S.E. (Electronics Engineering) – Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX401	Applied Mathematics IV	04	---	01@	04	---	01	04
ELX402	Electronic Devices and Circuits II	04	---	---	04	---	---	04
ELX 403	Microprocessors and Applications	04	---	---	04	---	---	04
ELX 404	Digital System Design	04	---	---	04	---	---	04
ELX 405	Principles of Communication Engineering	04	---	---	04	---	---	04
ELX 406	Linear Control Systems	04	---	---	04	---	---	04
ELXL 401	Electronic Devices and Circuits II Laboratory		02	---	---	01	---	01
ELXL 402	Microprocessors and Applications Laboratory		02	---	---	01	---	01
ELXL 403	Digital System Design Laboratory		02	---	---	01	---	01
ELXL 404	Principles of Communication Engineering Laboratory		02	---	---	01	---	01
	Total	**24**	**08**	**---**	**24**	**04**	**01**	**29**

@1 hour tutorial classwise

Course Code	Course Name	Examination Scheme – Semester IV							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX401	Applied Mathematics IV	20	20	20	80	3	25	---	125
ELX 402	Electronic Devices and Circuits II	20	20	20	80	3	---	---	100
ELX 403	Microprocessors and Applications	20	20	20	80	3	---	---	100
ELX 404	Digital System Design	20	20	20	80	3	---	---	100
ELX 405	Principles of Communication Engineering	20	20	20	80	3	---	---	100
ELX 406	Linear Control Systems	20	20	20	80	3	---	---	100
ELXL401	Electronic Devices and Circuits II Laboratory						25	25	50
ELXL402	Microprocessors and Applications Laboratory						25	25	50
ELXL 403	Digital System Design Laboratory						25	25	50
ELXL404	Principles of Communication Engineering Laboratory						25	--	50
Total		**120**	**120**	**120**	**480**	**18**	**125**	**75**	**800**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ELX401	Applied Mathematics IV	04	--	01	04	--	01	05

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX401	Applied Mathematics IV	20	20	20	80	25	--	100

Prerequisite:

FEC 101: Applied Mathematics I
FEC 201: Applied Mathematics II
ELX 301: 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 outcomes:

1 Students will demonstrate basic knowledge of Calculus of variation, Vector Spaces, Matrix Theory, Random Variables, Probability Distributions, Correlation and Complex Integration.

2 Students will demonstrate an ability to identify and Model the problems in the field of Electronics and Telecommunication and solve it.

3 Students will be able to apply the application of Mathematics in Telecommunication Engineering.

Module No.	Unit No.	Topics	Hrs.
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.	
		Total	**48**

Text books:

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 and II,VidyarthiGrihaPrakashan., 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. Seymour Lipschutz, “*Probability*” Schaum’s outline series, Mc-Graw Hill Publication

Internal Assessment (IA):

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

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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Term Work/ Tutorial:

At least 08 assignments covering entire syllabus must be given during the “**class wise tutorial’**. The assignments should be students centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per “**credit and grading system”** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ELX402	Electronic Devices &Circuits-II	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX402	Electronic Devices & Circuits-II	20	20	20	80	--	--	100

Prerequisite:

- **FEC105:** Basic Electrical & Electronics Engineering
- **ELX302:** Electronic Device and Circuits I

Course Objectives:

1. To enhance comprehension capabilities of students through understanding of electronic devices and circuits
2. To perform DC and AC analysis of single stage and multistage amplifiers
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To design electronic circuits using semiconductor devices.

Course Outcome:

1. Students will be able to Ability to understand amplifiers through frequency response.
2. Students will be able to perform DC and Ac analysis of single stage and multistage amplifiers, oscillators, differential amplifiers and power amplifiers.
3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters.
4. Student will be able to select appropriate circuit for given specifications/applications.
5. Students will be able to explain working and construction details of special, semiconductor devices.

Module No.	Topics	Hours
1	**Frequency response of amplifiers.**	**8**
1.1	High frequency equivalent circuit of BJT and MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth	
1.2	Effect of coupling, bypass and load capacitors on single stage BJT and MOSFET amplifiers.	
2	**Frequency Response of Multistage Amplifiers.**	**6**
2.1	Effect of parasitic capacitances on BJT and MOSFET amplifiers. Low, mid and high frequency response of multistage amplifiers (CE-CE, CE-CB, CS-CS, CS-CG)	
3	**Feedback Amplifiers and Oscillators**	**8**
3.1	Types of Negative Feedback block diagram representation, Effect of negative feedback on Input impedance, Output impedance, Gain and Bandwidth with derivation, feedback topologies (Introduction only).	
3.2	Positive feedback and principle of oscillations, RC oscillators: Phase shift oscillators, Wien bridge oscillators, LC Oscillators: Hartley, Colpitts and clapp, Tunned Oscillator, Twin T Oscillator, Crystal Oscillator (BJT circuit analysis).	
4	**Differential Amplifiers**	**10**
4.1	MOSFET current sources, Cascode current mirror, advanced MOSFET active load, small signal analysis: MOSFET active load	
4.2	Basic MOSFET differential amplifier, DC characteristics, transfer characteristics, differential and common mode input impedances.	
4.3	MOSFET differential amplifier with active load, MOSFET differential amplifier with cascode active load,	
5	**Power Amplifiers**	**8**
	Power BJTs, Heat sinks, Power BJTs, Power MOSFETs, Heat Sinks, Class A, Class B, Class C and Class AB operation, Power efficiency, Class AB output stage with diode biasing, VBE multiplier biasing, input buffer transistors, Darlington configuration.	
6	**Special Semiconductor Devices - II**	**8**
	PNPN diode, SCR, DIAC, TRIAC, UJT, IGBT, HEMT, Gunn diode, IMPATT diode, HBT	
	Total Hours	**48**

Text Books:

1. Millman and Halkies, “Integrated Electronics”, TATA McGraw Hill.
2. Donald A. Neamen, “Electronic Circuit Analysis and Design”, TATA McGraw Hill, 2nd Edition

Reference Books:

1. Boylestad," Electronic Devices and Circuit Theory", Pearson
2. David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.
3. Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage
4. S. Salivahanan, N. Suresh Kumar,“Electronic Devices and Circuits”, Tata McGraw Hill,
5. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar,” Microelectronic Circuits Theory and Applications”, International Version, OXFORD International Students Edition, Fifth Edition.

Internal Assessment (IA):

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

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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ELX403	Microprocessors & Applications	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX403	Microprocessors and Applications	20	20	20	80	--	--	100

Prerequisite:

- **ELX303**:Digital Circuit Design

Course Objectives:

1. To develop background knowledge and core expertise in microprocessor.
2. To study the concepts and basic architecture of 8086 and Co-processor 8087.
3. To know the importance of different peripheral devices and their interfacing to 8086.
4. To know the design aspects of basic microprocessor.
5. To write assembly language programs in microprocessor for various applications.

Course Outcomes:

1.Students will be able to understand and explain 16-bit microprocessor architecture.
2.Students will be able to understand and write programmes for 8086 microprocessor.
3.Students will be able to use various peripheral devices to design Single Board Computer(SBC).
4.Students will be able to understand and explain 32-bit microprocessor architecture.

Module No.	Topics	Hrs.
1.	**Intel 8086 Architecture:** Major features of 8086 processor, 8086 CPU Architecture and the pipelined operation, Programmer's Model, Memory Segmentation and 8086 pin description in detail.	05
2.	**Instruction Set of 8086 and Programming:** Addressing modes of 8086, Instruction Set of 8086 microprocessor in detail, Assembler directives,Procedures and Macros, Programming 8086 in assembly language, Mixed mode Programming with C-language and assembly language.	07
3.	**8086 Interrupts:** Interrupt types in 8086, Dedicated interrupts, Software interrupts, Programming examples related to INT 21H (DOS Interrupts).	05
4.	**Designing the 8086 CPU module:** Generating the 8086 System Clock and Reset Signals using 8284 clock generator, 8086 Minimum and Maximum Mode CPU Modules, Minimum and Maximum Mode Timing Diagrams, Memory interfacing.	07
5.	**Single Board Computer Design:** 8086 – 8087 coprocessor interfacing. Functional Block Diagram and description, Operating Modes, Control Word Formats and Applications of the Peripheral Controllers - 8255-PPI,8259- PIC and 8237-DMAC. Keyboard and Seven Segment Display Interface using 8255. System design using peripheral controllers.	12
6.	**Introduction to 32-bit Intel Pentium Architecture:** Features of Pentium Processor, Pentium Superscalar architecture, Pipelining, Branch Prediction, Instruction and Data cache.	12
	Total	48

Text Books:

1)8086/8088 family: Design Programming and Interfacing: By John Uffenbeck (Pearson Education)
2)Microprocessor and Interfacing: By Douglas Hall (TMH Publication)
3)The Intel Microprocessor family: Hardware and Software principles and Applications: By James L. Antonakos (Cengage Learning)

Reference Books:

1) 8086 Microprocessor Programming and Interfacing the PC: By Kenneth Ayala (West Publication)
2) Pentium Processor System Architecture: By Don Anderson & Tom Shanley (Mindshare, Inc.) (Addison-Wesley Publisher)
3) The INTEL Microprocessors, Architecture, Programming and Interfacing: By Barry B. Brey (PearsonPublishers, 8th Edition)
4) Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI 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 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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX404	Digital System Design	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX404	Digital System Design	20	20	20	80	--	--	100

Prerequisite*:*

- **ELX303**: Digital Circuit Design

Course Objectives:

1. To perform analysis of synchronous sequential circuits.
2. To perform the design of synchronous and asynchronous counters using intuitive approaches.
3. To apply fundamental design procedure for synchronous sequential circuits; consisting of the steps as construction of initial state transition table/diagram, perform state reduction and state assignment, develop flip-flop excitations, and design of registers and counters.
4. To understand the basics of Hardware Description language. .
5. To make VHDL implementations on the structured design of synchronous sequential circuits.
6. To apply algorithmic state machines (ASMs) approach for large-size digital system design; consisting of the steps as development of ASM charts and ASM blocks, make state assignment on ASMs, and perform data path and control path designs.

Course Outcome:

1. Students will be able to design and implement synchronous sequential logic circuits.
2. Students will be able to analyze various types of digital logic circuits.
3. Students will be able to understand engineering concepts in the design of digital circuits.
4. Students will be able to understand the role of hardware description languages in digital circuit implementation.
5. Students will be able to describe simple hardware functions using a hardware description language.
6. Students will be able to understand the purpose of and steps involved in digital circuit implementation using Field-Programmable Gate Arrays.

Module No.	Topics	Hrs.
1	**Sequential logic design** Mealy and Moore models, state machine notations, clocked synchronous state machine analysis, construction of state diagram, sequence detector (word problem), state reduction techniques (inspection, partition and implication chart method), clocked synchronous state machine design, design examples like a few simple machines and traffic light controller, vending machine.	**09**
2	**Algorithmic State Machine (ASM) Chart and Register Transfer Luanguage(RTL)** Standard symbols for ASM Chart, Realization techniques for sequential/logic functions using ASM Chart, Top Down Design Example, Generalized ASM output, ASM Chart representation of control unit, RTL, Construction of data unit using RTL Description, Timing of connection and transfer, sequencing of control, Combinational logic and conditional transfer, Graphical and RTL Bus notation, Design examples of waveform controllable generator ,pulse width adjustor using ASM chart, design data unit and control unit for sequential circuits using RTL Description.	**08**
3	**Sequential logic design practices** Synchronous counter design and applications, MSI asynchronous counters (IC 7490, 7493), MSI synchronous counters (IC 74161, 74163, 74168, 74169) and applications, decoding binary counter states, MSI shift registers, Synchronous design methodology, impediments in synchronous design, synchronizer failure and metastability.	**09**
4	**Introduction to VHDL** Introduction to Hardware Description Language, Core features of VHDL, data types, concurrent and sequential statements, data flow, behavioral, structural architectures, subprograms, Examples like Adder, subtractor, Multiplexers, De-multiplexers, encoder, decoder.	**08**
5	**Design of Sequential circuits using VHDL** VHDL code for flip flop, counters, registers, Moore, Mealy type FSMs, Serial adders, sequence detector.	**08**
6	**Programmable Logic Devices** ROM, RAM, SRAM, PLA, PAL, CPLD and FPGA architecture. Numerical based on PLA and PAL.	**06**
	Total	**48**

Text Books:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. Digital Design, Morris Mano Second Edition, PHI, 2002
3. Volnei A. Pedroni, "Circuit Design with VHDL" MIT Press (2004)

Reference Books:

1. Digital Design Principles and Practices, 3rd ed. by Wakerly. Prentice Hall, 2000
2. Digital Design – Morris Mano, M.D.Ciletti, 4th Edition, PHI
3. Digital Circuits and Logic Design – Samuel C. Lee , PHI
4. William I.Flectcher, "An Engineering Approach to Digital Design", PrenticeHall of India.
5. Parag K Lala, "Digital System design using PLD", BS Publications, 2003.
6. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
7. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic Design" McGraw Hill, 2nd edition Charles H.Roth Jr "Fundamentals of Logic Design" Thomson Learning 2004

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 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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX405	Principles of Communication Engineering	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX405	Principles of Communication Engineering	20	20	20	80	--	--	100

Prerequisite:

- Applied Mathematics-III
- Applied Mathematics-IV

Course Objectives:

1. Understand the need for various analog modulation techniques
2. Analyse the characteristics of the receivers
3. Understand pulse modulation methods
4. Identify the necessity of multiplexing

Course Outcomes:

1. Students will be able to comprehend the need for various components in analog communication systems
2. Students will be able to analyse various analog modulation methods
3. Students will be able to design modulators, demodulators for amplitude and frequency modulated systems.
4. Students will be able to assess the characteristics of pulse modulation techniques.
5. Recognize the need for multiplexing techniques.

Module No.	Unit No.	Topics	Hrs
1		**Introduction to Electronic Communication**	06
	1.1	**Introduction:** Electromagnetic frequency spectrum, concepts of wave propagation-ground wave, sky wave and space wave	
	1.2	**Elements of communication systems:** Information sources, communication channels, noise, sources of noises, need for modulation, bandwidth and power trade-off.	
	1.3	**1.3 Representation of the signals:** Fourier series, Fourier transform, two sided spectrum	
2		**Amplitude Modulation and demodulation**	10
	2.1	**Amplitude Modulation :** Types of Analog Modulation, Principles of Amplitude Modulation , AM for a Complex Modulating Signal, AM Power Distribution, AM Current Distribution, Limitations of AM , AM modulators and Demodulator	
	2.2	**Types of AM**: Modulation & Demodulation Techniques: DSB-SC, SSB-SC , , Vestigial-Sideband (VSB) Modulation , Comparison of AM, DSBSC, SSB and VSB	
	2.3	**2.3** Applications of AM	
3		**Angle modulation and demodulation**	08
	3.1	Frequency Modulation: Principles of Angle Modulation, Theory of FM—Basic Concepts, Spectrum Analysis of FM Wave, Narrowband and Wideband FM, Noise triangle,Pre-emphasis, de-emphasis FM Generation: Direct methods and Indirect method,FM Detection: Frequency discriminator and Phase discriminator methods	
	3.2	**Phase Modulation** : Theory of Phase Modulation, Relationship between FM and PM, Advantages and Disadvantages of Angle Modulation, Comparison of AM, FM and PM	
	3.3	3 Applications of FM and PM	
4		**Radio Transmitters and Receivers**	08
	4.1	Radio receivers: Receiver Characteristics : Sensitivity, Selectivity, Fidelity, Image frequency rejection ratio, TRF Receivers and its characteristics , Concept of Heterodyning , Superheterodyne Receiver , choice of Intermediate frequency	
	4.2	**AM Transmitters and Receivers**: AM Radio Transmitters, AM Radio Receivers, Practical diode detector, Automatic Gain control(AGC), Types of AGC.	
	4.3	**FM Transmitters and Receivers**: FM Transmitters, FM Receivers , Automatic Frequency control(AFC) , Importance of Limiter,Communication Receivers	
5		**Pulse-Modulation and demodulation**	08
	5.1	**Introduction to digital transmission of signals**: comparison of Digital Analog Transmissions, Concept of regenerative Repeater	
	5.2	**Sampling and quantization**: Sampling Theorem, Aliasing error, Natural Sampling , Flat top sampling, Quantization of Signals	
	5.3	**Pulse Modulation Techniques** :Generation and detection of Pulse	

		Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM)	
6		**PCM and Multiplexing**	08
	6.1	**PCM**: Pulse-Code Modulation (PCM), Noise Performance of PCM Systems, Differential PCM (DPCM), Adaptive Differential PCM (ADPCM), Delta Modulation, Adaptive Delta Modulation, Continuous Variable Slope DM (CVSDM), Comparison of PCM Techniques	
	6.2	Multiplexing in Telecommunications Networks, Synchronous and Asynchronous TDM, Single-Channel PCM Transmission System, T1 Digital Carrier System, FDM	
		Total	48

Text Books:

1.Kennedy and Davis "Electronics communication system ",Tata McGraw Hill
2.T L Singal , Analog and Digital communication, Tata McGraw Hill
3.R P Singh &Sapre , Analog and Digital communication, Tata McGraw Hill 2nd Ed.

Reference books :

1.Wayne Tomasi "Electronics communication systems" Pearson Education, Third Edition, 2001.
2.Taub and Schilling "Principles of communication systems", Tata McGraw Hill
3.Roy Blake, "Electronics communication system", Thomson learning, Second Edition.
4.B.P. Lathi "Modern Digital and analog Communication system" Third Edition, OXFORD
5.Robert J. Schoenbeck "Electronics communications modulation and transmission"
6.Lean W couch "Digital and Analog communication system", Pearson Education, Sixth Edition
7.Roddy Coolen, "Electronic Communications" PHI

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

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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX406	Linear Control System	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX406	Linear Control System	20	20	20	80	--	--	100

Prerequisites Topics:
Differential Equations; Laplace transforms and Matrices.

Course Objectives:

1. To teach fundamental concepts of Control systems and mathematical modelling of the system.
2. To teach the concepts of time response and frequency response analysis of Control Systems.
3. To teach the concepts of state variable models as applicable to linear time invariant systems
4. To teach concepts of controllers and compensators

Course Outcomes:
1. Students will be able to understand the basic concepts of control system and identify control systems in real life applications.
2. Students will be able to derive the mathematical model of different types of control systems and represent them in various forms
3. Students will be able to analyze systems using time domain analysis techniques
4. Students will be able to apply concepts of frequency domain techniques in stability analysis of control systems
5. Students will be able to create state variable models of systems andanalyze their controllability, observability and time response
6. Students will be able to identify controllers and compensators in different controllers.

Module No.	Topics	Hrs.
1	**Models for Control System**	08
	1.1 Introduction: Open loop and closed loop systems; feedback and feed-forward control structure; examples of control systems.	
	1.2 Mathematical Modelling: Types of models; Impulse response model; State Variable model and Transfer function model for Electrical, Mechanical and Thermal systems	
	1.3 Manipulations: Block Diagram Representation of complex systems, Block diagram reduction, Signal flow graph and the Mason's gain rule for determining overall transfer function of Single Input, Single output systems	
2	**Time Response Analysis**	08
	2.1 Dynamic Response: Standard test signals; Transient and steady state behaviour of first and second order systems	
	2.2. Performance Specifications for a second order system and derivations for rise time, settling time, peak time, peak overshoot and steady state error	
	2.3. Steady State errors in feedbackcontrol systems and their types, Error constants and type of system.	
3	**State Variable Models**	10
	3.1 State variable models: State variable models of electrical systems	
	3.2 State transition equation: Concept of state transition matrix; Properties of state transition matrix; Solution of homogeneous systems; solution of nonhomogeneous systems.	
	3.3 Controllability and Observability: Concept of controllability; Controllability analysis of LTI systems; Concept of observability; Observability analysis of LTI systems using Kalman approach.	
4	**Stability Analysis in Time Domain**	06
	4.1 Concepts of Stability: Concept of absolute, relative and robust stability; Routh stability criterion.	
	4.2 Root Locus Analysis: Root-locus concepts; General rules for constructing root-locus; Root-locus analysis of control systems.	
5	**Stability Analysis in Frequency Domain**	
	5.1 Introduction: Frequency domain specifications, Response peak and peak resonating frequency; Relationship between time and frequency domain specifications of system; Stability margins.	10
	5.2 Bode plot: Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots; Stability analysis using Bode plot.	
	5.3 Nyquist Criterion: Polar plots, Nyquist stability criterions; Nyquist plot; Gain and phase margins.	
6	**Compensators and Controllers**	06
	6.1 Compensators: Types of compensation; Need of compensation; Lag compensator; Lead compensator.	
	6.2 Controllers: Concept of ON/OFF controllers; Concept of P, PI, PD and PID Controllers.	
	6.3 Advances in Control Systems: Introduction to Robust Control, Adaptive Control and Model Predictive control.	
	Total	**48**

Text Books

1. K. Ogata, Modern Control Engineering, Pearson Education India, Fifth Edition, 2015.
2. I. J. Nagrath, M. Gopal, Control Systems Engineering, New Age International, Fifth Edition, 2012.

Reference Books

1. M. Gopal, Control Systems: Principle and design, Tata McGraw Hill, First Edition, 1998
2. Richard C. Dorf and Robert H. Bishop, Modern Control System, Pearson, Eleventh Edition, 2013.
3. Norman S. Nise, Control Systems Engineering, John Wiley and Sons, Fifth Edition, 2010.
4. Farid Golnaraghi and Benjamin C. Kuo, Automatic Control Systems, Wiley, Ninth Edition, 2014.
5. S.P. Eugene Xavier and Joseph Cyril Babu, Principles of Control Systems, S. Chand, First Edition

Internal Assessment (IA):

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

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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL401	Electronic Devices and Circuits II Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL401	Electronic Devices and Circuits II Laboratory	--	--	--	--	25	25	50

Term Work:

At least 6 experiments covering entire syllabus of ELX 402 (Electronic Devices and Circuits II) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. 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. 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. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design own experiments as per the guidelines

Laboratory Experiments

1. To perform frequency response of single stage CE amplifier.
2. To perform frequency response of single stage CS MOSFET amplifier..
3. To perform frequency response of Cascode amplifier.
4. To perform frequency response of two stage RC coupled CE amplifier
5. To perform RC phase shift oscillator
6. To perform Wein Bridge oscillator.
7. To perform Hartley oscillator.
8. To perform Colpitts oscillator
9. To perform Crystal oscilator.
10. To perform Class B push pull amplifier
11. To perform Class AB amplifier

Guidelines for Simulation Experiments:

1. SPICE simulation ofs of frequency response of single stage CE amplifier

2. SPICE simulation of of frequency response of single stage CS MOSFET amplifier..
3. SPICE simulation of of frequency response of Cascode amplifier.
4. SPICE simulation of of frequency response of two stage RC coupled CE amplifier
5. SPICE simulation of RC phase shift oscillator
6. SPICE simulation of Wein Bridge oscillator.
7. SPICE simulation of Hartley oscillator.
8. SPICE simulation of Colpitts oscillator
9. SPICE simulation of Crystal oscilator.
10. SPICE simulation of Class B push pull amplifier
11. SPICE simulation of Class AB amplifier

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL402	Microprocessors and Applications Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL402	Microprocessors and Applications Laboratory	--	--	--	--	25	25	50

Term Work:

At least 6 experiments covering entire syllabus of ELX 403 (Microprocessors and Applications) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. 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. 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. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design own experiments as per the guidelines

1. Write a program to arrange block of data in (i) Ascending and (ii) Descending order.
2. Write a program to find out any power of a number.
3. Write a programmable delay.
4. Write a program to find out largest number in an array.
5. Experiment on String instructions (e.g Reversing of string &Palindrome).
6. Write a program to multiply 32 bit numbers.
7. Menu driven programming.
8. Write a program for code conversion.
9. Programming the 8255 to read or write to port (any one application).
10. Programming the 8259 to demonstrate rotating priority, Specific priorityetc.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL403	Digital System Design Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL403	Digital System design Laboratory	--	--	--	--	25	25	50

Term Work:

At least 6 experiments covering entire syllabus of ELX 404 (Digital System Design) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. 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. 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. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design own experiments as per the guidelines

Experiments based on Hardware:

1. Implementation of Counter using IC 7490, IC 7493
2. Implementation of Synchronous Counter using MSI counter ICs
3. Implementation of Universal Shift Register using IC 74194
4. Design and implement Moore Machine
5. Design and implement Mealy Machine
6. Serial Adder using a Melay/Moore Machine.
7. Design Sequence Detector using FF

Suggested experiments based on software:

1. Implement basic digital logic gates and simulate with HDL.

2. Implement basic Flip Flops and simulate with HDL.
4. Design and implement full adder logic with HDL and simulate the same.
5. Design and implement multiplexer with HDL and simulate the same.
6. Design and implement multiplexer with HDL and simulate the same.
7. Design and implement decoder (74138) with HDL and simulate the same.
8. Design and implement 4-bit counter with HDL and simulate the same.
9. Design and implement shift register with HDL and simulate the same.
10. Design and simulate the Finite State Machine (FSM) design by HDL.
11. Design and simulate the ALU design by HDL.

Additional suggested experiments (optional)

Implementation of any of above using **CPLD/FPGA**

Course Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL404	Principles of Communication Engineering Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL404	Principles of Communication Engineering Laboratory	--	--	--	--	25	--	25

Term Work:

At least 6 experiments covering entire syllabus of ELX 405 (Principles of Communication Engineering) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. 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. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design own experiments as per the guidelines

1. Amplitude Modulation and demodulation
2. DSB-SC Balanced Modulator
3. Frequency Modulation and Demodulation
4. Super-heterodyne radio receiver
5. Pulse Amplitude Modulation
6. Verification of Sampling Theorem
7. Pulse Width Modulation
8. Pulse Position Modulation
9. Pulse Code Modulation
10. Delta Modulation
11. Adaptive Delta Modulation
12. Time Division Multiplexing