Revised syllabus as per letter No. AAU/ICD/ 2018-19/179 dt. 10-06-2019.

UNIVERSITY OF MUMBAI

No. UG/42 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/239 of 2010, dated 12th August, 2010 relating to syllabus of the Bachelor of Engineering (B.E.) degree course.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Electronics & Telecommunication Engineering at its meeting held on 9th April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.53 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.E. & B.E. in Electronics & Telecommunication Engineering (Sem - V to VIII) has been brought into force with effect from the academic year 2018-19 and 2019-2020, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c. REGISTRAR

MUMBAI – 400 032
25th June, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.53/05/05/2018

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No. UG/42 -A of 2018 MUMBAI-400 032 25th June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies in Electronics & Telecommunication Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

AC- 5.05.2018
Item No. 4.53

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

Dean, Faculty of Science and Technology

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 (PEOs) and give freedom to affiliated Institutes to add few (PEOs). 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 scales 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
Dean (I/c) Faculty of Science and 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

Program Structure for
B.E. Electronics & Telecommunication Engineering (Rev. 2016)
University of Mumbai (With Effect from 2017-2018)
Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC501	Microprocessor & Peripherals Interfacing	4	-	-	4	-	4
ECC502	Digital Communication	4	-	-	4	-	4
ECC503	Electromagnetic Engineering	4	-	1@	4	1	5
ECC504	Discrete Time Signal Processing	4	-	-	4	-	4
ECCDLO 501X	Department Level Optional Course I	4	-	-	4	-	4
ECL501	Microprocessor & Peripherals Interfacing Lab	-	2	-	-	1	1
ECL502	Digital Communication Lab	-	2	-	-	1	1
ECL503	Business Communication & Ethics Lab	-	2+2*	-	-	2	2
ECL504	Open Source Technology for Communication Lab	-	2	-	-	1	1
ECLDLO 501X	Department Level Optional Lab I	-	-	2#	-	1	1
Total		**20**	**10**	**3**	**20**	**7**	**27**

@ 1 hour to be taken as tutorial classwise #2 hours to be taken as either lab or tutorial based on subject requirement
*2 hours to be taken as tutorial batchwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral/ Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC501	Microprocessor & Peripherals Interfacing	20	20	20	80	03	--	--	100
ECC502	Digital Communication	20	20	20	80	03	--	--	100
ECC503	Electromagnetic Engineering	20	20	20	80	03	25	--	125
ECC504	Discrete Time Signal Processing	20	20	20	80	03	--	--	100
ECCDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ECL501	Microprocessor & Peripherals Interfacing Lab	--	--	--	--	--	25	25	50
ECL502	Digital Communication Lab	--	--	--	--	--	25	25	50
ECL503	Business Communication & Ethics Lab	--	--	--	--	--	50	--	50
ECL504	Open Source Technology for Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 501X	Department Level Optional Lab I	--	--	--	--	--	25	--	25
Total				**100**	**400**		**175**	**75**	**750**

Course Code	Department Level Optional Course I
ECCDLO 5011	Microelectronics
ECCDLO 5012	TV & Video Engineering
ECCDLO 5013	Finite Automata Theory
ECCDLO 5014	Data Compression and Encryption

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

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC701	Microwave Engineering	4	-	-	4	-	4
ECC702	Mobile Communication System	4	-	-	4	-	4
ECC703	Optical Communication	4	-	--	4	-	4
ECCDLO 703X	Department Level Optional Course III	4	-	-	4	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	3
ECL701	Microwave Engineering Lab	-	2	-	-	1	1
ECL702	Mobile Communication System Lab	-	2	-	-	1	1
ECL703	Optical Communication Lab	-	2	-	-	1	1
ECLDLO 703X	Department Level Optional Lab III	-	2	-	-	1	1
ECL704	Project-I	-	6	-	-	3	3
Total		**19**	**14**	**-**	**19**	**7**	**26**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC701	Microwave Engineering	20	20	20	80	03	--	--	100
ECC702	Mobile Communication System	20	20	20	80	03	--	--	100
ECC703	Optical Communication	20	20	20	80	03	--	--	100
ECCDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100
ILO701X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
ECL701	Microwave Engineering Lab	--	--	--	--	--	25	25	50
ECL702	Mobile Communication System Lab	--	--	--	--	--	25	25	50
ECL703	Optical Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 703X	Department Level Optional Lab III	--	--	--	--	--	25	25	50
ECL704	Project-I	--	--	--	--	--	50	50	100
Total				**100**	**400**		**150**	**150**	**800**

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I[#]
ECCDLO7031	Neural Networks and Fuzzy Logic	ILO7011	Product Lifecycle Management
ECCDLO7032	Big Data Analytics	ILO7012	Reliability Engineering
ECCDLO7033	Internet Communication Engineering	ILO7013	Management Information System
ECCDLO7034	CMOS Mixed Signal VLSI	ILO7014	Design of Experiments
ECCDLO7035	Embedded System	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

 # Common with all branches

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC801	RF Design	4	-	--	4	--	4
ECC802	Wireless Networks	4	-	-	4	-	4
ECCDLO 804X	Department Level Optional Course IV	4	-	-	4	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	3
ECL801	RF Design Lab	-	2	-	-	1	1
ECL802	Wireless Networks Lab	-	2	-	-	1	1
ECLDLO 804X	Department Level Optional Lab IV	-	2	-	-	1	1
ECL803	Project-II	-	12	-	-	6	6
Total		**15**	**18**	**-**	**15**	**9**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC801	RF Design	20	20	20	80	03	--	--	100
ECC802	Wireless Networks	20	20	20	80	03	--	--	100
ECCDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
ECL801	RF Design Lab	--	--	--	--	--	25	25	50
ECL802	Wireless Networks Lab	--	--	--	--	--	25	25	50
ECLDLO 804X	Department Level Optional Lab IV	--	--	--	--	--	25	25	50
ECL803	Project-II	--	--	--	--	--	100	50	150
Total				**80**	**320**		**175**	**125**	**700**

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II[#]
ECCDLO8041	Optical Networks	ILO8021	Project Management
ECCDLO8042	Advanced Digital Signal Processing	ILO8022	Finance Management
ECCDLO8043	Satellite Communication	ILO8023	Entrepreneurship Development and Management
ECCDLO8044	Network management in Telecommunication	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

 # Common with all branches

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC501	Microprocessors & Peripherals	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					
ECC501	Microprocessors & Peripherals	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

- To understand the basic concepts of microcomputer systems.
- To develop background knowledge and core expertise in 8086 microprocessor and co-processor 8087.
- To write assembly language programs for 8086 microprocessor
- To understand peripheral devices and their interfacing to 8086 and to study the design aspects of basic microprocessor based system.

Course outcomes:

After successful completion of the course student will be able to

- Understand the basic concepts of microcomputer systems.
- Understand the architecture and software aspects of microprocessor 8086.
- Write Assembly language program in 8086.
- Know the Co-processor configurations.
- Interface peripherals for 8086.
- Design elementary aspect of microprocessor based system.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Microcomputer System**	**06**
	1.1	Block diagram of microprocessor based system: CPU, I/O Devices, Clock, Memory, Concept of Address, Data and Control Bus and Tristate logic.	
	1.2	Need of Assembly Language and its Comparison with higher level languages	
	1.3	Need of Assembler and Compiler and their comparison.	
2.0		**Architecture of 8086 Microprocessor**	**06**
	2.2	8086 Architecture and organization, pin configuration.	
	2.3	Minimum and Maximum modes of 8086.	
	2.4	Read and Write bus cycle of 8086.	
3.0		**Instruction set and programming of 8086**	**10**
	3.1	8086 Addressing modes.	
	3.2	8086 Instruction encoding formats and instruction set.	
	3.3	Assembler directives.	
	3.4	8086 programming and debugging of assembly language program. Programs related to: arithmetic, logical, delay, string manipulation, stack and subroutines, input, output, timer/counters.	
	3.5	Elementary DOS Programming: Introduction to int-21h services.	
4.0		**Peripherals interfacing with 8086 and applications.**	**10**
	4.1	8086-Interrupt structure.	
	4.2	Programmable peripheral Interface 8255.	
	4.3	Programmable interval Timer 8254.	
	4.4	Elementary features of 8259A and 8257 and interface.	
	4.5	Interfacing 8255, 8254 with 8086 and their applications	
5.0		**ADC, DAC interfacing with 8086 and its application**	**08**
	5.1	Analog to Digital Converter (ADC) 0809	
	5.2	Digital to Analog Converter (DAC) 0808	
	5.3	Interfacing ADC 0809, DAC 0808 with 8086 and their applications.	
	5.4	8086 based data Acquisition system.	
6.0		**8086 Microprocessor interfacing**	**08**
	6.1	8087 Math co-processor, its data types and interfacing with 8086.	
	6.2	Memory interfacing with 8086 microprocessor	
		Total	**48**

Text Books:

1. John Uffenbeck: "8086/8088 family: "Design, Programming and Interfacing", Prentice Hall, 2nd Edition
2. B. B. Brey: "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor", Pearson Pub, 8th Edition
3. Hall D.V: "Microprocessor and Interfacing Programming and Hardware", Tata McGraw Hill, 2nd Edition.
4. Yu-Cheng Liu/Glenn A. Gibson: "Microcomputer Systems: The 8086/8088 Family Architecture, Programming and Design", Phi Learning.

Reference Books:

1. Peter Abel: "IBM PC ASSEMBLY LANGUAGE & PROGRAMMING", Phi Learning.
2. A. K. Ray and K. M. Burchandi: "Advanced Microprocessor and Peripherals, Architecture Programming and Interfacing", Tata McGrawHill, 3rd Edition
3. Don Anderson, Tom Shanley: "Pentium Processor System Architecture", MindShare Inc., 2nd Edition
4. National Semiconductor: Data Acquisition Linear Devices Data Book
5. Intel Peripheral Devices: Data Book.
6. The Intel 8086 family user manual.

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
ECC502	Digital Communication	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					
ECC502	Digital Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication

Course objectives:

- To identify the signals and functions of its different components,
- To learn about theoretical aspects of digital communication system and Draw signal space diagrams, compute spectra of modulated signals,
- To learn about error detection and correction to produce optimum receiver.

Course outcomes:

After successful completion of the course student will be able to

- Understand random variables and random processes of signal,
- Apply the concepts of Information Theory in source coding,
- Evaluate different methods to eliminate Inter-symbol interference,
- Compare different band-pass modulation techniques,
- Evaluate performance of different error control codes.

Module No.	Unit No.	Topics	Hrs.
1.0		**Probability Theory & Random Variables**	**08**
	1.1	Information, Probability, Conditional Probability of independent events, Relation between probability and probability Density , Raleigh Probability Density , CDF, PDF.	
	1.2	Random Variables, Variance of a Random Variable, correlation between Random Variables, Statistical Averages(Means),Mean and Variance of sum of Random variables, Linear mean square Estimation, Central limit theorem, Error function and Complementary error function Discrete and Continuous Variable, Gaussian PDF, Threshold Detection, Statistical Average, Chebyshev In-Equality, Auto-correction.	
	1.3	Random Processes	
2.0		**Information Theory and Source Coding**	**06**
	2.1	Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and it's properties	
	2.2	Mini Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding, Huffman Source Coding	
	2.3	Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem	
3.0		**Error Control Systems**	**12**
	3.1	Types of error control, error control codes, linear block codes, systematic linear block codes, generator matrix, parity check matrix, syndrome testing ,error correction, and decoder implementation	
	3.2	**Systematic and Non-systematic Cyclic codes**: encoding with shift register and error detection and correction	
	3.3	**Convolution Codes**: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods.	
4.0		**Bandpass Modulation & Demodulation**	**10**
	4.1	Band-pass digital transmitter and receiver model, digital modulation schemes	
	4.2	Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying QPSK), M- ary PSK Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK)	

5.0		**Baseband Modulation & Transmission**	**04**
	5.1	Discrete PAM signals and it's power spectra	
	5.2	Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern	
6.0		**Optimum Reception of Digital Signal**	**08**
	6.1	Baseband receiver	
	6.2	Probability of Error	
	6.3	Optimum Receiver and Filter	
	6.4	Matched Filter and its probability of error	
	6.5	Coherent Reception	
	Total		**48**

Text Books:

1. H. Taub, D. Schlling, and G. Saha, "Principles of Communication Systems," Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
2. Lathi B P, and Ding Z., "Modern Digital and Analog Communication Systems," Oxford University Press, Fourth Edition, 2009.
3. Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.

Reference Books:

1. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. T L Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3. P Ramakrishna Rao, "Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2011.
4. M F Mesiya, "Contempory Communication systems", Mc-Graw Hill, Singapore, First Edition, 2013.

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
ECC503	Electromagnetic Engineering	04	--	@1	04	--	01	05

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					
ECC503	Electromagnetic Engineering	20	20	20	80	25	--	--	125

@ 1 hour to be taken as tutorial class wise

Course prerequisite:

- Vector Algebra and vector Calculus
- Various Co-ordinate system
- Two port network

Course objectives:

- To learn electromagnetics, including static and dynamic electromagnetic fields and waves within and at the boundaries of media.
- To learn mathematical skills, including Vectors and phasors and Partial differential equations.
- To learn Electromagnetic radiation and propagation in space and within transmission lines

Course outcomes:

After successful completion of the course student will be able to explain and evaluate EM fields and key physical parameters for:

- Fields and energies in simple planar, cylindrical, and spherical geometries, Fields within conducting and anisotropic media
- Electric and magnetic forces on charges, wires, and media Sinusoids and transients on TEM lines with mismatched impedances and tuning

Module No.	Unit No.	Topics	Hrs.
1.0		**Electrostatics**	**07**
	1.1	Coulomb's Law & Electric Field Intensity, Electric Field due to point charge, line charge and surface charge distributions	
	1.2	Electric Flux Density, Gauss's Law and its Application to differential volume element, divergence, divergence theorem.	
	1.3	Electric potential, Relationship between Electric field & potential , Potential Gradient., electric dipole	
2.0		**Electric Fields in Material Space**	**06**
	2.1	Energy density in electrostatic field, Current and current Density, continuity equation, Polarization in dielectrics	
	2.2	Capacitance, capacitance of parallel plate; spherical; cylindrical capacitors with multiple di-electrics, Boundary conditions	
	2.3	Poisson's and Laplace's equation, General procedures for solving Poisson's and Laplace's equations.	
3.0		**Steady Magnetic Field**	**07**
	3.1	Biot-Savart's Law, Ampere's Circuital Law and its Applications, magnetic flux density, Magnetic Scalar and vectors potentials, Derivations of Biot-Savart's law and Ampere's law based on Magnetic Potential	
	3.2	Forces due to magnetic field, magnetic dipole, Classification of Magnetic Materials, Magnetic boundary conditions.	
4.0		**Maxwell's Equation and Electromagnetic Wave Propagation**	**12**
	4.1	Faraday's law, Displacement current, Maxwell's equations in point form and integral form, Boundary conditions for time varying field , magnetic vector potential, Time harmonic field, Introduction to the concept of Uniform Plane Wave and Helmholtz equation.	
	4.2	Wave Propagation in Free Space, Lossy and Lossless Dielectrics and in Good Conductors. Reflection of Plane Wave, Poynting Vector, Wave Power, Skin Effect, Wave Polarization and Standing Wave Ratio	
5.0		**Transmission Lines**	**10**
	5.1	Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio, Power, Transients on transmission lines.	
	5.2	Smith Chart, Applications of Smith Chart in finding VSWR ,and reflection coefficient, admittance calculations, impedance calculations over length of line.	

6.0		Applications of Electromagnetics	06
	6.1	Electrostatic discharge, Materials with high dielectric constant, Graphene, Inkjet printer, RF mems, Multidielectric systems, magnetic levitation, Memristor, Optical nanocircuits, Metamaterials, Microstrip lines and characterization of Data cables, RFID	
		Total	**48**

Text Books:

1. Engineering Electromagnetics, William H Hayt and John A Buck - Tata McGraw-Hill Publishing Company Limited, Seventh Edition
2. Principles of Electromagnetics, Matthew N. O.Sadiku ,S.V.Kulkarni- Oxford university press, Sixth edition

Reference Books:

1. Electromagnetics with applications by J.D.Krauss and Daniel Fleisch fifth edition
2. Electromagnetic Field Theory Fundamentals, Bhag Singh Guru, Hüseyin R. Hiziroglu Cambridge University Press, Second Edition.
3. Electromagnetics, Joseph Edminister, , Mahmood Nahvi, Schaum Outline Series, Fourth edition.
4. R. K. Shevgaonkar, "Electromagnetic Waves" Tata McGraw Hil

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
ECC504	Discrete Time Signal 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					
ECC504	Discrete Time Signal Processing	20	20	20	80	--	--	--	100

Course prerequisite:

- Signals & Systems

Course objectives:

- To develop a thorough understanding of DFT and FFT and their applications.
- To teach the design techniques and performance analysis of digital filters
- To introduce the students to digital signal processors and its applications.

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts of discrete-time Fourier transform and fast Fourier transform.
- Apply the knowledge of design of IIR digital filters to meet arbitrary specifications.
- Apply the knowledge of design of FIR digital filters to meet arbitrary specifications.
- Analyze the effect of hardware limitations on performance of digital filters.
- Apply the knowledge of DSP processors for various applications.

Module No.	Unit No.	Topics	Hrs.
1.0		**Discrete Fourier Transform & Fast Fourier Transform**	**10**
	1.1	Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT	
	1.2	Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and introduction to composite FFT.	
2.0		**IIR Digital Filters**	**10**
	2.1	Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop and All Pass), Analog filter approximations: Butterworth, Chebyshev I, Elliptic.	
	2.2	Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with examples.	
	2.3	Analog and digital frequency transformations with design examples.	
3.0		**FIR Digital Filters**	**10**
	3.1	Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters. Frequency response, location of the zeros of linear phase FIR filters.	
	3.2	Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann, Kaiser), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.	
4.0		**Finite Word Length effects in Digital Filters**	**06**
	4.1	Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Co-efficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling.	
	4.2	Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters.	
5.0		**DSP Processors**	**06**
	5.1	Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC), Special Instructions, Replication, On-chip memory, Extended Parallelism.	

	5.2	General purpose digital signal processors, Selecting digital signal processors, Special purpose DSP hardware, Architecture of TMS320CX fixed and floating DSP processors.	
6.0		**Applications of Digital Signal Processing**	**06**
	6.1	Application of DSP for ECG signals analysis.	
	6.2	Application of DSP for Dual Tone Multi Frequency signal detection.	
	6.3	Application of DSP for Radar Signal Processing.	
		Total	**48**

Text Books:

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing"*, A Practical Approach by, Pearson Education
2. Tarun Kumar Rawat, " *Digital Signal Processing"*, Oxford University Press, 2015

Reference Books:

1. Proakis J., Manolakis D., "*Digital Signal Processing*", 4th Edition, Pearson Education.
2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited.
3. Oppenheim A., Schafer R., Buck J., "*Discrete Time Signal Processing*", 2nd Edition, Pearson Education.
4. B. Venkata Ramani and M. Bhaskar, "*Digital Signal Processors, Architecture, Programming and Applications*", Tata McGraw Hill, 2004.
5. L. R. Rabiner and B. Gold, "*Theory and Applications of Digital Signal Processi*ng", Prentice-Hall of India, 2006.

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 5011	Microelectronics	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 5011	Microelectronics	20	20	20	80	--	--	--	100

Course prerequisite:

- Electronics Devices and Circuits- I
- Electronics Devices and Circuits- II

Course objectives:

- To understand integrated circuit biasing using MOSFET.
- To analyze single stage active load MOS amplifier.
- To analyze active load differential amplifier
- To understand implementation of passive components in ICs.

Course outcomes:

After successful completion of the course student will be able to

- Analyze various constant current source circuit using MOS
- Design and implement active load MOS amplifier.
- Design and implement active load differential amplifier

Module No.	Unit No.	Topics	Hrs.
1.0		**Basics of MOSFETs**	**08**
	1.1	Introduction to various fabrication process(in brief) Fabrication of NMOS and PMOS transistors along with mask layout diagram, Multi finger transistor, Scaling of MOSFET, Various Short channel effects in MOSFET, Second order effects in MOSFET, MOS as controlled resistor, MOS device capacitances	
2.0		**Integrated Circuit Biasing & Active Loads using MOSFET**	**08**
	2.1	Current Mirror, cascade current source, Wilson current source, bias independent current source using MOSFET,DC analysis and small signal analysis of MOS active load, DC analysis and small signal analysis of MOS advanced active load	
3.0		**Single Stage MOS Active Load amplifiers**	**08**
	3.1	CS amplifier with current source load, CS amplifier with diode connected load, CS amplifier with current source load, Common gate circuit, Cascode amplifier, Double Cascoding, Folded Cascode.	
4.0		**Active Load MOSFET Differential Amplifier**	**10**
	4.1	Basic MOS Differential Amplifier, DC transfer characteristics, small signal equivalent analysis, MOS differential amplifier with active load, MOS differential amplifier with cascode active load,	
5.0		**Passive Device Fabrication in IC**	**07**
	5.1	Fabrication of inductors, fabrication of transformers, fabrication of varactors, and fixed value capacitors.	
6.0		**Power Amplifiers**	**07**
	6.1	Class A, class B, Class C, Class D, Class E, Class F using MOSFET	
		Total	**48**

Text Books:

1. A. Sedra, K. Smith, adapted by A. Chanorkar "Microelectronic Circuits-Theory and Application *Advanced engineering mathematics*", Oxford Higher Education, 7th Edition
2. D. Neamen, "Electronic Circuits Analysis and Design", McGraw Hill Education, 3rd Edition
3. B. Razavi, "Design of Analog Integrated Circuits", McGraw Hill Education, Indian Edition

Reference Books:

1. B. Razavi,"R F Microelectronics", Pearson Publication, 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:
3. Question paper will comprise of 6 questions, each carrying 20 marks.
4. 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 5012	TV & Video 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 5012	TV & Video Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand basic concepts of TV system .
- To understand compression techniques
- To introduce to advanced systems and dvb standards

Course outcomes:

After successful completion of the course student will be able to

- Understand overview of TV system.
- Understand details of compression technique.
- Know about different dvb standards.
- Understand advanced digital systems

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of TV system**	**10**
	1.1	Interlaced scanning, Composite video signal, VSB(Vestigial sideband transmission), Channel bandwidth, Study of transmitter and receiver block diagram of monochrome Television	
	1.2	Camera Tubes: Vidicon, Image Orthicon	
2.0		**Colour Television**	**10**
	2.1	Colour Fundamentals, Chromaticity diagram, Frequency interleaving, compatibility considerations	
	2.2	NTSC system characteristics, Encoder and Decoder block diagram, PAL system characteristics, Encoder and Decoder block diagram, Comparison of NTSC and PAL systems	
3.0		**Digital Video**	**08**
	3.1	Basics of digital video	
	3.2	Chroma subsampling:4:4:4,4:2:2,4:2:0,4:1:1 digital video formats	
	3.3	Video compression standards:MPEG2:DCT coding, codec structure. Introduction to H.264/MPEG-4 AVC, Introduction to H.265	
	3.4	Set-Top Box	
4.0		**Digital Video Broadcasting**	**06**
	4.1	Introduction to DVB-T,DVB-T2,DVB-H,DVB-S,DVB-C	
	4.2	Satellite Television	
5.0		**Advanced Digital TV Systems**	**10**
	5.1	MAC MACd2	
	5.2	HDTV,SUHDTV	
	5.3	Smart TV and its functions	
	5.4	Introduction to IPTV	
	5.5	Application of TV system as CCTV	
6.0		**Displays & Streaming Media Device**	**04**
	6.1	LCD,LED	
	6.2	Chromcast	
		Total	**48**

Text Books:

1. Monochrome and colour Television by R.R.Gulathi
2. Television and video engineering by A.M. Dhake

Reference Books:

1. Digital Television (Practical guide for Engineers) by Fischer

Websites:

1. https://www.dvb.org/resources/public/factsheets
2. https://en.wikipedia.org/wiki/Digital_Video_broadcasting

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 5013	Finite Automata Theory	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 5013	Finite Automata Theory	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit. The main objectives are:

- To understand learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To design combinational logic circuits and its optimization and fault detection.
- To study Mealy and Moore synchronous and asynchronous sequential circuits design and their applications.

Course outcomes:

After successful completion of the course student will be able to

- Manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
- Design and analyze small combinational circuits and to use standard combinational functions/ building blocks to build larger more complex circuits.
- Design and analyze small sequential circuits and devices and to use standard sequential functions/ building blocks to build larger more complex circuits.
- Design finite state machine understand the fundamentals and areas of applications for the integrated circuits.
- Perform symmetric and cascade threshold function and element

Module No.	Unit No.	Topics	Hrs.
1.0		**Combinational Logic**	**09**
	1.1	Notations of sets, Relations and Lattices, Venn diagram	
	1.2	Switching Algebra and functions, Boolean algebras and functions, Minimization of Boolean functions using map method and Tabulation Method, Prime implicant chart, Reduction of the chart, Branching method	
	1.3	Design of combinational Logic circuits, Contact networks, Functional decomposition and symmetric functions. Identification of symmetric functions	
2.0		**Threshold Logic & Synthesis of Threshold Networks**	**06**
	2.1	Threshold Logic, Threshold elements, Capabilities and limitations of threshold logic, elementary properties, Linear separability, Unate functions, Synthesis of threshold functions, Cascading of threshold elements.	
3.0		**Testing of Combinational Circuits**	**09**
	3.1	Reliable Design and fault Diagnosis, Fault Detection in combinational circuits, Fault location experiments, Fault Detection by Boolean Differences and path sensitization, Synthesis for testability, Multiple fault detection using map method, failure-Tolerant Design.	
4.0		**Sequential Circuits**	**12**
	4.1	Synchronous sequential circuits and iterative networks: Memory elements and their excitation functions; Synthesis of synchronous sequential circuits, Capabilities and limitations, State equivalence and Minimization, Minimization of completely specified and Incompletely specified sequential machines, Partition technique, Merger methods	
	4.2	Asynchronous sequential circuits: Hazards, Synthesis, State assignment and minimization	
	4.3	Finite state Machines – Mealy and Moore synchronous and asynchronous sequential circuits Design,	
5.0		**Structure and testing of Sequential Circuits**	**08**
	5.1	Structure of sequential Machines, Lattice of closed partitions, State Assignment using partitions, Reduction of output dependency, Input Independence and Autonomous clock.	
	5.2	Homing sequence, synchronizing sequence, Distinguishing sequence, Checking experiments, Machine identification, Recent Trends/Developments	

6.0		**Algorithmic State Machine**	**04**
	6.1	Introduction and components of ASM charts, Representation of sequential circuits using ASM charts, Example using ASM chart: 2 bit counter, binary multiplier, Weighing machine etc.	
		Total	**48**

Text Books:

1. Zvi Kohavi and Niraj K. Jha. "*Switching and Finite Automata Theory*", 3 Editions, Cambridge University Press.
2. Zvi Kohavi, *"Switching Theory and Finite Automata",* 2nd edition, Tata McGraw Hill
3. R. P. Jain, "*Switching Theory and Logic Design*", Tata McGraw Hill Education, 2003.
4. Lee Samuel C.," *Modern Switching Theory and Digital Design*", Prentice Hall PTR

Reference Books:

1. Morris Mano, "*Digital Logic and Computer Design*", Pearson Education
2. Samuel Lee, "*Digital Circuits and Logic design*", Prentice Hall.
3. William I. Fletcher, "*An Engineering Approach to Digital Design*", Prentice Hall.
4. John F. Wakerly, "*Digital Design ‐ Principles and Practices*", Pearson Education
5. A. Anand Kumar, *"Switching Theory and Logic Design",* PHI Learning private limited, 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
ECCDLO 5014	Data Compression & Encryption	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 5014	Data Compression & Encryption	20	20	20	80	--	--	--	100

Course objectives:
To teach the students

- Lossless and Lossy compression techniques for different types of data.
- Data Encryption Techniques.
- Network and Web Security.

Course outcomes:
After successful completion of the course student will be able to

- Implement text, audio and video compression techniques.
- Understand Symmetric and Asymmetric Key Cryptography schemes.
- Understand network security.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Data Compression**	**12**
	1.1	Data Compression : Modelling and Coding, Statstical Modelling, Dictionary Schemes, LZ, Lossy Compression	
	1.2	Shannon – Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding	
	1.3	Difficulties in Huffman Coding, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window Compression: LZ-77, LZ-78, LZW	
2.0		**Image Compression**	**06**
	2.1	DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards	
3.0		**Video and Audio Compression**	**08**
	3.1	Analog Video, Digital Video, MPEG – 2, H – 261 Encoder and Decoder	
	3.2	Sound, Digital Audio, μ-Law and A-Law Companding, MPEG – 1 Audio Layer (MP3 Audio Format)	
4.0		**Data Security**	**06**
	4.1	Security Goals, Cryptographic Attacks, Techniques	
	4.2	Symmetric Key: Substitution Cipher, Transposition Cipher , Stream and Block Cipher	
	4.3	DES, AES	
5.0		**Number Theory and Asymmetric Key Cryptography**	**08**
	5.1	Prime Numbers, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Discreet Logarithms	
	5.2	Principles of Public Key Crypto System, RSA	
	5.3	Key Management, Deffie-Hellman Key Exchange	
	5.4	Message Integrity, Message Authentication and Hash Functions, SHA, H MAC, Digital Signature Standards	
6.0		**Network Security**	**08**
	6.1	Email, PGP, S/MIME, Intrusion Detection System	
	6.2	Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions	
	6.3	Kerberos, X.509 Authentication Service, Public Key Infrastructure	
		Total	**48**

Text Books:

1. Mark Nelson, Jean-Loup Gailly,"The Data Compression Book", 2nd edition, BPB Publications
2. Khalid Sayood, "Introduction to Data Compression", 2nd Edition Morgan Kaufmann.
3. William Stallings, "Cryptography and Network Security Principles and Practices 5th Edition", Pearson Education.
4. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill.

Reference Books:

1. David Salomon, "Data Compression: The Complete Reference", Springer.
2. Matt Bishop, "Computer Security Art and Science", Addison-Wesley.

Internal Assessment:
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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
ECL501	Microprocessors & Peripherals Interfacing 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					
ECL501	Microprocessors & Peripherals Interfacing Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

Experiments can be conducted on Assembler, Emulator or Hardware kits, in Assembly language.

- To write an assembly language program to perform 8-bit addition using multiple addressing modes, viz., direct, indirect, register, etc. addressing mode.
- To write an assembly language program to perform 16-bit Logical operations, viz., AND, OR, XOR, NAND, etc.
- To write an assembly language program to perform 32-bit Subtraction
- To write an assembly language program to generate 10 msec delay using software (register) and 8254
- To write an assembly language program to move 10 memory locations using String Instruction
- To write an assembly language subroutine (program) that takes a number as input and returns the square of it
- To write an assembly language program for interfaced 7 segment display or keypad or both, through 8255
- To write an assembly language program to read and save value from ADC
- To write an assembly language program to generate square / triangular / ramp waveforms using DAC
- To write an assembly language program for performing floating point division using 8087
- To write an assembly language program to use INT 21h DOS Functions, viz. read character, write character, get system date, etc

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

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
ECL502	Digital Communication 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					
ECL502	Digital Communication Laboratory	--	--	--	--	25	25	--	50

Experiments should be performed on Bread-board or on experimentation kits.

Suggested Experiment List

- To understand sampling theorem and reconstruction
- To understand Various line codes
- To observe the performance of Return to Zero (RZ) types of line code
- To observe the performance of Non- Return to Zero (NRZ) types of line code
- Modulation and Demodulation of Binary Amplitude Shift Keying
- Modulation and Demodulation of Binary Frequency Shift Keying
- Modulation and Demodulation of Binary Phase Shift Keying
- Modulation and Demodulation of Quadrature Phase Shift Keying
- To observe the effect of signal Distortion using EYE-Diagram
- To Study and perform Linear Block codes
- To Study and perform cyclic codes

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

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
ECL503	Business Communication & Ethics Laboratory	2 (classwise)	2 (batch wise)	--	--	2	--	2

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					
ECL503	Business Communication & Ethics Laboratory	--	--	--	--	50	--	--	50

Course objectives:
To teach the students

- To inculcate professional and ethical attitude.
- To enhance effective communication and interpersonal skills.
- To build multidisciplinary approach towards all life tasks.

Course outcomes:
After successful completion of the course student will be able to

- Design a technical document using precise language, suitable vocabulary and apt style.
- Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
- Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
- Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
- Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module No.	Unit No.	Topics	Hrs.
1.0		**Report Writing**	**05**
	1.1	Objectives of Report Writing	
	1.2	Language and Style in a report	
	1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
2.0		**Technical Writing**	**03**
	2.1	Technical Paper Writing (IEEE Format)	
	2.2	Proposal Writing	
3.0		**Introduction to Interpersonal Skills**	**09**
	3.1	Emotional Intelligence	
	3.2	Leadership and Motivation	
	3.3	Team Building	
	3.4	Assertiveness	
	3.5	Conflict Resolution and Negotiation Skills	
	3.6	Time Management	
	3.7	Decision Making	
4.0		**Meetings & Documentations**	**02**
	4.1	Strategies for conducting effective meetings	
	4.2	Notice, Agenda and Minutes of a meeting	
	4.3	Business meeting etiquettes	
5.0		**Introduction to Corporate Ethics**	**02**
	5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
	5.2	Introduction to Intellectual Property Rights	
	5.3	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
6.0		**Employment Skills**	**07**
	6.1	Group Discussion	
	6.2	Resume Writing	
	6.3	Interview Skills	
	6.4	Presentation Skills	
	6.5	Statement of Purpose	
		Total	**28**

References

1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, *"Personal Development for Life and Work",* Thomson Learning, 12th edition
5. Heta Murphy, *"Effective Business Communication",* Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing",* Tata McGraw-Hill Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development",* Tata McGraw Hill.
8. Lehman, Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
10. Dr. Alex, K., "Soft Skills", S Chand and Company
11. Subramaniam, R., "Professional Ethics" Oxford University Press.
12. Robbins Stephens P., "Organizational Behavior", Pearson Education
13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

List of Assignments:

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work:

Term work will consist of all assignments from the list. The distribution of marks for term

Work willl be as follows:

Book Report……..(10) Marks

Assignments …… (10) Marks

Project Report Presentation…….. (15) Marks

Group Discussion…… (10) Marks

Attendance …… (05) Marks

TOTAL: ……(50) Marks

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL504	Open Source technology for Communication Lab	--	2	--	--	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					
ECL504	Open Source technology for Communication Lab	--	--	--	--	25	25	--	50

Prerequisites:

- Principals of Communication Engineering
- Digital System Design
- Signals and Systems
- Electronics Circuits and Devices

Course objectives:

- Introduction to open source tools for communication lab.
- To simulate and analyze the various parameters of communication systems.
- To understand and implement the communication system/sub system.

Course outcomes:

After successful completion of the course student will be able to

- Learn open source programming tools for communication technology.
- Simulate and analyze the performance of communication system.
- Implement the communication system/subsystem.

Sample List of Experiments:

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

Sr. No	Title	Resource
1	Installation of a. Python, NumPy and commPy or b. Octave or c. Scilab or d. Xilinx using HDL Or e. LT SPICE Or f. SEQUEL Note: Any one tool or a combination of tools .	See the E-resource Links
2	Write a program to represent analog signal to digital signal (A to D conversion)	http://www.scilab.in/files/textbooks/ProfSenthikumar/DC.pdf
3	Write a program to generate basic functions a. Unit Impulse Signal b. Unit Step Signal c. Generate Ramp Signal d. Exponential Sequence e. Generate Sine Sequence f. Cos Sequence	See the E-resource Links
4	Write a program to perform convolution and correlation on the given signal.	See the E-resource Links
5	Plot the ASK, FSK and PSk Waveforms using scilab/python	See the E-resource Links
6	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
7	Write a program to read a speech signal and plot it and play it.	See the E-resource Links

8	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
9	Write a code to design Butterworth/Chebyshev filter using Scilab/Octave/Python.	See the E-resource Links
10	Write a program to calculate Hamming distance using Scilab/python.	See the E-resource Links
11	Encoding and decoding of convolutional codes	1.https://github.com/veeresht/CommPy/blob/master/commpy/examples/conv_encode_decode.py 2.https://media.readthedocs.org/pdf/commpy/latest/commpy.pdf
12	Design and programming of of 1-bit Full adder and testing using Testbench.	See the E-resource Links
13	Design and programming of 4-bit adder using Full adder and testing using Testbench	See the E-resource Links
14	Design and programming of 8:1 Mux and testing using Testbench	See the E-resource Links
15	Design and programming of 3:8 Decoder and testing using Testbench	See the E-resource Links
16	Design and programming of D Latch and D Flip Flop and testing using Testbench	See the E-resource Links
17	Design and programming of T FF and testing using Testbench	See the E-resource Links
18	Design and programming of Counter and testing using Testbench	See the E-resource Links
19	Design and programming of RAM and testing using Testbench	See the E-resource Links

20	Design and Programming of FSM and testing using Testbench	See the E-resource Links
21	Design and Simulation of Basic diode Circuits like Clipper, Clapper, Voltage Doubler using Sequel or LT Spice	See the E-resource Links
22	Design and simulation of single stage and Multistage BJT amplifier using Sequel or LT SPICE	See the E-resource Links
23	Design and simulation of Differential amplifier and current mirror circuit using Sequel or LT SPICE	See the E-resource Links
24	Design and Simulation of Basic Op-circuits like Inverting amplifier , Non-Inverting amplifier, Difference amplifier, I to V convertor, V to I Convertor etc using Sequel ot LT SPICE.	See the E-resource Links
25	Design and Simulation of oscillators and Filters using Op-amp using LT SPICE or Sequel.	See the E-resource Links
26	Simulation of non-linear applications of Op-amp like Schmitt Trigger, Window Detector, Precision Rectifier, Square Wave Generator etc using LT SPICE or Sequel.	See the E-resource Links

List of Mini projects:

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

1. Implementing liner block code of (7,4).
2. Implementing FSK TX and RX.
3. Implementing Nyquist criteria with noisy environment.

Suggested List of Mini Projects on Xilinx using HDL Programming

4. 16 bit Multiplier
5. 32 Bit CLA adder
6. Shift and Add Multiplier
7. GCD Calculator
8. 3-bit FIR Filter design
9. 4 Bit ALU
10. 4-bit Comparator

11. 2’s Complement adder

Suggested List of Mini Projects using LT SPICE or SEQUEl

12. Audio Equalizer using Op-amp.
13. Strain Guage amplifier Circuit.
14. Synchronous DC-DC Buck Convertor.
15. RTD based 4 to 20mA transmitter circuit.

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

E-Resources:

1. Spoken Tutorial : http://spoken-tutorial.org/
2. Scilab: http://www.scilab.org/
3. Octave: https://www.gnu.org/software/octave/
4. Python: https://www.python.org/
5. Xilinx using HDL: **https://www.xilinx.com/products/design-tools/ise-design-suite/ise-webpack.html**
6. LT SPICE : http://www.linear.com/designtools/software/
7. SEQUEL**:** https://www.ee.iitb.ac.in/~sequel/

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments 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 5011	Microelectronics 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 5011	Microelectronics Laboratory	--	--	--	--	25	--	--	25

Term Work:

At least 08 tutorials covering entire syllabus must be given during the "**Tutorial session batch wise"**

Term work assessment must be based on the overall performance of the student with every tutorial 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 5012	TV & Video 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 5012	TV & Video Laboratory	--	--	--	--	25	--	--	25

Suggested List of Experiments

- To study CVS
- Measurement of horizontal and vertical scanning frequency
- To study sound section of TV receiver
- To study receiver sections by using fault simulation switches
- To study DTH receiver
- To study HDTV
- To study set top box trainer
- To study LCD display
- To study LED display

Term Work:

At least 8 Practicals/ Tutorials 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 5013	Finite Automata Theory	--	--	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 5013	Finite Automata Theory	--	--	--	--	25	--	--	25

List of Mini Projects:

1. Combinational circuits
2. Synchronous sequential circuits (Finite state machine)
3. Asynchronous sequential circuits (Finite state machine)
4. Algorithmic state machine

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

Term Work:

At least 8 Tutorials 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 5014	Data Compression & Encryption	--	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 5014	Data Compression & Encryption	--	--	--	--	25	--	--	25

Suggested Practical List:

- Huffman Code.
- Adaptive Huffman Code.
- Arithmetic Code.
- LZW Compression and Decompression.
- Companding Implementation.
- Implementation of DCT.
- RSA and MD5 Algorithm.
- Packet Analyzer.
- PGP (Pretty Good Privacy).
- Vulnerability Scanner.
- Intrusion Detection System.
- Firewall.
- SSL

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

Term Work:

At least 08 Experiments 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	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:
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
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		**Image Segmentation and Boundary Representation**	**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.

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 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.

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 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.
- Analyze complex engineering problems critically for conducting research in speech signal

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:
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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	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.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC701	Microwave 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					
ECC701	Microwave Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna and Radio Wave Propagation
- Communication Engineering

Course objectives:

- To learn fundamentals of microwave systems.
- To learn to make system level design decisions.
- To learn passive and active device characteristics

Course outcomes:

After successful completion of the course student will be able to

- Characterize devices at higher frequencies.
- Design and analyze microwave circuits.
- Design and analyze amplifiers and oscillators at microwave frequencies.
- Demonstrate skills of planning, design and deployment of microwave networks.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Microwaves**	**08**
	1.1	Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves.	
	1.2	Scattering parameters: Characteristics and Properties.	
	1.3	Strip lines, Microstrip lines and coupled lines: Analysis and design.	
	1.4	Design of Impedance matching network using lumped and distributed parameters.	
2.0		**Waveguides and Passive Devices**	**08**
	2.1	Rectangular and circular waveguides: Construction, Working and Mode analysis.	
	2.2	Resonators, Re-entrant cavities, Tees, Hybrid ring, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Isolators, Gyrators, and Circulators.	
3.0		**Microwave Tubes**	**10**
	3.1	Two Cavity Klystron, Multi-Cavity Klystron and Reflex Klystron.	
	3.2	Helix Travelling Wave Tube and Cross Field Amplifier.	
	3.3	Backward Wave Oscillator, Cylindrical Magnetron and Gyrotron.	
4.0		**Microwave Semiconductor Devices**	**10**
	4.1	Diodes: Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT.	
	4.2	Transistors: BJT, Hetro junction BJT, MESFET, and HEMT	
	4.3	Parametric Amplifiers and Applications.	
5.0		**Microwave Measurements**	**06**
	5.1	VSWR, Frequency, Power, Noise, *Q*-Factor, Impedance, Attenuation, Dielectric Constant, Antenna Gain.	
6.0		**Microwave Integrated Circuits (MIC)**	**06**
	6.1	MIC Materials.	
	6.2	Types of MIC: Hybrid and Monolithic MIC.	
	6.3	Chip Mathematics.	
		Total	**48**

Text Books :

1. Samuel Liao, “Microwave Devices and Circuits”, Prentice Hall
2. David Pozar, “Microwave Engineering”, Wiley Publication, Fourth Edition
3. Matthew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Pearson Education.
4. Annapurna Das and S. K Das, “Microwave Engineering”, McGraw Hill Education, Third Edition.

References:

1. Colin, Foundations of Microwave Engineering, Second Edition, Wiley Interscience, 2nd Edition.
2. Devendra Misra, “ Radio Frequency and Microwave Communication Circuits- Analysis and Design”, John Wiley & Sons, 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
ECC702	Mobile Communication 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					
ECC702	Mobile Communication System	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To understand the cellular fundamentals and different types of radio propagation models.
- To study the system architecture of 2G, 2.5 G and 3G.
- To develop the concepts of emerging technologies for 4 G standards and beyond.

Course outcomes:

After successful completion of the course student will be able to

- Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.
- Classify different types of propagation models and analyze the link budget.
- Illustrate the fundamentals and system architecture of GSM, 2.5G and IS-95.
- Apply the concepts of 3G technologies of UMTS and CDMA 2000.
- Elaborate the principles of 3GPP LTE.
- Identify the emerging technologies for upcoming mobile communication systems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of Mobile Communication**	**08**
	1.1	**Introduction to wire1ess communication:** Mobile radio telephony, Examples of Wireless Communication Systems, Related design problems.	
	1.2	**The Cellular Concept System Design Fundamentals:** Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems	
2.0		**Mobile Radio Propagation**	**08**
	2.1	**Large scale fading:** Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, diffraction, scattering, practical Link budget design using path loss models	
	2.2	**Small scale fading:** Small scale multipath propagation, parameters of mobile multipath channels, types of small-scale fading, Rayleigh and Ricean distributions.	
	2.3	**Features of all conventional multiple access techniques:** Frequency division multiple access(FDMA), time division multiple access(TDMA),space spectrum multiple access (SSMA), space division multiple access (SDMA),OFDM-PAPR,OFDMA	
3.0		**2G Technologies**	**10**
	3.1	**GSM:** GSM Network architecture, GSM signalling protocol architecture, identifiers used in GSM system, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures, GSM services and features	
	3.2	**GSM evolution:** GPRS And EDGE- architecture, radio specifications, channels.	
	3.3	**IS-95:** Architecture of CDMA system, CDMA air interface, power control in CDMA system, power control, handoff, rake receiver	
4.0		**3G Technology**	**06**
	4.1	**UMTS:** Objectives, standardisation and releases, network architecture, air interface specifications, channels, security procedure, W-CDMA air interface, attributes of W-CDMA system, W-CDMA channels	
	4.2	**Cdma2000 cellular technologies:** Forward And Reverse Channels, Handoff And Power Control.	
5.0		**3GPP LTE**	**08**

	5.1	**Introduction, system overview**: Frequency bands and spectrum flexibility, network structure, protocol structure	
	5.2	**Physical layer**: Frames, slots, and symbols, modulation, coding, multiple-antenna techniques	
	5.3	**Logical and Physical Channels:** Mapping of data onto (logical) sub-channels.	
	5.4	**Physical layer procedures:** Establishing a connection, retransmissions and reliability, scheduling, power control, handover.	
6.0		**Advanced techniques for 4G deployment**	**08**
	6.1	**Multi-antenna Techniques:** Smart antennas, multiple input multiple output systems	
	6.2	**Cognitive radio:** Architecture, spectrum sensing	
	6.3	**Relaying multi-hop and cooperative communications:** Principles of relaying, fundamentals of relaying	
		Total	**48**

Text Books :

1. Theodore S. Rappaport “wireless communications - principles and practice”, PEARSON , Second edition.
2. T L Singal “wireless communications”, Mc Graw Hill Education.
3. Andreas F. Molisch “wireless communications” WILEY INDIA PVT LTD, Second edition.

References:

1. Upena Dalal “Wireless and Mobile Communications”, Oxford university Press.
2. Vijay K.Garg “Wireless Communications and Networking”,Morgan–Kaufmann series in Networking-Elsevier

E-Resources:

1. MIT Open Course ware : https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/
2. NPTL: http://nptel.ac.in/courses/117104099/
3. Virtual Lab : http://vlab.co.in/

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
ECC703	Optical Communication	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					
ECC703	Optical Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Physics
- Electromagnetic wave propagation
- Electronics devices and circuits
- Principles of communication

Course objectives:

- List, write and explain fundamentals and transmission characteristics of optical fiber communication
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Course outcomes:

After successful completion of the course student will be able to

- List, write and explain fundamentals and transmission characteristics of optical fiber Communication.
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Module No.	Unit No.	Topics	Hrs.
1.0		**Optical Fiber and their properties**	**10**
	1.1	Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wave length, and mode filed diameter. Wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, loss and bandwidth window	
2.0		**Transmission Characteristics of Optical Fiber**	**12**
	2.1	Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion, dispersion and pulse broadening, dispersion shifted and dispersion flattened fibers. General Overview of nonlinearties , Stimulated Raman Scattering, Stimulated Brillouin Scattering , Self Phase modulation , Cross –Phase modulation , Four wave mixing and its mitigation , Solitons. Measurements of attenuation, dispersion and OTDR	
3.0		**Optical Sources**	**06**
	3.1	Working principle and characteristics of sources (LED, LASER), Tunable lasers Quantum well lasers , Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers	
4.0		**Optical Detectors**	**06**
	4.1	Working principle and characteristics of detectors (PIN, APD), Material requirement for RCEPD ,Resonant cavity enhancement (RCE) Photo Detector ,Noise analysis in detectors, coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance	
5.0		**Fiber Optic Components**	**08**
	5.1	Fiber fabrication (VAD,MCVD), fiber joints, fiber connectors, splices Couplers, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.	
6.0		**Optical Link**	**06**
	6.1	Introduction, Point to point links, system considerations, link power budget, and rise time budget. RF over fiber, key link parameters, Radio over fiber links, microwave photonics.	
		Total	**48**

Text Books :

1. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications– – John M. Senior, Pearson Education. 3rd Impression, 2007.

References:

1. Fiber optics communications-Harold Kolimbiris
2. Introduction to optical fibers, Cheri, McGraw Hill.
3. An introduction to fiber optics, A. Ghatak and K.Thyagrajan, Cambridge Univ, press 10
4. Optical fiber communication and sensors-M. Arumugam Agencies, 20002 optic sensors.
5. Fiber optic communication– Joseph C Palais: 4th Edition, Pearson Education.

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 7031	Neural networks & Fuzzy Logic	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 7031	Neural networks & Fuzzy Logic	20	20	20	80	--	--	--	100

Prerequisites:

- Numerical Methods
- Optimization Techniques

Course objectives:

- To introduce the concepts and understanding of artificial neural networks
- To provide adequate knowledge about supervised and unsupervised neural networks
- To introduce neural network design concepts
- To expose neural networks based methods to solve real world complex problems
- To teach about the concept of fuzziness involved in various systems and provide adequate knowledge about fuzzy set theory, and fuzzy logic
- To provide knowledge of fuzzy logic to design the real world fuzzy systems

Course outcomes:

After successful completion of the course student will be able to

- Comprehend the concepts of biological neurons and artificial neurons
- Analyze the feed-forward and feedback neural networks and their learning algorithms.
- Calculate Comprehend the neural network training and design concepts
- Analyze the application of neural networks to non linear real world problem
- Comprehend the concept of fuzziness involved in various systems, fuzzy set theory and fuzzy logic
- Apply fuzzy logic to real world problems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Neural Networks and their basic concepts:**	**07**
	1.1	Biological neurons and Artificial neuron, McCulloch-Pitts models *of* neuron, Types of activation functions and Neural Network architectures, Pre-requisites for training of neural networks. Linearly separable and linearly non-separable systems with examples, Features and advantages of Neural Networks over statistical techniques, Knowledge representation, Terminologies related to artificial neural networks, Concepts of Supervised learning, Unsupervised learning, Reinforcement	
2.0		**Supervised Learning Neural Networks:**	**08**
	2.1	Perceptron - Single Layer, Multilayer and their architecture, Error back propagation algorithm, Generalized delta rule, Concept of Training, Testing and Cross-validation data sets for design and validation of networks. Over-fitting. Stopping criterion for training.	
3.0		**Unsupervised Learning Neural Networks:**	**09**
	3.1	Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means and LMS algorithms, Radial Basis Function (RBF) neural network – architecture and algorithm, and Discrete Hopfield networks. Introduction to the concept of Support Vector Machine based classifier.	
4.0		**Applications of Neural Networks:**	**06**
	4.1	Applications of Neural networks in pattern classification, Character Recognition**,** Face recognition, Image compression and Decompression	
5.0		**Fuzzy logic:**	**12**
	5.1	Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems, Mamdani Fuzzy Models, Fuzzy knowledge based controllers.	
6.0		**Applications of Fuzzy Logic and Fuzzy Systems:**	**06**
	6.1	Fuzzy pattern recognition, fuzzy image processing, Simple applications of Fuzzy knowledge based controllers like washing machines, home heating system, and train break control.	
		Total	**48**

Text Books :

1. S. N. Sivanandam and S. N. Deepa *Introduction to Soft computing,* Wiley India Publications
2. Thimothy J. Ross, *Fuzzy Logic with Engineering Applications,* Wiley India Publications
3. John Yen and Reza Langari, *Fuzzy Logic- Intelligence, Control and Information,* Pearson Publications.
4. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI
5. Satish Kumar, *Neural Networks: A classroom Approach,* Tata McGraw-Hill.
6. Meherotra Kishan, Mohan C. K., Ranka Sanjay, *Elements of artificial neural networks*, Penram Publications

References:

1. Hagan, Demuth, and Beale, *Neural Network Design,* Thomson Learning
2. Simon Haykin, *Neural Network- A Comprehensive Foundation,* Pearson Education
3. Christopher M Bishop, *Neural Networks For Pattern Recognition*, Oxford University Press
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences Neural Network and Kernels,* Cambridge Publications
5. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, *Introduction to Neural Network Using Matlab* Tata McGraw-Hill Publications
6. Bart Kosko, *Neural networks and Fuzzy Systems*, Pearson Education
7. J. S. R. Jang, C.T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI
8. J. M. Zurada, *Introduction to Artificial Neural Systems,* Jaico publishers

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 7032	Big Data Analytics	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 7032	Big Data Analytics	20	20	20	80	--	--	--	100

Prerequisites:

- Data Base Management System

Course objectives:

- To Provide an Overview of an exciting growing field of Big Data Analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
- To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

Course outcomes:

After successful completion of the course student will be able to

- Understand the key issues in big data management.
- Acquire fundamental enabling techniques using tools in big data analytics.
- Achieve adequate perspectives of big data analytics in various applications like sensor, recommender systems, social media applications etc.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Big Data Analytics**	**06**
	1.1	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach.	
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.	
2.0		**Hadoop**	**06**
	2.1	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem, Physical Architecture, Hadoop limitations.	
3.0		**NoSQL**	**08**
	3.1	Introduction to NoSQ, NoSQL business drivers, NoSQL case studies.	
	3.2	NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns.	
	3.3	Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	
4.0		**MapReduce**	**08**
	4.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.	
		MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.	
		Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce.	
5.0		**Techniques in Big Data Analytics**	**12**
	5.1	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents	
	5.2	Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis	
	5.3	Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce	
	5.4	Frequent Itemset Mining : Market-Basket Model, Apriori Algorithm, Algorithm of Park-Chen-Yu	

6.0		**Big Data Analytics Applications**	**08**
	6.1	Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative-Filtering System: Nearest-Neighbor Technique, Example.	
	6.2	Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using MapReduce.	
		Total	**48**

Text Books :

1. Radha Shankarmani and M Vijayalakshmi "Big Data Analytics", Wiley
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.

References:

1. Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley
2. Chuck Lam, "Hadoop in Action", Dreamtech Press

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 7033	Internet Communication 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 7033	Internet Communication Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Analog communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To focus on Internet protocol, standards, services and administration.
- To discuss the Internet security protocol and security services
- To discuss multimedia communication standards and compression techniques
- To discuss the Multimedia communication across the networks

Course outcomes:

After successful completion of the course student will be able to

- Explain the operation of the components of a router including, DHCP, NAT/PAT, Routing function, Switching function.
- Describe how DNS works in the global Internet including caching and root servers.
- Understand the current state-of-the-art developments in Internet technologies for multimedia communications.
- Understand the security protocol and services In the Internet
- Appreciate the principles used in designing multimedia protocols, and so understand why standard protocols are designed the way that they are.
- Understand the system design principles of multimedia communications systems.
- Solve problems and design simple networked multimedia systems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Internet**	**06**
	1.1	What is the Internet, ,Evolution of the Internet, Brief History and Growth of Internet , service description, Network protocol, the network edge	
	1.2	Overview of TCP/IP, layer functions,	
	1.3	Application Layer- Host configuration, DHCP Domain Name System (DNS),Multicast DNS	
	1.4	Remote Login, TELNET and SSH , HTTPs, electronic mail	
2.0		**Transport Layer**	**10**
	2.1	Properties of reliable stream delivery, Overview of TCP segment, TCP connection	
	2.2	Flow control, error control, congestion control	
	2.3	User datagram protocol(UDP) header, pseudo header	
	2.4	SCTP, introduction, Packet format ,	
	2.5	Flow control, error control, congestion control	
3.0		**Internetworking layer**	**08**
	3.1	Overview of Internet protocol (IP) datagram, IP address classes, subnets and supernets	
	3.2	Private IP addresses, classless inter domain routing (CIDR), CIDR subnet addressing, variable length in CIDR subnet addressing, ICMP	
	3.3	Internet Protocol version 6 (IPv6), Packet format, Transition from IPv4 to IPv6, ICMPv6	
4.0		**Internet Security**	**06**
	4.1	Network layer security(AH, ESP, IPsec),	
	4.2	Transport layer security(SSL), Application layer security(secure E mail-PGP, S/MIME),	
	4.3	VPN Firewall, Intrusion Detection System.	
5.0		**Multimedia Communications**	**10**
	5.1	Information Representation- text, images, audio and video, Text and image compression, Audio and video compression, video	
	5.2	compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video	
	5.3	Multimedia Communication Across Networks- Layered video coding, error resilient video coding techniques,	

	5.4	multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, Signalling Protocols: Real-Time Streaming Protocol (RTSP) ,Multimedia across wireless- (Mobiles Networks – Broadcasting Networks – Digital Television infrastructure for interactive multimedia services)	
6.0		**Quality of Services (QoS)**	**08**
	6.1	Integrated services (intserv): Architecture and Service Model, Resource Reservation Protocol (RSVP), Packet Scheduling Disciplines in the Internet	
	6.2	Differentiated Services (diffserv): Framework and Concept, Assured and Expedited Services, Packet Classification, Routers Internals and Packet Dropping Techniques	
		Total	**48**

Text Books :

1. B. Forouzan, ―*TCP/IP Protocol Suite*‖, 4th Edition, McGraw-Hill Publication
2. K. R. Rao, Zaron S. Bojkovic, Dragorad A. Milocanovic, Multimedia Communication Systems, Prentice Hall India, 2002. ISBN: 81-203-2145-6.

References:

1. Steve Heath, Multimedia and Communication Technology, Second Edition, Focal Press, 2003.
2. ISBN: 81-8147-145-8. Ted Wallingford, ―*Switching to VoIP*‖, Oreilly Publication
3. Fred Halsall, "Multimedia Communications", Pearson education, 2001
4. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004
5. Raif steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002
6. Tay Vaughan, "Multimedia: Making it Work", 6th edition, Tata McGraw Hill, 2004
7. Pallapa Venkataram, "Multimedia information systems", Pearson education (InPress),2005.
8. Multimedia Communication Techniques and Standards

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 7034	CMOS Mixed Signal VLSI	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 7034	CMOS Mixed Signal VLSI	20	20	20	80	--	--	--	100

Prerequisites:

- Electronic Devices and Circuits I
- Electronic Devices and Circuits II
- Linear Integrated Circuits
- Microelectronics
- Digital VLSI

Course objectives:

- Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
- Underlying methodologies for analysis and design of fundamental CMOS Mixed signal Circuits like Data Converters.
- The issues associated with high performance Mixed Signal VLSI Circuits

Course outcomes:

After successful completion of the course student will be able to

- Analyze and design single stage MOS Amplifiers.
- Analyze and design Operational Amplifiers.
- Analyze and design data converter circuits.
- Identify design requirements of analog and mixed signal circuits
- Analyze and design CMOS based switched capacitor circuits
- Understand Oscillators and Phase Locked Loops.

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of MOS Amplifiers**	**10**
	1.1	MOS Single-stage Amplifiers: Basic concepts of common source stage, source follower, common gate stage, Differential Amplifiers:	
	1.2	Current mirrors: Basic current mirror, cascode current mirror, active current mirror, Wilson and Widlar current mirrors, voltage and current references.	
2.0		**Design of MOS operational amplifier**	**08**
	2.1	General considerations, One-Stage Op amps, Two-Stage Op amps, Gain Boosting, Input Range Limitation.	
	2.2	Frequency Response and Compensation, Slew Rate.	
3.0		**Oscillators and Phase Locked Loops**	**08**
	3.1	General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators (VCO), tuning range, tuning linearity Mathematical Model of VCO.	
	3.2	Simple PLL-phase detector, Charge-pump PLL's, Non ideal effects in PLL, Delay locked Loops, applications of PLL.	
4.0		**Switched Capacitor circuits**	**06**
	4.1	Theory of sampled data systems, Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, design and analysis of switched capacitor circuits.	
	4.2	Switched capacitor amplifiers (SC), switched capacitor integrators, first and second order switched capacitor circuits.	
5.0		**Data converters**	**06**
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics. DAC specifications, ADC specifications.	
	5.2	Mixed signal Layout issues, Floor planning, power supply and Ground issues, other interconnect Considerations.	
6.0		**Data Converter Architectures**	**10**
	6.1	DAC architectures: R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC, Switched capacitor based DAC design.	
	6.2	ADC architectures: flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC, Switched capacitor based ADC design	
		Total	**48**

Text Books :

1. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
2. Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
3. P. E. Allen and D R Holberg, **“***CMOS Analog Circuit Design***”**, second edition, Oxford University Press, 2002.
4. Baker, Li, Boyce, “CMOS: Circuit Design, layout and Simulation”, PHI, 2000.
5. Sedra/Smith, “Microelectronic Circuits”, Oxford University Press.

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. Duation 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 7035	Embedded Systems	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 7035	Embedded Systems	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge Embedded Systems.
- To understand communication techniques.
- To write programs for embedded systems and real time operating sytems

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed processor design techniques and methods of communication.
- Study the in-depth program modelling concepts.
- Study the concepts of Real time operating systems and write programs
- Design embedded system applications using RTOS

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction:-**	**08**
	1.1	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Classification, Major Application Areas	
	1.2	Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle	
	1.3	**Program modeling concepts:** DFG, FSM, Petri-net, UML	
2.0		**Processor**	**08**
	2.1	Overview of Custom Single-Purpose Processors, General-Purpose Processors,	
	2.2	Parallel Port example, Standard Single-Purpose Processors	
	2.3	RISC and CISC architectures	
	2.4	GCD example	
3.0		**Communication**	**06**
	3.1	CAN bus, I2C, MOD bus, SPI,	
	3.2	Examples on Parallel Communication, Serial Communication, Wireless Communication	
4.0		**Real Time Operating Systems[RTOS]**	**07**
	4.1	Operating system basics	
	4.2	Types of OS	
	4.3	Tasks, process,Threads	
	4.4	Multiprocessing and ,Multitasking	
	4.5	Task scheduling	
	4.6	Threads, Process , Scheduling :- Putting them all together	
5.0		**Task & RTOS applications**	**07**
	5.1	Task communications,	
	5.2	Task synchronization	
	5.3	Device drivers	
	5.4	How to choose RTOS	
	5.5	Examples of RTOS	
6.0		**Design examples and case studies of program model and programming with RTOS**	**12**
	6.1	Digital Camera:-Introduction to simple digital camera, Requirements and specifications, Design using Microcontroller and Microcontroller and CCDPP	
	6.2	Automatic Chocolate Vending Machine	
	6.3	Adaptive Cruise Control in car	
		Total	**48**

Text Books :

1. Frank Vahid, and Tony Givargis, “Embedded System Design: A unified Hardware/Software Introduction”, Wiley Publication.
2. Raj Kamal,” Embedded Systems Architecture, Programming and design”, Tata MCgraw-Hill Publication.
3. Iyer, Gupta,” Embedded real systems Programming”, TMH
4. David Simon, “Embedded systems software primer’, Pearson
5. Shibu K.V,” Introduction to Embedded Systems”, Mc Graw Hill, 2nd edition.
6. K.V.K.K. Prasad, “Embedded Real Time Systems: Concepts, Design & Programming”,Dreamtech Publication.

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.
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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
ECCILO 7011	Product Lifecycle Management	03	--	--	03	--	--	03

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					
ECCILO 7011	Product Lifecycle Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Course outcomes:

After successful completion of the course student will be able to

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Product Lifecycle Management (PLM)**	**10**
	1.1	Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications	
	1.2	**PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	
2.0		**Product Design**	**09**
	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3.0		**Product data Management**	**05**
	3.1	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
4.0		**Virtual Product Development Tools**	**05**
	4.1	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
5.0		**Integration of Environmental Aspects in product Design**	**05**
	5.1	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	

6.0		**Life Cycle Assessment and Life Cycle Cost Analysis**	**05**
	6.1	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	
		Total	**39**

References :

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Internal Assessment:
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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
ECCILO 7012	Reliability Engineering	03	--	--	03	--	--	03

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					
ECCILO 7012	Reliability Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Course outcomes:

After successful completion of the course student will be able to

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Module No.	Unit No.	Topics	Hrs.
1.0		**Probability Theory**	**08**
	1.1	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	
2.0			**08**
	2.1	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	
3.0		**System Reliability**	**05**
	3.1	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	
4.0		**Reliability Improvement**	**08**
	4.1	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
5.0		**Maintainability and Availability**	**05**
	5.1	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
6.0		**Failure Mode, Effects and Criticality Analysis**	**05**
	6.1	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	
		Total	**39**

References :

1. L. S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.

2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B. S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Internal Assessment:
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End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
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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
ECCILO 7013	Management Information System	03	--	--	03	--	--	03

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					
ECCILO 7013	Management Information System	20	20	20	80	--	--	--	100

Course objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Course outcomes:

After successful completion of the course student will be able to

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction To Information Systems (IS)**	**04**
	1.1	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	
2.0		**Data and Knowledge Management**	**07**
	2.1	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management **Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Presenting Results	
3.0		**Ethical issues and Privacy**	**07**
	3.1	Information Security. Threat to IS, and Security Controls	
4.0		**Social Computing (SC)**	**07**
	4.1	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	
5.0			**06**
	5.1	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	
6.0		**Information System within Organization**	**08**
	6.1	Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	
		Total	**39**

References :

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K. C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

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
ECCILO 7014	Design of experiments	03	--	--	03	--	--	03

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					
ECCILO 7014	Design of experiments	20	20	20	80	--	--	--	100

Course objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Course outcomes:

After successful completion of the course student will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Strategy of Experimentation	
	1.2	Typical Applications of Experimental Design	
	1.3	Guidelines for Designing Experiments	
	1.4	Response Surface Methodology	
2.0		**Fitting Regression Models**	**08**
	2.1	Linear Regression Models	
	2.2	Estimation of the Parameters in Linear Regression Models	
	2.3	Hypothesis Testing in Multiple Regression	
	2.4	Confidence Intervals in Multiple Regression	
	2.5	Prediction of new response observation	
	2.6	Regression model diagnostics	
	2.7	Testing for lack of fit	
3.0		**Two-Level Factorial Designs**	**07**
	3.1	The 2^2 Design	
	3.2	The 2^3 Design	
	3.3	The General2^k Design	
	3.4	A Single Replicate of the 2^k Design	
	3.5	The Addition of Center Points to the 2^k Design,	
	3.6	Blocking in the 2^k Factorial Design	
	3.7	Split-Plot Designs	
4.0		**Two-Level Fractional Factorial Designs**	**07**
	4.1	The One-Half Fraction of the 2^k Design	
	4.2	The One-Quarter Fraction of the 2^k Design	
	4.3	The General 2^{k-p} Fractional Factorial Design	
	4.4	Resolution III Designs	
	4.5	Resolution IV and V Designs	
	4.6	Fractional Factorial Split-Plot Designs	
5.0		**Response Surface Methods and Designs**	**07**
	5.1	Introduction to Response Surface Methodology	
	5.2	The Method of Steepest Ascent	
	5.3	Analysis of a Second-Order Response Surface	
	5.4	Experimental Designs for Fitting Response Surfaces	
6.0		**Taguchi Approach**	**04**
	6.1	Crossed Array Designs and Signal-to-Noise Ratios	
	6.2	Analysis Methods	
	6.3	Robust design examples	
		Total	**39**

References :

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

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
ECCILO 7015	Operations Research	03	--	--	03	--	--	03

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					
ECCILO 7015	Operations Research	20	20	20	80	--	--	--	100

Course objectives:

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models

Course outcomes:

After successful completion of the course student will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Operations Research**	**14**
	1.1	Introduction, , Structure of the Mathematical Model, Limitations of Operations Research	
	1.2	**Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method,	
	1.3	**Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	
	1.4	**Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	
	1.5	**Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	
	1.6	**Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
2.0		**Queuing Models**	**05**
	2.1	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	
3.0		**Simulation**	**05**
	3.1	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
4.0		**Dynamic programming**	**05**
	4.1	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	
5.0		**Game Theory**	**05**

	5.1	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	
6.0		**Inventory Models**	**05**
	6.1	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	
		Total	**39**

References :

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

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:
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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
ECCILO 7016	Cyber Security and Laws	03	--	--	03	--	--	03

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					
ECCILO 7016	Cyber Security and Laws	20	20	20	80	--	--	--	100

Course objectives:

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Cybercrime**	**04**
	1.1	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the	
2.0		**Cyber Offenses & Cybercrime**	**09**
	2.1	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
3.0		**Tools and Methods Used in Cyberline**	**06**
	3.1	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
4.0		**The Concept of Cyberspace**	**08**
	4.1	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	
5.0		**Indian IT Act**	**06**
	5.1	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	
6.0		**Information Security Standard compliances**	**06**
	6.1	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	
		Total	**39**

References :

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi

6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

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
ECCILO 7017	Disaster Management and Mitigation Measures	03	--	--	03	--	--	03

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					
ECCILO 7017	Disaster Management and Mitigation Measures	20	20	20	80	--	--	--	100

Course objectives:

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Course outcomes:

After successful completion of the course student will be able to

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**03**
	1.1	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change	
2.0		**Natural Disaster and Manmade disasters**	**09**
	2.1	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion	
	2.2	Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters	
3.0		**Disaster Management, Policy and Administration**	**06**
	3.1	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management	
	3.2	**Policy and administration:** Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
4.0		**Institutional Framework for Disaster Management in India**	**06**
	4.1	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.	
		Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
5.0		**Financing Relief Measures**	**09**
	5.1	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	
	5.2	International relief aid agencies and their role in extreme events	
6.0		**Preventive and Mitigation Measures**	**06**

	6.1	Pre-disaster, during disaster and post-disaster measures in some events in general	
	6.2	Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication	
	6.3	Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans	
	6.4	Do's and don'ts in case of disasters and effective implementation of relief aids.	
		Total	**39**

References :

1. Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

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
ECCILO 7018	Energy Audit and Management	03	--	--	03	--	--	03

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					
ECCILO 7018	Energy Audit and Management	20	20	20	80	--	--	--	100

Course objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course outcomes:

After successful completion of the course student will be able to

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Module No.	Unit No.	Topics	Hrs.
1.0		**Energy Scenario**	**04**
	1.2	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	
2.0		**Energy Audit Principles**	**08**
	2.1	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	
3.0		**Energy Management and Energy Conservation in Electrical System**	**10**
	3.1	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. **Energy conservation opportunities in**: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4.0		**Energy Management and Energy Conservation in Thermal Systems**	**10**
	4.1	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
5.0		**Energy Performance Assessment**	**04**
	5.1	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	
6.0		**Energy conservation in Buildings**	**03**

	6.1	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	
		Total	**39**

References :

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

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
ECCILO 7019	Development Engineering	03	--	--	03	--	--	03

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					
ECCILO 7019	Development Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
- To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
- An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
- To understand the Nature and Type of Human Values relevant to Planning Institutions

Course outcomes:

After successful completion of the course student will be able to

- Apply knowledge for Rural Development.
- Apply knowledge for Management Issues.
- Apply knowledge for Initiatives and Strategies
- Develop acumen for higher education and research.
- Master the art of working in group of different nature.
- Develop confidence to take up rural project activities independently

Module No.	Unit No.	Topics	Hrs.
1.0			**08**
	1.1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	
2.0			**04**
	2.1	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	
3.0			**06**
	3.1	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
4.0			**04**
	4.1	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	
5.0			**10**

	5.1	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
6.0			**04**
	6.1	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	
		Total	**36**

References :

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407

Internal Assessment:
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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
ECL701	Microwave 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					
ECL701	Microwave Engineering Laboratory	--	--	--	--	25	25	--	50

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
ECL702	Mobile Communication 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					
ECL702	Mobile Communication System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- To observe the effect of velocity and direction of arrival of a vehicle on Doppler frequency
- To observe the effect of N on C/I ratio and comment on the voice quality
- To observe the effect of incidence angle on reflection coefficient using MATLAB
- To observe the effect of different propogation models on coverage distance
- To observe the effect of C/I ratio in a sectorised cell site and perform worst case analysis for different values of N and degree of sectorisation
  A) Worst case C/I in a 3 sector cellular system for K=7
  B) Worst case C/I in a 3-sector cellular system for K=4
  C) Worst case C/I in a 6 sector cellular system for K=7
  D) Worst case C/I in a 6 sector cellular system for K=4
- To generate Pseudo noise code used in a CDMA system
- To generate Walsh Codes using Hadamard Matrix.
- To plot Knife edge diffraction gain as a function of Fresnel diffraction parameter
- To plot channel capacity versus SNR for different MIMO systems
- Simulation of OFDMA system
- Simulation of spectrum sensing using energy detection method in cognitive radio

List of Mini projects:

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

1. Developing automated Notification based System using GSM
2. Mobile Communication Based App development
3. Creating Virtual Lab Experiments**.**

Software Tools:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.co.in/
3. Scilab Experiments Book: http://www.scilab.in/textbook_companion/generate_book/2081

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. **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
ECL703	Optical Communication 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					
ECL703	Optical Communication Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Calculation of Numerical aperture
- Calculation of dispersion for given fiber
- Calculation of link Loss for given link
- Performance analysis of Single mode fiber
- Performance Analysis of Optical Link with Different Sources
- Performance Analysis of Optical Link with Different Detectors
- Performance Analysis of Optical Amplifier
- Calculation of link Loss for given link with nonlinearities

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 7031	Neural networks & Fuzzy Logic 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 7031	Neural networks & Fuzzy Logic Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program for implementing perceptron based linear functions AND and OR function. Conclude about the noise tolerance of the function.
- Write a program for implementing optimal neural network based XOR functions. Conclude about the noise tolerance of the function
- Write a program for training and testing of Multilayer Perceptron for pattern classification application
- Write a program for training and testing of Multilayer Perceptron for interpolation application
- Program for Support vector Machine based classifiers and compare result with that of Multilayer Perceptron based neural network classification
- Program for application of Multilayer perceptron for character recognition
- Program to develop Fuzzy Inference System for Speed control of DC motor
- Program for fuzzy logic based train brake control with suitable input variable assumptions
- Program to develop Fuzzy Inference System for fuzzy control of washing machines

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 7032	Big Data Analytics 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 7032	Big Data Analytics Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Study of Hadoop ecosystem
- Programming exercises on Hadoop
- Programming exercises in No SQL
- Implementing simple algorithms in Map- Reduce - Matrix multiplication, Aggregates.

List of Mini project

1. Design and implementation of any case study/ applications based on standard Datasets available on the web

a. Twitter data analysis b. Fraud Detection c. Text Mining etc. using modern tools.

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 7033	Internet Communication 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 7033	Internet Communication Engineering Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Simulation study on congestion control
- Multimedia networking
- Multimedia streaming
- Assignments / Practicals can be given on writing the programs to encode and decode the various kinds of data by using the algorithms. Students can collect several papers from journals/conferences/Internet on a specific area of Internet and multimedia communications and write a review paper and make a presentation.
- Form small groups to complete projects in audio, image and video coding. The use of C/C++ is encouraged
- Conduct network simulations using OPNET and protocol analysis using Wireshark.

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	Practical	Tutorial	Total
ECLDLO 7034	CMOS Mixed Signal VLSI Laboratory	--	--	02	--	--	01	01

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 7034	CMOS Mixed Signal VLSI Laboratory	--	--	--	--	25	25	--	50

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 7035	Embedded 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 7035	Embedded System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Interfacing of I2C,CAN,SPI,zigbee etc with ARM
- Simulation of multitasking using RTOS
- Simulation of mutex using RTOS
- Simulation of mailboxes using RTOS
- Interprocess communication using semaphore in RTOS
- Simulation of message queues using RTOS

Minimum One project based on any application related to RTOS and embedded system can be implemented.

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
ECL704	Project Stage-I	--	06	--	--	3	--	3

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					
ECL704	Project Stage-I	--	--	--	--	50	50	--	100

Objective: The Project work enables the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a specific problem or issue, via a substantial piece of work which is carried out over an extended period. It also enables the students to demonstrate the proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:

1. **Project Topic:**
   - To proceed with the project work it is very important to select a right topic. Project can be undertaken on any domain of electronics and telecommunication programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
   - Project work must be carried out by the group of at least two students and maximum four and must be original.
   - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
   - The project work can be undertaken in a research institute or organization/company/any business establishment.
   - Student must consult internal guide along with external guide (if any) in selection of topic.
   - Head of department and senior staff in the department will take decision regarding selection of projects.
   - Student has to submit weekly progress report to the internal guide and whereas internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding the term work marks.
   - In case of industry projects, visit by internal guide will be preferred.

2. **Project Report Format:**

At the end of semester a project report should preferably contain at least following details:-

- Abstract
- Introduction
- Literature Survey
  a) Survey Existing system
  b) Limitation of the Existing system or research gap
  c) Problem Statement and Objective
  d) Scope
- Proposed System
  a) Analysis/Framework/ Algorithm
  b) Details of Hardware & Software
  c) Design details
  d) Methodology (your approach to solve the problem)
- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**

Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day
b) Contribution in the Project work
c) Project Report (Spiral Bound)
d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. **Oral & Practical :**

Oral &Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project- I.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC801	RF 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					
ECC801	RF Design	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna & Radio Wave Propagation
- Communication Engineering
- Microwave Engineering

Course objectives:

- To learn RF circuit fundamentals for designing various circuit building blocks in a typical RF transceiver
- To learn importance of EMI/EMC

Course outcomes:

After successful completion of the course student will be able to

- Design impedance matching networks and passive RF filters.
- Design and appraise RF amplifiers and oscillators.
- Analyze EMI and EMC in RF circuits.

Module No.	Unit No.	Topics	Hrs.
1.0		**RF Filter Design**	**10**
	1.1	Image parameter method	
	1.2	Insertion loss method- Maximally flat low pass prototype, Equal ripple low pass prototype, Filter transformation and filter implementation	
2.0		**Amplifier Design**	**08**
	2.1	Two-port power gain stability	
	2.2	Single stage amplifier design: Design for maximum gain, design for specified gain, low noise amplifier design	
	2.3	Power amplifier design.: Characteristics of power amplifier and classes of amplifiers, design of class A power amplifier	
3.0		**Frequency Generation & Mixer**	**08**
	3.1	One-port and two-port microwave oscillator design.	
	3.2	Analysis of phase noise in oscillators.	
	3.3	Mixers: Characteristics, Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers.	
4.0		**Frequency Synthesizers**	**06**
	4.1	Direct Frequency Synthesis, Frequency Synthesis by Phase Lock, Effects of Reference Frequency on Loop Performance,	
	4.2	Variable-Modulus Dividers, Down Conversion, Methods for Reducing Switching Time, Direct Digital Synthesis, Synthesizer Design .	
	4.3	Phase Noise: A Model for Oscillator Phase Noise, Phase Noise in Phase-Locked Loops, Effect of Frequency Division and Multiplication on Phase Noise.	
5.0		**Electromagnetic Interference in RF circuits**	**08**
	5.1	Introduction. Natural and Nuclear Sources of EMI, EMI From Apparatus and Circuits. **Quantification Of Communication System EMI**	
	5.2	Elements Of Interference, Including Antennas, Transmitters, Receivers And Propagation. **Electronic Equipment And System EMI Concepts.** Examples Of EMI Coupling Modes	
	5.3	**Equipment Emissions And Susceptibilities- Types of coupling: Common-Mode Coupling:** Common-Mode Coupling Mechanisms Including Field To Cable, Ground Impedance, Ground Loop And Coupling Reduction Techniques **Differential-Mode Coupling** : Differential-Mode Coupling Mechanisms Including Field To Cable, Cable To Cable And Coupling Reduction Techniques.	
	5.4	**Other Coupling mechanisms:** Power Supplies And Victim Amplifiers	

6.0		**Electromagnetic Compatibility**	**08**
	6.1	**The Importance Of Grounding For Achieving EMC.** Grounding, Including The Reasons (I.E., Safety, Lightning Control, EMC, Grounding Schemes (Single Point, Multi-Point And Hybrid), Shield Grounding And Bonding. Shielding Effectiveness, Shielding Considerations (Reflective And Absorptive), Shielding Compromises (I.E., Apertures, Gaskets, Waveguide Beyond Cut-Off)	
	6.2	**EMI Diagnostics And Fixes:** Techniques Used In EMI Diagnostics And Fixes	
	6.3	**EMC Specifications, Standards And Measurements.** A Discussion Of The Genesis Of EMC Documentation Including A Historical Summary, The Rationale, And A Review Of MIL-Stds, FCC And CISPR Requirements.	
		Total	**48**

Text Books

1. David M Pozar, Microwave Engineering, John Wiely and Sons, 2005
2. Ludwig R. and Bogdanov G, RF Circuit Design, Prentice Hall, 2007.
3. Jack Smith, Modern Communication circuits,Tata McgrawHill.
4. W. Prasad Kodali, Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models, 2nd Edition, ISBN: 978-0-7803-4743-4, January 2001, Wiley-IEEE Press
5. David. A. Weston, Electromagnetic Compatibility-principles and applications, Second Edition, Publisher: Marcel Dekker, Inc. 2001, ISBN 0-8247-8889-3

References:

1. Guillermo Gonzalez, 'Microwave Transistor Amplifiers Analysis and Design', Prentice Hall, 2nd Edition.
2. Devendra Misra, 'Radio Frequency and Microwave Communication Circuits-Analysis and Design', John Wiley & Sons, 2nd Edition.
3. Clayton R. Paul, 'Electromagnetic Compatibility', John Wiley & Sons, 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
ECC802	Wireless 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					
ECC802	Wireless Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Computer Communication and Networks
- Mobile Communication

Course objectives:

- To understand architecture, planning and design of various mobile and wireless networks.
- To study various WBAN, WPAN and WLAN technologies like Bluetooth, Zigbee, Wimax etc.
- To develop the concepts of wireless adhoc network architecture and the protocol to build WSN applications.

Course outcomes:

After successful completion of the course student will be able to

- Explain the fundamentals, architecture, design issues and standards of wireless networks
- List and compare Body area network (BAN) and personal area network (PAN) technologies such as Zigbee, Bluetooth, UWB, RFID, NFC etc.
- Classify different LAN topologies and technologies
- Illustrate the fundamentals and architecture of wireless Metropolitan Area Networks (WMAN) and describe the phases of planning and design of wireless networks
- Discuss various wireless adhoc networks architecture, traffic related protocols and transmission technology
- Understand the basic architecture and working of IOT

Module No.	Unit No.	Topics	Hrs.
1.0		**Basics of Wireless Networks**	**04**
	1.1	Wire1ess Network Architecture, Classifications, Switching Technology, Communication Problems, Reference Models, Networking Issues, Networking Standards	
	1.2	**Wireless Body Area Networks:** Properties, Network Architecture, Network Components, Applications.	
2.0		**Wireless Personal Area Networks**	**12**
	2.1	**WPAN: Bluetooth (802.15.1):** Radio Specifications, Protocol Stack, Link Types, Security, State Model, Error Correction, Topologies, Applications	
	2.2	**ZigBee (802.15.4):** Radio Specifications, Components, Topologies, Protocol Stack, Applications.	
	2.3	**RFID : Radio Specifications, Architecture & Types**	
	2.4	**Near Field Communication & UWB (802.15.3 a):** Introduction and working.	
3.0		**Wireless Local Area Network**	**06**
	3.1	Equipment, Topologies, Technologies, Applications, IEEE802.11 WLAN	
	3.2	Joining an existing Basic Service Set, Security and Power Management	
	3.3	Main features of IEEE802.11a,b, i and n	
4.0		**Wireless Metropolitan and Wide Area Networks**	**12**
	4.1	**WMAN(IEEE802.16):**Introduction, WMAN Network Architecture, Network Protocols, Broadband Wireless Networks, Applications	
	4.2	**WWAN**: Planning and design of Wireless Network: Radio Link and Coverage Planning	
	4.3	Link Budgets for GSM, CDMA, CDMA2000, HSDPA Systems	
5.0		**Wireless Adhoc Networks**	**06**
	5.1	**Wireless Adhoc Networks:** Features, advantages & Applications	
	5.2	**Mobile Adhoc Networks:** Network Architecture, MAC Protocols	
	5.3	**Vehicular Adhoc Networks** (VANETs): Characteristics, Protocols & Applications	

6.0		**Wireless Sensor Networks**	**08**
	6.1	**Wireless Sensor Networks** : Network architecture, Protocols, technologies & Applications	
	6.2	**Wireless Mesh Networks** : Network architecture, Protocols, technologies & Applications	
	6.3	**Internet of Things:** Frame work, Architecture, Technology & examples, M2M communication	
		Total	**48**

Text Books & References :

1. Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann Series in Networking—Elsevier
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley Student Edition
3. Dr SunilkumarS. Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocol"Wiley India Pvt Ltd.
4. Raj Kamal, "Internet of Things Architecture & Design Principles" 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
ECCDLO 8041	Optical 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					
ECCDLO 8041	Optical Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Principles of Communication Engineering
- Digital Communication
- Antenna Wave Propagation
- Optical Communication

Course objectives:

- The issues related to signal degradation due to linear impairment
- High data rate WDM optical transport networks
- Link budget and optical networks, design and management.

Course outcomes:

After successful completion of the course student will be able to

- Identify the issues related to signal degradation and multiplexing.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.
- Apply the knowledge developed in-class to contemporary optical fiber communication research and industrial areas.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Optical Components and Networks**	**06**
	1.1	OPTICAL Components - Couplers, Isolators and Circulators, Multiplexes and Filters Optical Amplifiers. Transmitters, Detectors, Switches, Wavelength Converters	
	1.2	OPTICAL Networks - Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, System and network evolution	
2.0		**Optical Networks Architecture**	**08**
	2.1	SONET/SDH, Computer interconnects, MANS, Layered architecture for SONET and second generation networks.	
	2.2	Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols,	
	2.3	Operational principle of WDM, WDM network elements and Architectures, Introduction to DWDM, Solitons	
3.0		**Packet Switching and Access Networks**	**08**
	3.1	Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing,	
	3.2	Synchronization, Broadcast OTDM networks, Switch-based networks	
	3.3	Access Networks – Network Architecture overview, Future Access Networks,	
	3.4	Optical Access Networks Architectures; and OTDM networks	
4.0		**Wavelength Routing Networks**	**10**
	4.1	Optical layer, Node design, Network design and operation, routing and wavelength assignment architectural variations	
	4.2	Optical Network Routing Principles - Impairment Aware Routing Optical Circuit Switching ,Optical Packet Switching Optical Burst Switching	
	4.3	Energy Awareness in Optical Networking ,Network Modeling Tools Network Design Guidelines	
5.0		**Design of Optical Networks**	**10**
	5.1	Core Optical Networks, Metro Optical networks, Access Optical Networks	
	5.2	Wavelength Routing and Assignment, Traffic Grooming and Protection, Multilayer Network Structure	
	5.3	Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization	
6.0		**Virtual topology, Network Control and Management**	**06**
	6.1	Virtual topology design problem, Combines SONET/WDM network design, an ILP formulation, Regular virtual topologies,	

	6.2	Control and management, Network management configuration management, Performance management, fault management. Network management functions, Optical safety	
		Total	**48**

Text Books :

1. Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, Optical Networks: A Practical Perspective, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
2. Harry G. Parros, Communication Oriented Networks, Wiley
3. G. Agrwal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Edition, New York, 2014.

References:

1. C. Siva Ram Moorthy and Mohan Gurusamy, WDM Optical Networks: Concept, Design and Algorithms, Prentice Hall of India, 1st Edition, 2002.
2. Biswajit Mukherjee, Optical Communication Networks, TMG1998.
3. Jane M. Simoons, Optical Network Design and Planning, Second Edition, Springer
4. Ulysees Black, Optical Networks, Pearson education 2007.
5. Milorad Cvijetic, Ivan B. Djordjevic, Advanced Optical Communication Systems and Networks, Artech House Applied Photonics, 2012.

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 8042	Advanced Digital Signal 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 8042	Advanced Digital Signal Processing	20	20	20	80	--	--	--	100

Prerequisites:

- Discrete Time Signal Processing

Course objectives:

The aim of this course is to provide in-depth treatment on methods and techniques on

- Multirate Signal Processing, Power Spectrum Estimation, Adaptive Filtering and Wavelet Transform.
- Application of signal processing to real world problems.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate an understanding of multirate sampling and its mechanism.
- Study and apply the techniques of power spectrum estimation and wavelet theory for various applications.
- Implement adaptive filters for given applications.
- Apply signal processing tools to Biomedical and Telecommunication Applications

Module No.	Unit No.	Topics	Hrs.
1.0		**Multirate Digital Signal Processing**	**08**
	1.1	Advantages of Multirate Signal Processing	
	1.2	Interpolation and Decimation	
	1.3	Sampling Rate Conversion by Non Integer Factor	
	1.4	Multistage Interpolation and Decimation	
	1.5	Polyphase Decomposition	
	1.6	Digital Filter Banks	
	1.7	Applications of Multirate Signal Processing	
2.0		**Power Spectrum Estimation**	**10**
	2.1	**Non Parametric Method of Power Spectrum Estimation:** Periodogram, Modified Periodogram, Barlett Method, Welch's Method, Blackman-Tukey Approach	
	2.2	**Parametric Methods of Power Spectrum Estimation:** Auto Regressive Spectrum Estimation, Model Parameters-Yule-Walker Equation, Least Square Method and Linear Prediction, Moving Average Spectrum Estimation, Autoregressive Moving Average Spectrum Estimation	
	2.3	Eigen Analysis Algorithm for Spectrum Estimation	
3.0		**Linear Prediction and Optimum Linear Filters**	**10**
	3.1	Representation of Stationary Random Process	
	3.2	Forward and Backward Linear Prediction	
	3.3	Solution of Normal Equation(Levinson-Durbin and Schur Algorithm)	
	3.4	AR Lattice and ARMA Lattice Ladder Filters	
	3.5	Weiner Filters for Filtering and Prediction	
4.0		**Adaptive Filters**	**10**
	4.1	**Applications of Adaptive Filters:** System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation, Suppression of Narrowband Interference in Wideband Signals, Adaptive Arrays.	
	4.2	**Adaptive Algorithms:** LMS Algorithm, RLS Algorithm, Lattice Ladder Algorithm	
5.0		**Wavelet Transform**	**06**
	5.1	Introduction to Time Frequency Analysis	
	5.2	Short Time Fourier Transform	
	5.3	Continuous Wavelet Transform	
	5.4	Discrete Wavelet Transform	
	5.5	Multiresolution Analysis	

	5.6	Applications	
6.0		**Application Of Signal Processing**	**04**
	6.1	Biomedical Applications	
	6.2	Audio Applications	
	6.3	Telecommunication Applications(Radar)	
		Total	**48**

Textbooks

1. John G. Proakis, Dimitris G. Monolakis " Digital Signal Processing", PHI 2007.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing A Practical Approach", Pearson Education 2008.

Reference Books

1. Simon Haykin, "Adaptive Filter Theory", Pearson Education 2013.
2. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press.
3. Raghuveer M. Rao and Ajit S. Bopardikar, "Wavelet Transforms", "Introduction to Theory and Applications", Pearson Education Asia 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	Practical	Tutorial	Total
ECCDLO 8043	Satellite Communication	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 8043	Satellite Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication

Course objectives:

- To understand the basics of satellite communications and different satellite communication orbits
- Provide an in-depth understanding of satellite communication system operation, launching techniques, satellite link design and earth station technology
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- Review the state of the art in new research areas such as speech and video coding, satellite networking and satellite personal communications, mobile satellite communication, Laser satellite

Course outcomes:

After successful completion of the course student will be able to

- Explain basics of satellite communication, space segment and earth segment
- Understand different satellite orbits and orbital parameters
- Explain and analyze link budget of satellite signal for proper communication
- Understand various applications of satellite communications

Module No.	Unit No.	Topics	Hrs.
1.0		**Overview of Satellite Systems, Orbits and Launching**	**09**
	1.1	An overview of space and satellite, Frequency allocation for satellite communication, Polar orbiting satellites, Kepler's First, second and third law, orbital elements, apogee, perigee heights, orbital perturbations, effects of a non-spherical earth, atmospheric drag	
	1.2	Wave Propagation & Polarization, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other impairments, Antenna Polarization, Polarization of Satellite signals, Cross polarization discrimination, Ionospheric depolarization, Rain depolarization, Ice depolarization	
	1.3	Sub-satellite Point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage	
	1.4	Selection of launching site, launch window, zero and non-zero degree latitude launching, sea launch, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV)	
2.0		**Space Segment**	**06**
	2.1	Satellite configuration, Transponder sub-system, Antenna sub-system, AOC Sub-system, TT&C Sub-system, power sub-system, Thermal sub-system, reliability and quality Assurance.	
3.0		**Earth station**	**05**
	3.1	Design consideration	
	3.2	General configuration- Block diagram, Receive only type earth, transmit-receive type earth station, Antenna system, Feed system, Tracking system, LNA, HPA	
4.0		**Satellite Links**	**10**
	4.1	Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, link power budget	
	4.2	System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio	
	4.3	Uplink: Saturation flux density, input back off, earth station HPA, Downlink: Output back off, satellite TWTA output	
	4.4	Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise	
5.0		**The Space Segment Access and Utilization**	**08**
	5.1	Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system, bandwidth-limited and power-limited TWT amplifier operation	

	5.2	TDMA: Reference Burst; Preamble and Postamble, carrier recovery, network synchronization, unique word detection, traffic date, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA, satellite switched TDMA	
	5.3	Code Division Multiple Access: Direct-sequence spread spectrum–acquisition and tracking, spectrum spreading and dispreading – CDMA throughput	
6.0		**Satellite Applications**	**10**
	6.1	VSAT systems: Advantages, configurations, frequency bands, elements, Applications	
	6.2	Broadcast services: Television broadcast systems, DAB,	
	6.3	Mobile satellite communication: INMARSAT, LMSS, mobile satellite systems with non GEO satellites	
	6.4	Satellite navigation systems	
	6.5	Laser Satellite Communication: Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link	
	6.6	Recent applications	
	6.7	Modern development and future trends	
		Total	**48**

Text Books & References :

1. Dennis Roddy, “Satellite Communications”, 4th Ed., Mc. Graw-Hill International Ed. 2009.
2. M. Richharia, “Satellite Communication Systems Design Principles”, Macmillan Press Ltd. Second Edition 2003.
3. R. N. Mutangi, “ Satellite Communication”, Oxford university press, 2016.
4. Gerard Maral and Michel Bousquet, “Satellite Communication Systems”, 4th Edition Wiley Publication
5. Gerard Maral, “VSAT Networks”, John Willy & Sons
6. Timothy Pratt, Charles Bostian, and Jeremy Allmuti, “Satellite Communications”, John Willy & Sons (Asia) Pvt. Ltd. 2004
7. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, “Satellite Communication systems Engineering”, Pearson Publication

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 8044	Network Management in TeleCommunication	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 8044	Network Management in TeleCommunication	20	20	20	80	--	--	--	100

Prerequisites:

- Computer Communication and Networks,
- Operating System
- Basic Programming skills

Course objectives:

- To understand the concept of Telecommunication, network management, architecture and protocol

Course outcomes:

After successful completion of the course student will be able to

- Explain the need for interoperable network management & analyze the trends and development of the Telecommunications Network Management.
- Demonstrate broad knowledge of fundamental principles and technical standards underlying.
- Describe the concepts and architecture behind standards based network management associated with SNMP and CMIP.
- Apply basic of telecommunication, networking and information technologies and architect and implement networked informative systems.
- Continuously improve their technology knowledge and communication skills.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction of Network Management**	**10**
	1.1	Introducing Network Design Concepts: Network designers ensure that our communications networks can adjust and scale to the demands for new services. To support our network-based economy, designers must work to create networks that are available nearly 100 percent of the time. Challenges of IT managers.	
	1.2	Network Management: Goals, organization and functions	
	1.3	Network management architecture and organization network management perspectives	
2.0		**OSI Network Management**	**04**
	2.1	Network management standards	
	2.2	Network management models	
	2.3	Organization model	
	2.4	Information model	
	2.5	Communication model and functional model	
	2.6	Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE	
3.0		**Internet Management**	**12**
	3.1	SNMP-organizational model-	
	3.2	System overview.	
	3.3	Information model, communication model, functional model	
	3.4	SNMP proxy server, Management information, Protocol	
	3.5	SNMPv1,v2 and V3	
	3.6	Remote monitoring. RMON	
4.0		**Telecommunication Management Networks(TMN)**	**04**
	4.1	Need for TMN , Conceptual TNM model	
	4.2	TMN Network Management Architecture	
	4.3	TMN management services architecture and TMN implementation	
5.0		**Network Management Tools and Applications**	**12**
	5.1	System Utilities for network management	
	5.2	Network statistics and measurements	
	5.3	NMS Design, NMS components, NMS Server Architecture	
	5.4	Network Management Systems and FCAPS	
	5.5	Automatic Fault Management and Event correlation Techniques	
	5.6	Security Management	
6.0		**Broadband Network Management**	**06**
	6.1	Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN	

	6.2	ATM Network Management – ATM network reference model, integrated local management interface. ATM management management information base, role of SNMP and ILMI in ATM.	
	6.3	M1, M2, M3, M4 interface. ATM digital exchange interface management	
		Total	**48**

Text Books & References :

1. Mani Subramaniam, ―Network Management Principles and Practise", Addison Wisely, New York, 2000.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide By Kenneth Stewart, Aubrey Adams, Allan Reid, Jim Lorenz, Cisco Press
3. Network Management: Concepts and Practice, A Hands-On Approach by J. Richard Burke, Pearson Publications.
4. Network Management: Accounting and Performance Strategies by Benoit Claise - CCIE No. 2686; Ralf Wolter CISCO Press
5. Network Management Fundamentals, Alexander Clemm, Cisco Press, December 2006, ISBN-13: 978-158720137
6. Python for Software Design by Allen B. Downey, Cambridge University Press, March 2009, ISBN-13: 978-0521725965. A free manuscript is available at the author's website.

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
ECCILO 8021	Project Management	03	--	--	03	--	--	03

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					
ECCILO 8021	Project Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course outcomes:

After successful completion of the course student will be able to

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module No.	Unit No.	Topics	Hrs.
1.0		**Project Management Foundation**	**05**
	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	
2.0		**Initiating Projects**	**06**
	2.1	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	
3.0		**Project Planning and Scheduling**	**08**
	3.1	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	
4.0		**Planning Projects**	**06**
	4.1	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
5.0			**08**
	5.1	**Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings	
	5.2	**Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	
	5.3	**Project Contracting** Project procurement management, contracting and outsourcing,	
6.0			**06**
	6.1	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects	

	6.2	**Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	
		Total	**39**

References:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

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
ECCILO 8022	Finance Management	03	--	--	03	--	--	03

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					
ECCILO 8022	Finance Management	20	20	20	80	--	--	--	100

Course objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Course outcomes:

After successful completion of the course student will be able to

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module No.	Unit No.	Topics	Hrs.
1.0			**06**
	1.1	**Overview of Indian Financial System** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2.0			**06**
	2.1	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3.0			**09**
	3.1	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4.0			**10**
	4.1	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	

5.0			**05**
	5.1	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
6.0			**03**
	6.1	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	
		Total	**39**

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

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
ECCILO 8023	Entrepreneurship Development and Management	03	--	--	03	--	--	03

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					
ECCILO 8023	Entrepreneurship Development and Management	20	20	20	80	--	--	--	100

Course objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Module No.	Unit No.	Topics	Hrs.
1.0			**04**
	1.1	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
2.0			**09**
	2.1	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	
3.0			**05**
	3.1	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	
4.0			**08**
	4.1	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
5.0			**08**
	5.1	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	
6.0			**05**
	6.1	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	
		Total	**39**

References:

1. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
2. T N Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
3. C N Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
4. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
5. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
6. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

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
ECCILO 8024	Human Resource Management	03	--	--	03	--	--	03

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					
ECCILO 8024	Human Resource Management	20	20	20	80	--	--	--	100

Course objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
- To familiarize the students about the latest developments, trends & different aspects of HRM
- To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to HR**	**05**
	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions	
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	
2.0		**Organizational Behaviour (OB)**	**07**
	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues	
	2.2	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness	
	2.3	Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour	
	2.4	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor)	
	2.5	Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team	
	2.6	Case study	
3.0		**Organizational Structure &Design**	**06**
	3.1	Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	
	3.2	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	
	3.3	Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
4.0		**Human resource Planning**	**05**
	4.1	Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale	
	4.2	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning	
	4.3	Training & Development: Identification of Training Needs, Training Methods	
5.0		**Emerging Trends in HR**	**06**

	5.1	Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment	
	5.2	Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	
6.0			**10**
	6.1	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries	
	6.2	**Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	
	6.3	**Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	
		Total	**39**

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

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
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	03	--	--	03	--	--	03

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					
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	20	80	--	--	--	100

Course objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Course outcomes:

After successful completion of the course student will be able to

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Module No.	Unit No.	Topics	Hrs.
1.0			**04**
	1.1	**Professional Ethics and Business :** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	
2.0			**08**
	2.1	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	
3.0			**06**
	3.1	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	
4.0			**05**
	4.1	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	
5.0			**08**
	5.1	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	
6.0			**08**
	6.1	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	
		Total	**39**

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

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
ECCILO 8026	Research Methodology	03	--	--	03	--	--	03

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					
ECCILO 8026	Research Methodology	20	20	20	80	--	--	--	100

Course objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Course outcomes:

After successful completion of the course student will be able to

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction and Basic Research Concepts**	**09**
	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	
	1.2	Need of Research in Business and Social Sciences	
	1.3	Objectives of Research	
	1.4	Issues and Problems in Research	
	1.5	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	
2.0		**Types of Research**	**07**
	2.1	Basic Research	
	2.2	Applied Research	
	2.3	Descriptive Research	
	2.4	Analytical Research	
	2.5	Empirical Research	
	2.6	Qualitative & Quantitative Approaches	
3.0		**Research Design and Sample Design**	**07**
	3.1	Research Design – Meaning, Types and Significance	
	3.2	Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	
4.0		**Research Methodology**	**08**
	4.1	Meaning of Research Methodology	
	4.2	Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
5.0		**Formulating Research Problem**	**04**
	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	
6.0		**Outcome of Research**	**04**

	6.1	Preparation of the report on conclusion reached	
	6.2	Validity Testing & Ethical Issues	
	6.3	Suggestions and Recommendation	
		Total	**39**

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C. R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.), Singapore, Pearson Education

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
ECCILO 8027	IPR and Patenting	03	--	--	03	--	--	03

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					
ECCILO 8027	IPR and Patenting	20	20	20	80	--	--	--	100

Course objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Course outcomes:

After successful completion of the course student will be able to

- Understand Intellectual Property assets
- Assist individuals and organizations in capacity building
- Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module No.	Unit No.	Topics	Hrs.
1.0			**05**
	1.1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	
2.0			**07**
	2.1	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	
3.0			**05**
	3.1	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	
4.0			**07**
	4.1	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5.0			**08**
	5.1	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	
6.0			**07**
	6.1	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	
		Total	**39**

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

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
ECCILO 8028	Digital Business Management	03	--	--	03	--	--	03

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					
ECCILO 8028	Digital Business Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Course outcomes:

After successful completion of the course student will be able to

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Module No.	Unit No.	Topics	Hrs.
1.0			**09**
	1.1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	
2.0			**06**
	2.1	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	
3.0			**06**
	3.1	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	
4.0			**06**
	4.1	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
5.0			**04**
	5.1	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	

6.0			**08**
	6.1	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	
		Total	**39**

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

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
ECCILO 8029	Environmental Management	03	--	--	03	--	--	03

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					
ECCILO 8029	Environmental Management	20	20	20	80	--	--	--	100

Course objectives:

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Module No.	Unit No.	Topics	Hrs.
1.0			**10**
	1.1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	
2.0			**06**
	2.1	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3.0			**05**
	3.1	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	
4.0			**10**
	4.1	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	
5.0			**05**
	5.1	Total Quality Environmental Management, ISO-14000, EMS certification	
6.0			**03**
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	
		Total	**39**

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management **V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC

Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Internal Assessment:
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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
ECL801	RF 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					
ECL801	RF Design Laboratory	--	--	--	--	25	25	--	50

Suggested List of experiments

- Calibration of Network analyser for measurements.
- Characterization of RF low pass filter.
- Characterization of RF high pass filter.
- Characterization of RF band pass filter.
- Design of passive matching networks.
- Stability circles for microwave transistor
- Gain and Noise circles for transistor amplifier design
- Measurement of radiated emission using EMI Probes for DOT.
- Measurement of conducted radiations.
- Grounding & shielding for EMC.
- Testing of various emission standards like MIL CESPARE.

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	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					
ECL802	Wireless Networks Laboratory	--	--	--	--	25	25	--	50

Sample List of Experiments:

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

1. Study of Hardware and Software aspects of Wireless Network and Internet of Things
2. Study, discussion and installation of different network simulation tools such as NS2/NS3, Netstumbler, Wireshark etc.
3. Analysis of Zigbee Network to compute the energy efficiency of the network
4. Simulation of a simple wireless network (IEEE802.11)using NS2 or any other simulator
5. Configuration of WPAN using Xbee S2 series modules and XCTU software
6. Use of wireshark to capture WiFi or Bluetooth packets.
7. Configuration of WLAN
8. Analysis of WiFi network to compute average end to end delay and packet delivery ratio
9. Link budget analysis of a GSM Network using Scilab / Matlab
10. Link budget analysis of a WCDMA Network using Scilab / Matlab
11. Simulation of Wireless Sensor Network (IEEE802.15.4)in NS2 or any other simulator
12. Mini Project
13. Virtual Lab experiments covered from the syllabus

List of Mini projects:

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

1. Creating a small wireless sensor networks for agriculture application./smart home/ hospital/ industry/ or similar applications
2. Creating a monitoring application using IOT
3. Creating Virtual Lab Experiments.

Software Tools:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.amrita.edu/index.php?sub=78&brch=256
3. Scilab Experiments Book: https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjgwcelodTTAhVJrI8KHTQUC9AQFggqMAA&url=http%3A%2F%2Fscilab.in%2Ftextbook_companion%2Fenerate_book%2F3446&usg=AFQjCNGDs2a6AHGKL93l3_j8Ra1UN-5SQQ&sig2=yT9ep5_ZlhfRDVsv-GmsWw&cad=rja

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Term Work:

1. At least 08 experiments covering entire syllabus and one mini project should be set to have well predefined inference and conclusion.

2.The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.

3.The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

4. Students are encouraged to share their experiments/mini project codes on online repository.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8041	Optical Networks 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 8041	Optical Networks Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 05 Experiments, 02 tutorials and 1 mini project 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 8042	Advanced Digital Signal 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 8042	Advanced Digital Signal Processing Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program to implement multirate sampling technique for Interpolation.
- Write a program to implement multirate sampling techniques for Decimation.
- Design Anti-aliasing and Anti-Imaging filters.
- Write a program to demonstrate LMS algorithm for noise cancellations.
- Write a program to demonstrate RLS algorithm to calculate it's error function.
- Demonstrate application of Wavelet Transform for denoising.
- Analyse the frequency contents in EEG record.
- Write a program to generate ECG signal and isolate the QRS complex.

Instructions:

1. Minimum 4 experiments and 4 assignments must be submitted by each student.
2. Assignments can be designed on problem based learning from the content of the syllabus.
3. Simulation tools like Matlab/Scilab can be used.

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 8043	Satellite Communication 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 8043	Satellite Communication Laboratory	--	--	--	--	25	25	--	50

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

Term Work:

At least 08 Experiments 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 8044	Network Management in TeleCommunication 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 8044	Network Management in TeleCommunication Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Network Monitoring tools

  a) Status b)Route c)Traffic Tools

- Network Audit using NMAP Gui
- Monitoring and management network using SNMP

  a) Basic SNMP b) Advanced SNMP v3 Authentication/Encryption and ACL

  c) SNMP Trap Daemon Implementation

- Configuration SNMP Protocol on Cisco Router using Packet Tracer
- Install and configure SNMP MIB browser

  a) qtmib b)snmpB c) OpManager MIB browser

- Configuration manageable Switch: Dlink DES 3026 24 Port L2 Switch
- Network Statistics and measurement

  a] LAN Traffic Monitoring b) Protocol statistics

- LAN Troubleshooting using Wireshark
- Monitoring of services and Servers using Observium\
- Monitoring of services and Servers using Cacti
- Install and configure NAGIOS and monitor server
- Installation and Configuration of OpenNMS as a NMS.
- Implementation of Centralized Log Management System: Syslog-ng
- Study of commercial network management tools: HPOpenView, OpManager, GFILanguard and IBM NMS.

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

Term Work:

At least 08 Experiments 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
ECL803	Project Stage-II	--	12	--	--	6	--	6

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					
ECL803	Project Stage-II	--	--	--	--	100	50	--	150

Objective: The primary objective is to meet the milestones formed in the overall project plan decided in Project - I. The idea presented in Project -I should be implemented in Project -II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

Guidelines:

Project Report Format:

At the end of the semester the student needs to prepare a project report which should be prepared as per the guidelines issued by the University of Mumbai. Along with the project report a CD containing: project documentation, Implementation code, required utilities, Software's and user Manuals need to be attached.

Term Work:

Student has to submit weekly progress report to the internal guide and the internal guide has to keep a track on the progress of the project and also has to maintain the attendance report. This progress report can be used for awarding the term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project. Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day
b) Project work contributions as per objective
c) Project Report (Hard Bound)
d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-II.