain Models for Speech Processing**	**12**
	4.1	Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech V/S silence discrimination using energy & Zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.	
5.0		**Short time Fourier Transform**	**10**
	5.1	Introduction- Definition and Properties, Fourier Transform Interpretation ,Linear Filtering Interpretation ,Sampling rates of X_n (e^{jw})in Time and Frequency ,Filter Bank Summation Method of Short -Time Synthesis ,Overlap Addition Method for Short -Time Synthesis.	
6.0		**Speech and Audio Processing**	**06**
	6.1	Vocoder- Voice excited channel vocoder, Voice excited and error signal excited LPC vocoders. Adaptive predictive coding of speech, Auditory Modeling. Audio signal processing for Music applications. Speech recognition pattern comparison techniques, Artificial Neural Network.	
		Total	**48**

Text Books:

1. L R Rabiner and S W Schafer, “Digital processing of speech signals”, Pearson Education, 2009.
2. L R Rabiner, B H Juang, B Yegnanarayana, “Fundamentals of speech Recognition”, Pearson Education, 1993.

Reference Books

1. Thomas F Quateri, “ Discrete Time Speech Signal Processing “Pearson Edition,2006.
2. Ben Gold and Nelson Morgan, “Speech & Audio Signal Processing”, wiley, 2007.
3. Douglas O Shaughnessy, “Speech Communications”, 2nd Edition, Oxford university press, 2000.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL601	Microcontroller & Applications Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL601	Microcontroller & Applications Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

1. Perform Arithmetic and Logical Operations
2. Transfer of data bytes between Internal and External Memory
3. Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc
4. Interfacing of LED,LCD, Stepper Motor, UART

Mini project based on any application related to 8051 or ARM7 can be implemented.

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL602	Computer Communication Network Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL602	Computer Communication Network Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

1. Create a Virtual Network using NETKIT emulator and use networking commands like route, arp, netstat, traceroute, ping on created topology.
2. To study installation and configuration of NS 2.35 simulator.
3. Design a connectionless and connection oriented network topology for static routing and dynamic routing with the help of NS2 simulator.
4. To study three way handshaking process as well as working process for connection oriented Protocols like FTP, TELNET and analysing packets generated by using packet capturing tool like tcpdump
5. To implement stream socket that can serve multiple clients at the same time.
6. To study requirements and scope of Subnetting and Network Translation by using Netkit Emulator.
7. Case Study: To study installation of linux operating system by using DHCP, TFTP and any repository server like HTTP, FTP or NFS.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL603	Antenna & Radio Wave Propagation Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL603	Antenna & Radio Wave Propagation Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Introduction to different Antenna parameters and its importance
- Introduction to Different Antenna Types
- Study of Radiation pattern of dipole, folded dipole and Monopole antenna
- Study of Antenna Arrays – N element array for given angle, Parametric study for various arrays parameters
- Study of Yagi-Uda Antenna
- Study of Aperture Antennas – Horn / Reflector Antennas
- Design, implementation and Pattern measurement of Regular shape MSA
- Case Study of Recent reported variations of Antenna types (Paper from reputed journal is to be referred and thoroughly study and present the report, maximum four students per group)

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL604	Image Processing and Machine Vision Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL604	Image Processing and Machine Vision Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- At least 8 programs written in C/MATLAB software

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6021	Digital VLSI Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6021	Digital VLSI Design Laboratory	--	--	--	--	25	--	--	25

Suggested Experiment List

1. At least **08** experiments covering entire syllabus of Digital VLSI should be set to have well predefined inference and conclusion.
2. The first 05 experiments as described below can be conducted by using Free or Professional tools
    - **01** experiments on Layouts of NAND and NOR gates to understand design rules
    - **01** experiment on Layout design of logical expression
    - **01** experiments on NAND/NOR gate implementation using at least 03 design styles
    - **02** experiment on Multiplexer/Decoder/Flip flop/Memory etc design
3. Last **03** experiments on HDL

Note: Small Project can be considered as a part of term-work.
Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6022	Radar Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6022	Radar Engineering Laboratory	--	--	--	--	25	--	--	25

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6023	Database Management System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6023	Database Management System Laboratory	--	--	--	--	25	--	--	25

Suggested Experiment List

- Design a Database and create required tables. For e.g. Bank, College Database
- Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
- Write a sql statement for implementing ALTER, UPDATE and DELETE
- Write the queries to implement the joins
- Write the query for implementing the following functions: MAX (), MIN (), AVG (), COUNT ()
- Write the query to implement the concept of Integrity constrains
- Write the query to create the views
- Perform the queries for triggers
- Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints
- Write the query for creating the users and their role

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Library Management System
2. Hospital Management System
3. Pharmacy Management System
4. Human Resource Database Management System in Java
5. Student Database Management System
6. Employee Management System
7. Inventory Control Management Database

8. Pay Roll Management System
9. Railway System Database
10. Airline Reservation System
11. Blood Donation System
12. School Management System

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6024	Audio Processing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6024	Audio Processing Laboratory	--	--	--	--	25	--	--	25

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.