UNIVERSITY OF MUMBAI

Bachelor of Engineering
Electronics and Telecommunication Engineering

Final Year Engineering
(Sem. VII and VIII), Revised course
(REV- 2012) effective from Academic Year 2014 -15

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

From Dean's Desk:

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

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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.

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

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:
In the process of change in the curriculum there is a limited scope to have major changes in the fundamental subjects which are mainly part of second year of engineering. The exposure to the latest technology and tools used all over the world is given by properly selecting subjects and their hierarchy in pre-final and final year. Thus this syllabus is made to groom the undergraduate students best suited and competent in all respect with best possible efforts put in by the experts in framing detail contents of individual subjects.

The engineering education in India is expanding in manifolds and the main challenge is the quality education. All the stakeholders are very much concerned about it.

The institution or program of study is committed and open to external review to meet certain minimum specified standards. 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 graduation.

So the curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them. 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.

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

1. To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
2. To prepare students to demonstrate an ability to identify, formulate and solve electronics and telecommunication engineering problems.
3. To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.
4. To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
5. To develop the ability among students to synthesize data and technical concepts from applications to product design.
6. To provide opportunity for students to work as part of teams on multidisciplinary projects.
7. To promote awareness among students for the life-long learning and to introduce them to professional ethics and codes of professional practice.

These are the suggested and expected main objectives and individual affiliated institute may add further in the list. In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

The subjects offered to undergraduate students in final year are at par to the requirement of industry. The students are also made competent to appear for various competitive examination conducted in India and abroad. The subjects offered are at enough level to prepare a base of the students to understand and learn latest state of technology. The students are trained in such a way that they become versatile in hardware and software simulation. Some subjects offered upgrades them in the field of information and technology which is a need of today's' era.

At the end I must outset extend my gratitude to all experts who contributed to make curriculum competent at par with latest technological development in the field of electronics and telecommunication engineering.

Dr. Udhav Bhosle
Chairman, Board of Studies in Electronics and Telecommunication Engineering

Semester VII

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC701	Image and Video Processing	04	--	--	04	--	--	04
ETC702	Mobile Communication	04	--	--	04	--	--	04
ETC703	Optical Communication and Networks	04	--	-	04	--	-	04
ETC704	Microwave and Radar Engineering	04	--	--	04	--	--	04
ETE70X	Elective	04	--	--	04	--	--	04
ETL701	Image and Video Processing Laboratory	--	02	--	--	01	--	01
ETL702	Advanced communication Engineering. Laboratory I	--	02	--	--	01	--	01
ETL703	Advanced communication Engineering. Laboratory II	--	02	--	--	01	--	01
ETEL70X	Elective	--	02	--	--	01	--	01
ETP701	Project (Stage I)	--	*	--	--	03	--	03
Total		**20**	**08**	**--**	**20**	**07**	**--**	**27**

Course Code (ETE70X)	Sem. VII Elective
ETE 701	Data Compression and Encryption
ETE 702	Statistical Signal Processing
ETE 703	Neural Network and Fuzzy Logic
ETE 704	Analog and Mixed Signal VLSI

- **Work load of learner in Semester VII is equivalent to 6 hours /week**

Semester VII

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. of Test 1 & Test 2				
ETC701	Image and Video Processing	20	20	20	80	--	--	100
ETC702	Mobile Communication	20	20	20	80	--	--	100
ETC703	Optical Communication and Networks	20	20	20	80	-	--	100
ETC704	Microwave and Radar Engineering	20	20	20	80	--	--	100
ETE70X	Elective	20	20	20	80	--	--	100
ETL701	Image and Video Processing Laboratory	--	--	--	--	25	25	50
ETL702	Advanced communication Engineering. Laboratory I	--	--	--	--	25	25	50
ETL703	Advanced Communication Engineering. Laboratory II	--	--	--	--	25	25	50
ETEL70X	Elective	--	--	--	--	25	25	50
ETP701	Project (Stage I)					25	25	50
Total		**100**	**100**	**100**	**400**	**125**	**125**	**750**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC701	Image and Video Processing	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC701	Image and Video Processing	20	20	20	80	-	-	-	100

Course pre-requisite:

- ETC 405: Signals and Systems
- ETC 602: Discrete Time Signal Processing

Course Objectives:

- To cover the fundamentals and mathematical models in digital image and video processing.
- To develop time and frequency domain techniques for image enhancement.
- To expose the students to current technologies and issues in image and video processing.
- To develop image and video processing applications in practice.

Course outcomes: Students will be able to

- Understand theory and models in Image and Video Processing.
- Interpret and analyze 2D signals in frequency domain through image transforms.
- Apply quantitative models of image and video processing for various engineering applications.
- Develop innovative design for practical applications in various fields.

Module No.		Topics	Hrs.
1		**Image Fundamentals**	04
	1.1	Image acquisition, sampling and quantization, image resolution, basic relationship between pixels, color images, RGB, HSI and other models	
2		**Two Dimensional Transforms**	06
	2.1	Discrete Fourier Transform, Discrete Cosine Transform, KL Transform, and Discrete Wavelet Transform	
3		**Image Enhancement**	
	3.1	**Spatial Domain** **Point Processing:** Digital Negative, contrast stretching, thresholding, gray level slicing, bit plane slicing, log transform and power law transform. **Neighborhood Processing**: Averaging filters, order statistics filters, high pass filters and high boost filters	08
	3.2	**Frequency Domain:** DFT for filtering, Ideal, Gaussian and Butterworth filters for smoothening and sharpening, and Homomorphic filters	
	3.3	**Histogram Modeling:** Histogram equalization and histogram specification	
4		**Image Segmentation and Morphology**	07
	4.1	Point, line and edge detection, edge linking using Hough transform and graph theoretic approach, thresholding, and region based segmentation.	
	4.2	Dilation, erosion, opening, closing, hit or miss transform, thinning and thickening, and boundary extraction on binary images	
5		**Image Restoration:**	07
	5.1	Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters	
6		**Video Formation, Perception and Representation**	08
	6.1	Digital Video Sampling, Video Frame classifications, I, P and B frames, Notation, ITU-RBT 601Digital Video formats, Digital video quality measure.	
	6.2	**Video Capture and display:** Principle of colour video camera, video camera, digital video	
	6.3	**Sampling of video Signals:** Required sampling rates, sampling in two dimensions and three dimensions, progressive virus interlaced scans	
7		**Two Dimensional Motion Estimation**	12
	7.1	**Optical Flow:** 2-D motion Vs optical flow, optical flow equations, motion representation, motion estimation criteria, optimization method.	
	7.2	**Pixel based motion estimation:** Regularization using motion smoothing constraints, using multipoint neighborhood.	
	7.3	**Block Matching Algorithms:** Exhaustive block matching algorithms, phase correlation method, Binary feature matching.	
	7.4	**Multi resolution Motion Estimation:** General formulation, Hierarchical blocks matching Algorithms.	
Total			**52**

Recommended Books:

1. Gonzales and Woods, "*Digital Image Processing*", Pearson Education, India, Third Edition,
2. Anil K.Jain, "*Fundamentals of Image Processing*", Prentice Hall of India, First Edition, 1989.
3. Murat Tekalp, "*Digital Video Processing*", Pearson, 2010.
4. John W. Woods, "*Multidimensional Signal, Image and Video Processing*", Academic Press 2012
5. J.R.Ohm , "*Multimedia Communication Technology*", Springer Publication.
6. A.I.Bovik, "*Handbook on Image and Video Processing*", Academic Press.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final internal assessment.

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC702	Mobile communication	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC702	Mobile communication	20	20	20	80	-	-	-	100

Prerequisites:

- ETC 601 Digital Communication
- ETC 603 Computer Communication and Networks

Course Objective:

- To study the concept of Mobile radio propagation, cellular system design.
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies for 4 G standards.

Course Outcomes: Students will be able to:

- Understand GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.
- Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.
- Understand emerging technologies required for fourth generation mobile systems such as SDR, MIMO etc.
- Understand different indoor and outdoor propagation models related to losses and different types of fading.

Module No.		Topics	Hrs.
1. 0		**Fundamentals of Mobile Communication**	10
	1.1	Introduction to wire1ess communication	
	1.2	Frequency Division Multiple access, Time Division Multiple access, Spread Spectrum Multiple access, Space Division Multiple access, and OFDM	
	1.3	Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving the capacity of cellular systems. and related design problems	
2.0		**2G Technologies**	13
	2.1	GSM Network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features	
	2.2	**GSM evolution in GPRS and EDGE:** Architecture and services offered	
	2.3	**IS-95 A& B(CDMA-1):** Frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management	
3.0		**3G Technology**	09
	3.1	**IMT-2000/UMTS:** Network architecture, air Interface specification, forward and reverse channels in W-CDMA and CDMA 2000, spreading and modulation.	
	3.2	Cell search and synchronization, establishing a connection, hand off and power control in 3G system	
4.0		**3GPP LTE**	08
	4.1	Introduction and system overview	
	4.2	Frequency bands and spectrum ,network structure, and protocol structure	
	4.3	Frame slots and symbols, modulation, coding, multiple antenna techniques	
	4.4	**Logical and Physical Channels:** Mapping of data on to logical sub-channels physical layer procedures, establishing a connection, retransmission and reliability, power control.	
5.0		**Emerging Technologies for 4G**	06
	5.1	4G Introduction and vision	
	5.2	Multi antenna Technologies: MIMO; software defined radio	
	5.3	Adaptive multiple antenna techniques, radio resource management, QOS requirements	
	5.4	Overview of 4G research initiatives and developments.	
6.0		**Mobile Radio Propagation**	06
	6.1	Study of indoor and outdoor propagation models	
	6.2	Small scale fading and multi-path Small-scale multi-path propagation, parameter of multi-path channels, types of small scale fading, Raleigh and Ricean distribution,	
Total			**52**

Recommended Books:

1. Theodore S. Rappaport , "*Wireless Communications*", Prentice Hall of India, PTR publication
2. Andreas Molisch , "*Wireless Communications*", Wiley, Student second Edition.
3. Vijay Garg , "*Wireless Network Evolution 2G-3G*", Pearson Education.
4. Young Kyun Kim and Ramjee Prasad, "*4 G Roadmap and Emerging Communication Technologies* ", Artech house.:
5. Raj Pandya , "*Mobile And Personal Communications Systems And Services*", Prentice hall.
6. Singhal , "*Wireless Communication*", TMH
7. C.Y Lee , "Mobile Communication", Wiley

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC703	Optical Communication and Networks	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC703	Optical Communication and Networks	20	20	20	80	-	-	-	100

Pre requisites:

- ETC404 Wave Theory and Propagation
- ETC502 Analog Communication
- ETC601 Digital Communication.

Course Objective: To teach students

- Optical fiber structures wave guide, fabrication and signal degradation in fiber.
- The characteristics of optical sources and detectors.
- Link budged and optical networks, design and management.
- Study the multiplexing schemes.

Course Outcome: This course enables the students to:

- Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
- Identify structures, functions, materials, and working principle of optical fibers, light sources, couplers, detectors, and multiplexers.
- Design optical fiber communication links using appropriate optical fibers, light sources, couplers, detectors, and multiplexers.
- 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.		Topics	Hrs.
1.		**Optical Fiber Communication Technology**	10
	1.1	Block diagram**,** advantages**,** loss and bandwidth window**,** ray theory transmission, total internal reflection, acceptance angle, numerical aperture, and skew rays	
	1.2	EM waves, modes in planer guide, phase and group velocities, types of fibers according to refractive index profile and mode transmission.	
	1.3	Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splices.	
2		**Transmission Characteristic of Optical Fiber**	08
	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, and non linear effects	
	2.2	Measurements of attenuation, dispersion and OTDR	
3		**Optical Communication Systems**	08
	3.1	Working principle and **c**haracteristics of sources (LED, LASER), and optical amplifiers	
	3.2	Working principle and characteristics of detectors (PIN, APD), noise analysis in detectors, coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance.	
	3.3	Point to point links system considerations, link power budget, and rise time budget	
4		**Optical Network System Components and Optical Networks**	10
	4.1	Couplers, isolators, circulators, multiplexers, filters, **f**iber gratings, Fabry Perot filters, **a**rrayed waveguide grating, switches and wavelength converters	
	4.2	SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, protection schemes in SONET/SDH, and wavelength routed architectures.	
	4.3	Operational principle of WDM, WDM network elements and Architectures, Introduction to DWDM, Solitons.	
5		**Packet Switching and Access Networks**	08
	5.1	OTDM, multiplexing and de-multiplexing, synchronization and broadcast OTDM networks.	
	5.2	Network architecture overview, OTDN networks, optical access networks, and future access networks.	
6		**Network Design and Management**	08
	6.1	Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization.	
	6.2	Network management functions, configuration management, performance management, fault management, optical safety, and service interface	
Total			**52**

Recommended Books:

1. John M. Senior, "*Optical Fiber Communication*", Prentice Hall of India Publication, Chicago, 3rd Edition, 2013
2. Gred Keiser, "*Optical Fiber Communication*", Mc-Graw Hill Publication , Singapore, 4th Edition, 2012
3. G Agrwal, "*Fiber optic communication Systems*", John Wiley and Sons, 3rd Edition, New York 2014
4. Rajiv Ramaswami and Kumar N. Sivarajan, "*Optical Networks: A Practical Perespective*", Elsevier Publication Elsevier India Pvt.ltd, 3rd Edition, 2010
5. P.E.Green, "*Optical Networks*", Prentice Hall,1994
6. Biswanath Mukherjee, "*Optical Communication Networks*", McGraw-Hill, 1997.
7. Le Nguyen Binh, "*Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink*", CRC Press, 2010

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC704	Microwave and Radar Engineering	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC704	Microwave and Radar Engineering	20	20	20	80	-	-	-	100

Pre requisite :

- ETC 404 Wave Theory and Propagation
- ETC 504 RF Modeling and Antenna

Course Objective: To teach the students

- Radio-frequency spectrum space, microwave communication.
- Microwave principles, working of microwave devices.
- RADAR and their applications.

Course Outcome: After Completing this course student will be able to

- Analyze the microwave passive circuit components and design the tunning and matching networks.
- Identify the state of art in microwave tubes and semiconductors and their uses in real life.
- Apply the microwave devices and RADAR for industrial and scientific purposes

Module No.		Topics	Hrs.
1.		**Waveguides and Microwave Components**	10
	1.1	Frequency bands and characteristics of microwaves	
	1.2	Rectangular and circular waveguides, mode analysis	
	1.3	Resonators, reentrant cavities, scattering parameters, tees, hybrid ring, directional couplers, phase shifters, terminations attenuators, ferrite devices such as isolators, gyrators, and circulators.	
2		**Impedance Matching and Tuning**	08
	2.1	Lumped element matching	
	2.2	Single stub tuning, double stub tuning, triple stub tuning	
	2.3	Quarter wave transformer	
3		**Generation and Amplification of Microwaves**	10
	3.1	Two Cavity Klystron and Reflex Klystron	
	3.2	Helix Travelling Wave Tube and Backward Wave Oscillator	
	3.3	Cross Field Amplifier, Cylindrical Magnetron, and Gyrotrons	
4		**Semiconductor Microwave Devices** (construction, working, equivalent circuit and performance characteristics)	10
	4.1	Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT.	
	4.2	BJT, Hetro junction BJT, MESFET, and HEMT	
	4.3	Parametric Amplifiers	
5		**RADAR**	08
	5.1	Basics of RADAR and RADAR range equation	
	5.2	**Types of RADAR:** Pulsed, Continuous wave and FMCW, Doppler, MTI, and Phased Array	
	5.3	Types of displays and Clutter	
	5.4	**Tracking RADAR**: Monopulse, Conical, Sequentiallobing	
6		**Microwave Applications**	06
	6.1	Microwave heating and bio-medical applications	
	6.2	Remote sensing RADAR, MSTRADAR, radiometer, instrumentation landing system, and RADAR based navigation	
Total			**52**

Recommended Books:

1. David M Pozar, "*Microwave Engineering*", John Wieley & Sons,Inc. Hobokenh,New Jersey, Fourth Edition, 2012.
2. Samuel YLiao, "*Microwave Devices and Circuits*", Pearson Education, Third Edition
3. Merill Skolnik, "*Introduction to RADAR Systems*", TataMcgraw Hill , Third Edition
4. Annapurna Das and Sisir K Das, "*Microwave Engineering*", Tata McGraw Hill,New Delhi, Second Edition, 2009
5. K. T. Matthew, "*Microwave Engineering*", Wieleyindia, ,2011

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE701	Data Compression and Encryption	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETE701	Data Compression and Encryption	20	20	20	80	-	-	-	100

Pre requisite :

- ETC 503 Random Signal Analysis
- ETC 601 Digital Communication
- ETC 603 Computer Communication and Networks

Course Objective: To teach the students

- Lossless and Lossy compression techniques for different types of data.
- Understand data encryption techniques
- Network security and ethical hacking.

Course Outcome : Student will able to

- Implement text, audio and video compression techniques.
- Understand symmetric and asymmetric key cryptography schemes.
- Understand network security and ethical hacking.

Module No.		Topics	Hrs.
1.		**Data Compression**	08
	1.1	**Compression Techniques:** Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques	
	1.2	**Text Compression**: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques ,LZ 77, LZ 78, LZW	
2		**Audio Compression**	04
	2.1	High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard	
3		**Image and Video Compression**	12
	3.1	PCM, DPCM JPEG, JPEG –LS , and JPEG 2000 standards	
	3.2	Intra frame coding, motion estimation and compensation, introduction to MPEG - 2 H-264 encoder and decoder	
4		**Data Security**	12
	4.1	Security goals, cryptography, stenography cryptographic attacks, services and mechanics.	
	4.2	Integer arithmetic, modular arithmetic, and linear congruence	
	4.3	Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers	
	4.4	Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.	
5		**Number Theory and Asymmetric Key Cryptography**	12
	5.1	Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm	
	5.2	RSA, attacks on RSA, Diffie Hellman key exchange , key management, and basics of elliptical curve cryptography	
	5.3	Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm	
6		**System Security**	
	6.1	Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.	04
		Total	52

Recommended Books:

1. Khalid Sayood, " *Introduction to Data Compression*" ,Morgan Kaufmann, 2000
2. David Saloman, "*Data Compression: The complete reference*" , Springer publication
3. Behrous Forouzen, "*Cryptography and Network Security*", Tata Mc Graw –Hill Education 2011
4. Berard Menezes, "*Network Security and Cryptography*", learning publication Cengage
5. William Stallings, "*Cryptography and Network Security*", Pearson Education Asia Publication, 5th edition

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE702	Statistical Signal Processing	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETE702	Statistical Signal Processing	20	20	20	80	-	-	-	100

Course Prerequisite:

- ETC 405 Signals and Systems,
- ETC503 Random Signal Analysis

Course Objective:

- To enable the student to understand the basic principles of random signal processing.
- To study spectral detection and estimation methods used in communication system design and their applications.

Course Outcome Students will able to:

- Design System for estimation, spectral estimation
- To perform wave formation analysis of the system
- Understand role of statistical fundamentals in real world applications.

Module No.		Topics	Hrs.
1.		**Review of Signals and Systems**	**6**
	1.1	Review of stochastic Processes	
	1.2	Gauss-Markow models, representation of stochastic process, likelihood and sufficiency	
2		**Detection Theory**	**8**
	2.1	One way, two way ANOVA table, hypothesis testing, decision criteria	
	2.2	Multiple measurements, multiple-hypothesis testing, and composite	
	2.3	Chi-square testing, asymptotic error rate of LRT for simple hypothesis testing, CFAR detection, sequential detection and Wald's test.	
3		**Detection of Signals in Noise**	**8**
	3.1	Detection of known signals in white noise	
	3.2	Correlation receiver and detection of known signals in colored noise	
	3.3	Detection of known signals in noise and maximum SNR criterion	
	3.4	Solution of integral equations and detection of signals parameters	
4		**Estimation Theory**	**10**
	4.1	Estimation of Parameters	
	4.2	Bayes Estimates and estimation of nonrandom parameters	
	4.3	Properties of estimators, linear mean-square estimation, and reproducing densities	
5		**Estimation of Waveforms**	**10**
	5.1	Linear MMSE Estimation of Waveforms	
	5.2	The Wiener Filter for estimation of stationary processes	
	5.3	Kalman Filter for estimation of non-stationary processes	
	5.4	Relation between the Kalman and Wiener Filters, nonlinear estimation, and nonparametric detection	
6		**Applications**	**10**
	6.1	Spread spectrum communications	
	6.2	RADAR target models, and target detection	
	6.3	Parameter estimation in RADAR systems	
	6.4	Dynamic Target Tracking, pattern classification and system identification	
Total			**52**

Recommended Books:

1. M.D. Srinath, P.K. Rajasekaran, and R. Viswanathan, "*Introduction to Statistical Signal Processing with Application*", Pearson Education
2. Robert M. Gray and Lee D. Davisson, "*An Introduction to Statistical Signal Processing*", Pearson Education
3. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-I: Estimation Theory*", Prentice hall publication
4. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-II: Detection Theory*", Prentice hall publication
5. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-III: Practical Algorithm Development*", Prentice hall publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE703	**Neural Networks and Fuzzy Logic**	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETE703	**Neural Networks and Fuzzy Logic**	20	20	20	80	-	-	-	100

Prerequisites: FEC 101 Applied Mathematics I

Course Objective: To teach students

- Concepts and understanding of artificial neural networks
- Fuzzy logic basic theory and algorithm formulation
- To solve real world problems.

Course Outcome: Students will get:

- Knowledge about different neural networks, their architecture and training algorithm
- Concept of Fuzzy logic, Fuzzy Sets, fuzzy rules and fuzzy reasoning
- Exposure to the applicability of neural networks and fuzzy logic

Module No.		Topics	Hrs.
1.		**Introduction to Neural Networks and its Basic Concepts:**	08
	1.1	Biological neurons and McCulloch and Pitts models of neuron	
	1.2	Types of activation functions	
	1.3	Neural networks architectures	
	1.4	Linearly separable and linearly non-separable systems and their examples	
	1.5	Features and advantages of neural networks over statistical techniques	
	1.6	Knowledge representation, learning process, error-correction learning, concepts of supervised learning, and unsupervised learning	
2		**Supervised Learning Neural Networks:**	07
	2.1	Single layer perception and multilayer perceptron neural networks, their architecture	
	2.2	Error back propagation algorithm, generalized delta rule, learning factors, step learning	
	2.3	Momentum learning	
	2.4	Concept of training, testing and cross-validation data sets for design and validation of the networks	
3		**Unsupervised Learning Neural Networks:**	09
	3.1	Competitive earning networks, kohonen self-organizing networks	
	3.2	K-means and LMS algorithms	
	3.3	RBF neural network, its structure and Hybrid training algorithm for RBF neural networks	
	3.4	Comparison of RBF and MLP networks Learning	
	3.5	Vector Quantization neural network architecture and its training algorithm	
	3.6	Hebbian learning, Hopfield networks.	
4		**Applications of Neural Networks:**	06
	4.1	Pattern classification	
	4.2	Handwritten character recognition	
	4.3	Face recognition	
	4.4	Image compression and decompression	
5		**Fuzzy logic**	14
	5.1	Basic Fuzzy logic theory, sets and their properties	
	5.2	Operations on fuzzy sets	
	5.3	Fuzzy relation and operations on fuzzy relations and extension principle	
	5.4	Fuzzy membership functions and linguistic variables	
	5.5	Fuzzy rules and fuzzy reasoning	
	5.6	Fuzzification and defuzzification and their methods	
	5.7	Fuzzy inference systems, Mamdani Fuzzy models, and Fuzzy knowledge based controllers	
6		**Applications of Fuzzy Logic and Fuzzy Systems:**	08
	6.1	Fuzzy pattern recognition	
	6.2	Fuzzy image processing	
	6.3	Simple applications of Fuzzy knowledge based controllers like washing machines, traffic regulations, and lift control	
		Total	52

Recommended Books:

1. S. Rajsekaran and G. A. Vijaylakshmi Pai, "*Neural Networks, Fuzzy Logic, and Genetic Algorithms*", PHI
2. Simon Haykin, "*Neural Network- A Comprehensive Foundation*", Pearson Education
3. Thimothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Wiley India Publications
4. Laurence Fausett, "*Fundamentals of Neural Networks*", Pearson Education
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

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Subject Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE704	CMOS Analog and Mixed Signal VLSI Design	04	02	--	04	01	--	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ETE704	CMOS Analog and Mixed Signal VLSI Design	20	20	20	80	--	--	--	100

Course Pre-requisite:

- ETC302: Analog Electronics I
- ETC303. Digital Electronics
- ETC402: Analog Electronics II
- ETC 505: Integrated Circuits
- ETC 606 :VLSI Design

Course Objectives: To teach the students

- Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
- Underlying methodologies for analysis and design of fundamental CMOS Analog and Mixed signal Circuits like Current and Voltage references, Single stage Amplifiers, Operational Amplifiers, 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

- Differentiate between Analog, Digital and Mixed Signal CMOS Integrated Circuits.
- Analyze and design current sources and voltage references for given specifications.
- Analyze and design single stage MOS Amplifiers.
- Analyze and design Operational Amplifiers.
- Analyze and design data converter circuits.

Module No.		Topics	Hrs.
1		**Fundamental Analog Building Blocks**	08
	1.1	MOS Transistor as sampling switch, active resistances, current source and sinks, current mirror and current amplifiers	
	1.2	Voltage and current references, band gap voltage reference, Beta-Multipler referenced self-biasing	
2		**Single Stage MOS Amplifiers**	14
	2.1	Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascade stage, simulation of CMOS amplifiers using SPICE	
	2.2	Single-ended operation, differential operation, basic differential pair, large-signal and small-signal behavior, common-mode response, differential pair with MOS loads, simulation of differential amplifiers using SPICE	
	2.3	Noise characteristics in the frequency and time domains, thermal noise, shot noise, flicker noise, popcorn noise, noise models of IC components, representation of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise in differential pairs, noise bandwidth, noise figure, noise temperature.	
3		**MOS Operational Amplifiers Desing**	08
	3.1	Trans-conductance operational amplifier (OTA), two stage CMOS operational amplifier	
	3.2	CMOS operational amplifiers compensation, cascade operational amplifier and folded cascade	
4		**Non-Linear & Dynamic Analog Circuits**	08
	4.1	Switched capacitor amplifiers (SC), switched capacitor integrators, first and second order switched capacitor circuits.	
	4.2	Basic CMOS comparator design, adaptive biasing, analog multipliers	
5		**Data Converter Fundamentals**	06
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics	
	5.2	DAC specifications, ADC specifications, mixed-signal layout issues	
6		**Data Converter Architectures**	08
	6.1	DAC architectures, digital input code, resistors string, R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC,	
	6.2	ADC architectures, flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC	
Total			**52**

Recommended Books:

1. B. Razavi, **"***Design of Analog CMOS Integrated Circuits***"**, first edition, McGraw Hill,2001.
2. Harry W. Li and David E Boyce, **"***CMOS Circuit Design, Layout, Stimulation***",** PHI Edn, 2005
3. P.E.Allen and D R Holberg, **"***CMOS Analog Circuit Design***"**, second edition, Oxford University Press, 2002.
4. Gray, Meyer, Lewis and Hurst **"***Analysis and design of Analog Integrated Circuits***"**, 4th Edition Willey International, 2002

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL701	Image and Video Processing	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL701	Image and Video Processing	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 701: Image and Video Processing be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An 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. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL702	Advanced Communication Engineering Laboratory I	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL702	Advanced Communication Engineering Laboratory I	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 702: Mobile Communication be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An 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. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL703	Advanced Communication Engineering Laboratory II	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL703	Advanced Communication Engineering Laboratory II	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 703: Optical Communication and Network and ETC 704: Microwave and Radar Engineering be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An 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 average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus of ETC 703 and ETC 704

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL70X	Elective	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL70X	Elective	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for respective elective subject be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An 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. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETP701	Project (Stage I)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETP701	Project (Stage I)	--	--	--	--	25	-	25	50

Term Work:

The final year students have already under gone project assignment in their pre-final year in Mini Project I and II. In final year group of maximum **four** students will be completing a comprehensive project work based on the courses studied. The project work may be internally assigned or may be externally assigned by the research institutes, industry etc. Each group will be assigned one faculty as a supervisor. This project work in final year may be extension of the Mini Project work done in pre-final year.

The main intention of Project work is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The Project work may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be

- Learning additional skills
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning
- Learn the behavioral science by working in a group
- The project area may be selected in which the student intend to do further education and/or may be either intend to have employment or self employment
- The topic of project should be different and / or may be advancement in the same topic of Mini Project
- The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Project work.

The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding TW marks. The TW should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Report in prescribed University format.

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained.