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UNIVERSITY OF MUMBAI

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

FACULTY OF TECHNOLOGY

Electronics and Telecommunication Engineering

Second Year with Effect from **AY 2017-18**

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

Co-ordinator, Faculty of Technology's Preamble:

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

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

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

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

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

Chairman's Preamble:

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

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

Objectives:

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

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

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

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

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

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

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

Dr. Uttam D. Kolekar

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

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

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC401	Applied Mathematics- IV	4	-	2@	4	1	5
ECC402	Electronic Devices and Circuits II	4	-	-	4	-	4
ECC403	Linear Integrated Circuits	4	-	-	4	-	4
ECC404	Signals & Systems	4	-	2@	4	1	5
ECC405	Principles of Communication Engineering	4	-	-	4	-	4
ECL401	Electronic Devices and Circuits II Laboratory	-	2	-	-	1	1
ECL402	Linear Integrated Circuits Laboratory	-	2	-	-	1	1
ECL403	Principles of Communication Engineering Laboratory	-	2	-	-	1	1
Total		**20**	**6**	**4**	**20**	**5**	**25**

@ 2 hour to be taken as tutorial classwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC401	Applied Mathematics- IV	20	20	20	80	03	25	--	125
ECC402	Electronic Devices and Circuits II	20	20	20	80	03	--	--	100
ECC403	Linear Integrated Circuits	20	20	20	80	03	--	--	100
ECC404	Signals & Systems	20	20	20	80	03	25	--	125
ECC405	Principles of Communication Engineering	20	20	20	80	03	--	--	100
ECL401	Electronic Devices and Circuits II Laboratory	--	--	--	--	--	25	25	50
ECL402	Linear Integrated Circuits Laboratory	--	--	--	--	--	25	25	50
ECL403	Principles of Communication Engineering Laboratory	--	--	--	--	--	25	25	50
Total				**100**	**400**		**125**	**75**	**700**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC401	Applied Mathematics-IV	04	--	@2	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					
ECC401	Applied Mathematics-IV	20	20	20	80	25	--	--	125

@2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Applied Mathematics I
- Applied Mathematics II
- Applied Mathematics III

Course Objectives:

1. To build the strong foundation in Mathematics of students needed for the field of Electronics and Telecommunication Engineering
2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice.
4. To prepare students to work as part of teams on multi-disciplinary projects

Course Outcome:

After successful completion of the course student will be able to

1. Demonstrate basic knowledge of Calculus of variation, Vector Spaces, Matrix Theory, Random Variables, Probability Distributions, Correlation and Complex Integration.
2. Demonstrate an ability to identify and Model the problems in the field of Electronics and Telecommunication and solve it.
3. Apply the application of Mathematics in Telecommunication Engineering.

Module No.	Unit No.	Detailed Content	Hours
1		**Calculus of Variation:**	**06**
	1.1	Euler‟s Langrange equation, solution of Euler‟s Langrange equation (only results for different cases for Function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	Functions involving higher order derivatives: Rayleigh-Ritz method	
2		**Linear Algebra: Vector Spaces**	**06**
	2.1	Vectors in n-dimensional vector space: properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Vector spaces over real field, properties of vector spaces over real field, subspaces	
	2.3	The Cauchy-Schwarz inequality, Orthogonal Subspaces, Gram-Schmidt process	
3		**Linear Algebra: Matrix Theory**	10
	3.1	Characteristic equation, Eigen values and Eigen vectors, properties of Eigen values and Eigen vectors.	
	3.2	Cayley-Hamilton theorem (without proof), examples based on verification of Cayley- Hamilton theorem.	
	3.3	Similarity of matrices, Diagonalisation of matrices.	
	3.4	Functions of square matrix, derogatory and non-derogatory matrices.	
4		**Probability**	**10**
	4.1	Baye‟s Theorem (without proof)	
	4.2	Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function, expectation, variance.	
	4.3	Moments, Moment Generating Function.	

	4.4	Probability distribution: Binomial distribution, Poisson & normal distribution (For detailed study)	
5		**Correlation**	**04**
	5.1	Karl Pearson‟s coefficient of correlation, Covariance, Spearman‟s Rank correlation,	
	5.2	Lines of Regression.	
6		**Complex integration**	**12**
	6.1	Complex Integration:Line Integral, Cauchy‟s Integral theorem for simply connected regions, Cauchy‟s Integral formula.	
	6.2	Taylor‟s and Laurent‟s Series	
	6.3	Zeros, singularities, poles of f(z), residues, Cauchy‟s Residue theorem.	
	6.4	Applications of Residue theorem to evaluate real Integrals of different types.	

Note: Term Work should be based on Tutorials.

Textbooks :

1. H.K. Das, "*Advanced engineering mathematics*", S . Chand, 2008
2. A. Datta, *"Mathematical Methods in Science and Engineering",* 2012
3. B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publication
4. P.N.Wartilar&J.N.Wartikar, "*A Text Book of Applied Mathematics*" Vol. I & II, Vidyarthi Griha Prakashan, Pune

Reference Books:

1. B. V. Ramana, *"Higher Engineering Mathematics",* Tata Mc-Graw Hill Publication
2. Wylie and Barret, *"Advanced Engineering Mathematics",* Tata Mc-Graw Hill 6th Edition
3. Erwin Kreysizg, *"Advanced Engineering Mathematics",* John Wiley & Sons, Inc
4. Seymour Lipschutz "*Beginning Linear Algebra*" Schaum's outline series, Mc-Graw Hill Publication
5. SeymourLipschutz "*Probability*" Schaum's outline series, Mc-Graw Hill Publication

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC402	Electronic Devices & Circuits-II	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					
ECC402	Electronic Devices & Circuits-II	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Electronic Devices & Circuits-I

Course Objectives:

1. To understand the operation of the various bias circuits of MOSFET and Analyze and design MOSFET bias circuits.
2. To understand the operation and design of multistage amplifier for a given specification.
3. To understand the operation and design of transformer coupled various types of power amplifier circuits.
4. To understand the effects of negative feedback on amplifier circuits.
5. To analyze the different *RC* and *LC* oscillator circuits to determine the frequency of oscillation.

Course Outcome:

After successful completion of the course student will be able to

1. Design and analyse the basic operations of MOSFET.
2. Know about the multistage amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain.
3. Know about different power amplifier circuits, their design and use in electronics and communication circuits.
4. Know the concept of feedback amplifier and their characteristics.
5. Design the different oscillator circuits for various frequencies

Module No.	Unit No.	Detailed Content	Hours
1		**Introduction to MOSFET**	**08**
	1.1	MOSFET - Symbol, Types of MOSFET - Depletion and Enhancement type MOSFET (N channel and P channel),	
	1.2	Construction, Operation, and V-I characteristics of MOSFET	
	1.3	MOSFET biasing - Types of Depletion & enhancement MOSFET biasing,	
	1.4	MOSFET as amplifier	
2		**Introduction of Multistage amplifiers**	**06**
	2.1	RC coupled, transformer coupled, direct coupled,	
	2.2	Low and high frequency considerations of cascade amplifier, cascode amplifier (CE-CB), Darlington pair amplifier.	
3		**Design of Multistage amplifiers**	**10**
		Analysis and design considerations of multistage amplifiers (CE-CE, CS-CS, CS-CE,), effect of source and load resistance	
4		**Large signal amplifiers**	**08**
	4.1	Harmonic distortion and power efficiency of Class A, B, AB, and C amplifiers	
	4.2	Design of Class A, Class B, and Push-Pull Power amplifier design.	
	4.3	Thermal considerations and design selection of heat sinks.	
5		**Feedback amplifiers**	**08**
	5.1	Feedback concept, ideal feedback amplifier, classification of feedbacks, Various topologies	
	5.2	Analysis and design of different types of negative feedback.	
6		**Oscillators**	**08**
	6.1	Principle of oscillation, RC oscillator, twin T oscillator	
	6.2	Oscillator with LC feedback. Colpitts oscillator, Hartley oscillator, Crystal controlled oscillator.	
	6.3	Design of different oscillator circuits.	

Textbooks :

1. D. A. Neamen, *"Electronic Circuit Analysis and Design,"* Tata McGraw Hill, 2nd Edition.
2. R. L. Boylestad,"Electronic Devices and Circuit Theory," Pearson, 11th Edition.
3. T. F. Bogart,"Electronic Devices And Circuit," Merrill, 6th Edition.
4. R. S. Dudhe and M. Farhan, "Electronic Devices and Circuits," Synergy Knowledgeware, 1st Edition

Reference Books:

1. Salivahanan, N. Suresh Kumar,"*Electronic Devices and Circuits*," Tata McGraw Hill, 3rd Edition
2. J. Millman, Christos CHalkias, and Satyabratatajit, Millman‟s,"*Electronic Devices and Circuits*," McGrawHill, 3rd Edition
3. Muhammad H. Rashid, "*Microelectronics Circuits Analysis and Design*," Cengage Learning, 2nd Edition.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC403	Linear Integrated Circuits	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					
ECC403	Linear Integrated Circuits	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Basic Electrical Engineering
- Electronic Devices & Circuits-I

Course Objectives:

1. To understand the concepts, working principles and key applications of linear integrated circuits.
2. To perform analysis of circuits based on linear integrated circuits.
3. To design circuits and systems for particular applications using linear integrated circuits.

Course Outcome:

After successful completion of the course student will be able to

1. Understand the fundamentals and areas of applications for the integrated circuits.
2. Analyze important types of integrated circuits.
3. Demonstrate the ability to design practical circuits that perform the desired operations.
4. Understand the differences between theoretical, practical & simulated results in integrated circuits.
5. Select the appropriate integrated circuit modules to build a given application.

Module No.	Unit No.	Detailed Content	Hours
1		**Introduction to operational amplifiers**	**08**
	1.1	Analysis of differential amplifier circuit configurations using FETs, Effect of Swamping resistor, Current sources using FETs, Widlar current source, Wilson current source, Voltage sources and references, DC level shifters.	
	1.2	Ideal & Practical Operational Amplifiers, Operational amplifier characteristics, Operational amplifier parameters, Operational amplifier open loop and closed loop configurations.	
2		**Applications of Operational Amplifier**	**08**
	2.1	Amplifiers: Inverting, non-inverting, buffer, summing & difference amplifiers, integrator & differentiator (ideal & practical), current amplifier, instrumentation amplifier, log and antilog amplifiers..	
	2.2	Converters: Current to voltage converters, voltage to current converters, voltage to frequency converter, frequency to voltage converter.	
	2.3	Active Filters: Second order active low pass, high pass, band pass and band reject filters, Introduction to switch capacitor filters.	
	2.4	Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.	
3		**Non-Linear Applications of Operational Amplifier**	**08**
	3.1	Comparators: Inverting comparator, non-inverting comparator, zero crossing detector, window detector, peak detector, sample & hold circuits.	
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.	
	3.3	Waveform Generators: Square wave generator and triangular wave generator.	
	3.4	Precision Rectifiers: Half wave and full wave precision rectifiers.	
4		**Analog to Digital and Digital to Analog Convertors**	**08**
	4.1	Performance specifications of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC.	
	4.2	Performance specifications of DAC, binary weighted resistor DAC, R/2R ladder DAC, inverted R/2R ladder DAC.	
5		**Special Purpose Integrated Circuits**	**08**
	5.1	Functional block diagram and working of IC 555, design of astable and monostable multivibrator using IC 555, application	

		of IC 555 as pulse position modulator, pulse width modulator and Schmitt Trigger.	
	5.2	Functional block diagram and working of VCO IC 566 and application as frequency modulator, Functional block diagram and working of PLL IC 565 and application as FSK Demodulator, Functional block diagram and working of multiplier IC 534andapplication as a phase detector, Functional block diagram and working of waveform generator XR 2206 and application as sinusoidal FSK generator.	
6		**Voltage Regulators**	**08**
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators.	
	6.2	Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, Functional block diagram and working of LT1070 monolithic switching regulator.	

Textbooks :

1. Ramakant A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson Prentice Hall, 4th Edition.
2. K. R. Botkar, "*Integrated Circuits*", Khanna Publishers (2004)
3. D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition.

Reference Books:

1. Sergio Franco, "*Design with operational amplifiers and analog integrated circuits*", Tata McGraw Hill, 3rd Edition.
2. David A. Bell, "*Operation Amplifiers and Linear Integrated Circuits*", Oxford University Press, Indian Edition.
3. R. F. Coughlin and F. F. Driscoll, "*Operation Amplifiers and Linear Integrated Circuits*", Prentice Hall, 6th Edition.
4. "J. Millman, Christos CHalkias, and Satyabratatajit, Millman‟s,"Electronic Devices and Circuits," McGrawHill, 3rdEdition".

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC404	Signals and Systems	04	--	2@	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					
ECC404	Signals and Systems	20	20	20	80	25	--	--	125

@2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Applied Maths-III
- Circuit Theory and Networks

Course Objectives:

1. To introduce students the concept and theory of signals and systems needed in electronics and telecommunication engineering fields.
2. To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domain

Course Outcome:

After successful completion of the course student will be able to

1. Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them,
2. Understand use of transforms in analysis of signals and system in continuous and discrete time domain.
3. Observe the effect of various properties and operations of signals and systems.
4. Evaluate the time and frequency response of Continuous and Discrete time systems which are useful to understand the behaviour of electronic circuits and communication systems.

Module No.	Unit No.	Detailed Content	Hours
1		**Introduction to signals and systems**	**08**
	1.1	Introduction to signals: Definition, sampling theorem, sampling of continuous time signals, elementary signals: exponential, sine, step, impulse, ramp, rectangular, triangular, signum, sinc, operations on signals,	
	1.2	Classification of signals: Continuous and discrete time, deterministic and non-deterministic, periodic and aperiodic, symmetric (even) and asymmetric (odd), energy and power, causal and anti-causal signal, Case study of different signals from communication and biomedical field	
	1.3	Introduction to systems: Definition, Classification of systems: Static and dynamic, time variant and time invariant, linear and nonlinear, causal and non-causal, stable and unstable systems., communication and control system as examples	
2		**Time domain analysis of continuous time and discrete time systems**	**08**
	2.1	Representation of systems using differential /difference equation, Impulse, step and exponential response, system stability	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems	
	2.3	Correlation and spectral Density**:** auto-correlation, cross correlation, analogy between correlation and convolution, energy spectral density, power spectral density, relation of ESD,PSD with auto-correlation	
3		**Frequency domain analysis of continuous and discrete signals:**	**10**
	3.1	**Review of Fourier series:** Trigonometric and exponential Fourier series representation of signals, Gibbs phenomenon, Discrete Time Fourier Series, properties, analogy between Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS).	
	3.2	**Fourier Transform (FT):** Fourier Transform and Inverse Fourier Transform on periodic and non-periodic signals, limitations of CT/DT Fourier Transform and need for Laplace/Z Transform.	
	3.3	**Overview of Laplace Transform:** Need of Laplace Transform, review of unilateral and bilateral Laplace	

		Transform, properties, inverse of Laplace Transform, concept of Region of Convergence (ROC),poles and zeros, relation between continuous time Fourier Transform and Laplace Transform.	
4		**Z-Transform**	**08**
	4.1	Need of Z-Transform, definition of unilateral and bilateral Z-Transform, Z-Transform of finite and infinite duration sequences, properties, Inverse Z-Transform, relation between discrete time Fourier Transform and Z-Transform, Z-Transform of standard signals, ROC for ZT, plotting poles and zeros of transfer function.	
	4.2	Analysis of discrete time LTI systems using Z-Transform: Transfer Function, causality and stability of systems, frequency response (impulse and step), relation between Laplace Transform and Z–Transform.	
5		**State Space Analysis and Realization Structures**	**08**
	5.1	State Variable Analysis: Introduction to the notion of „state", systematic procedure for determining state equations, solution of state equations using Laplace transform, definition of *exp*(*A*) where *A* is a matrix, time domain solution of state equations.	
	5.2	Systems with finite duration and infinite duration, impulse response, recursive and non-recursive discrete time system, realization structures: direct form–I, direct form–II, Transpose, cascade, and parallel forms.	
6		**Applications of Signals and Systems**	**06**
	6.1	Signal Processing Applications: Speech and Audio Processing, Multimedia (image & video) processing, Underwater acoustic signal processing, Biological signal analysis	
	6.2	Communication and Control System Application: Modulation (Analog and Digital) process, Feedback/Feedforward Control system	

Textbooks :

1. NagoorKani, "*Signals and Systems"*, Tata McGraw Hill, Third Edition, 2011.
2. B.P. Lathi, "*Principles of Linear Systems and Signals"*, Oxford, Second Edition, 2010.
3. S. L. Nalbalwar, A. M. Kulkarni and S. P. Sheth, "*Signals and Systems"*, Synergy Knowledgeware, 2016.
4. Simon Haykin and Barry Van Veen, "*Signals and Sytems"*, John Wiley and Sons, Second Edition,2004.

Reference Books:

1. Hwei. P Hsu, "*Signals and Systems"*, Tata McGraw Hill, Third edition, 2010
2. V. Krishnaveni and A.Rajeshwari, "*Signals and Systems"*, Wiley-India, First Edition 2012.
3. NarayanaIyer, "*Signals and Systems"*, Cenage Learning, First Edition 2011.
4. Michael J Roberts, "*Fundamentals of Signals and systems*", Tata McGraw Hill, special Indian Economy edition, 2009.
5. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, "*Signals and Systems"*, Pearson Education, Fourth Edition 2009.
6. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, "*Signals and Systems*", Prentice-Hall of India, Second Edition, 2002.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC405	Principles of 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					
ECC405	Principles of Communication Engineering	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Applied Maths III
- Electronic Devices and Circuits I

Course Objectives:

1. To introduce students to various modulation and demodulation techniques of analog communication.
2. To analyze different parameters of analog communication techniques.
3. To study pulse modulation and demodulation.

Course Outcome:

After successful completion of the course student will be able to

1. Use different modulation and demodulation techniques used in analog communication
2. Identify and solve basic communication problems
3. Analyze transmitter and receiver circuits
4. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems

Module No.	Unit No.	Detailed Content	Hours
1		**Basics of Communication System**	**06**
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain.	
	1.2	Types of noise, signal to noise ratio, noise figure and noise temperature, Friss transmission formula.	
2		**Amplitude Modulation and Demodulation**	**12**
	2.1	Basic concepts, signal representation, need for modulation	
	2.2	Spectrum, waveforms, modulation index, bandwidth, voltage distribution and power calculations	
	2.3	DSBFC: Principles, modulating circuits, low level and high level transmitters DSB suppressed carrier :Multiplier modulator, nonlinear modulator and switching modulator	
	2.4	Amplitude demodulation: Diode detector, practical diode detector, square law detector	
	2.5	Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television	
3		**Angle Modulation and Demodulation**	**12**
	3.1	Frequency modulation (FM): Basic concept, mathematical analysis, spectrum of FM wave, sensitivity, phase deviation and modulation index, deviation and percent modulated waves, bandwidth requirement of angle modulated waves, deviation ratio, narrowband FM and wideband FM	
	3.2	Varactor diode modulator, FET reactance modulator, stabilized AFC, Direct FM transmitter, indirect FM Transmitter, noise emphasis and de-emphasis	
	3.3	Phase modulation (PM): Principle and working of transistor direct PM modulator and relationship and comparison between FM and PM	
	3.4	FM demodulation: Balance slope detector, Foster-Seely discriminator, ratio detector, FM demodulator using Phase lock loop (PLL), amplitude limiting and thresholding, comparison between FM demodulators, comparison between AM, FM and PM	
	3.5	Applications of FM and PM	

4		**Radio Receivers**	**06**
	4.1	TRF, Super - heterodyne receiver, receiver parameters and choice of IF	
	4.2	AM receiver circuits and analysis, simple AGC, delayed AGC, forward AGC, and communication receiver	
	4.3	FM receiver circuits, comparison with AM receiver	
	4.4	Single and independent sideband (SSB and ISB) receivers	
5		**Analog Pulse Modulation & Demodulation**	**08**
	5.1	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria	
	5.2	Sampling techniques, aliasing error and aperture effect	
	5.3	PAM,PWM, PPM generation and detection	
	5.4	Applications of Pulse Communication	
6		**Multiplexing & De-multiplexing**	**04**
	6.1	Frequency Division Multiplexing transmitter & receiver block diagram	
	6.2	Time Division Multiplexing transmitter & receiver block diagram	
	6.3	Examples and applications of FDM and TDM	

Textbooks :

1. Kennedy and Davis, "*Electronics Communication System*", Tata McGraw Hill, Fourth edition.
2. B.P. Lathi, Zhi Ding "*Modern Digital and Analog Communication system*", Oxford University Press, Fourth edition.
3. Wayne Tomasi, "*Electronics Communication Systems*", Pearson education, Fifth edition.

Reference Books:

1. Taub, Schilling and Saha, "*Taub's Principles of Communication systems*", Tata McGraw Hill, Third edition.
2. P. Sing and S.D. Sapre, "*Communication Systems: Analog and Digital*", Tata McGraw Hill, Third edition.
3. Simon Haykin, Michel Moher, "*Introduction to Analog and Digital Communication*", Wiley, Second edition.

4. Dennis Roddy and John Coolen, "*Electronic Communication*", Prentice Hall, Third Edition.
5. Louis Frenzel, "*Communication Electronics*", Tata McGraw Hill, Third Edition.
6. Roy Blake, "*Electronic Communication Systems*", Delmar Publication, Second edition

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL401	Electronic Devices & Circuits-II 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					
ECL401	Electronic Devices & Circuits-II Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Design and Analyze two stage BJT amplifier (Frequency response and performance parameters)
2. Design and Analyze two stage FET amplifier (Frequency response and performance parameters)
3. Design Multistage BJT amplifier and finding its parameters, Verify.
4. Design and Analyze Voltage series feedback amplifier using BJT/FET and verify its effect on frequency response. x
5. Design and Analyze Current series feedback using BJT/FET and verify its effect on frequency response.
6. Design Multistage JFET amplifier and finding its parameters, verify.
7. Design and Analyze RC Phase shift oscillator for different amplitude and frequency.
8. Design and Analyze Colpitt / Hartley oscillator for different amplitude and frequency.
9. Class C power amplifier and its efficiency

Minimum One project based on:

1. Simple Emergency light.
2. DC servo amplifier using MOSFET.
3. Audio tone control circuit.
4. Public address system.
5. Automatic Door Bell

6. Clapp Switch
7. Topic related to syllabus

Note :Small project should 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 are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit andGrading System"** manual and should be added and averaged. Based on above scheme gradingand 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
ECL402	Linear Integrated Circuits 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					
ECL402	Linear Integrated Circuits Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Discrete Differential Amplifier
2. Inverting, Non inverting, Buffer, Summing & Difference amplifiers
3. Differentiator & Integrator
4. Instrumentation amplifier
5. I to V and V to I converters
6. V to F and F to V convertors
7. Active Filters
8. Wien Bridge Oscillator
9. RC Phase shift Oscillator
10. Inverting & Non inverting Schmitt trigger
11. Square & Triangular wave generator
12. Precision rectifiers
13. Peak detector & Sample & Hold Circuits
14. Analog to Digital converter

15. Digital to Analog converter
16. Multivibrators using IC 555
17. PPM, PWM and Schmitt trigger using 555
18. Frequency modulatorusing VCO IC 566.
19. FSK DemodulatorusingPLL IC 565.
20. Phase detectorusing multiplier IC 534.
21. Sinusoidal FSK generator using XR 2206
22. Voltage Regulators using 78XX/79XX, 317/337, 723

Minimum One project based on:

1. Variable Power Supply
2. Data Acquisition System
3. Function Generator
4. Topic related to syllabus

Note :Small project should 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 are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit andGrading System"** manual and should be added and averaged. Based on above scheme gradingand 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
ECL403	Principles of 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					
ECL403	Principles of Communication Engineering Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Generation and detection of AM (DSB-FC, DSB-SC,SSB) signal.
2. Generation and detection of FM signal.
3. Study of AM broadcast receiver (Super heterodyne).
4. Generation of PAM signal and verify the sampling theorem.
5. Generation of PPM, PWM signal.
6. Study of TDM and FDM multiplexing techniques.

Suggested list of Minimum projects

1. AM transmitter/receiver.
2. FM transmitter/receiver.
3. PAM,PPM,PWM circuits with IC 555
4. FM remote encoder/decoder circuits,
5. Transistor Intercom circuit
6. Walkie -Talkie Circuit
7. Arduino based communication circuits

8. Electronic voting machine.
9. Electronic Notice Board Using Android.
10. Home security system.

Note :Small project should 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 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.