Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Revision: SPIT-2-17

Bachelor of Engineering/Technology (B.E./B.Tech)
in
Electronics Engineering

Second Year Engineering
(Sem. III and Sem. IV)
Effective from Academic Year 2017 -18

Principal
Sardar Patel Institute of Technology
Bhavans Andheri Campus
Munshi Nagar, Andheri (West)
Mumbai - 400 058.

Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
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Preamble:

Concept of academic autonomy is based on the argument that Institutions can undertake the work expected of them by all stakeholders such as Students , Parents , University , Industry , Society in general, only if they have freedom of choice and action.

We at S.P.I.T. would like to believe that this freedom of choice and action as far as academics is concerned will make us more Proactive in our offerings.

An academic autonomy is as good as its Curricula and execution of it is as well as its faculty. S.P.I.T. is confident of succeeding on both the fronts.

In the first offering we have tried to pro-actively bridge the ever discussed "Industry-academic gap" by way of our SCOPE program. The issue about sensitizing students to social needs is being addressed by special activity based courses. Liberal arts courses have been introduced to enhance functionality of both sides of brain. In all this the professional core has not been overlooked. Thus the curricula are designed to achieve multi dimensional outcomes.

The evaluation mechanism is tuned for assessing the attainment of the designed outcomes and is designed as a fair mechanism.

As our learning cycle begins from July 2017, I wish to place on record that entire S.P.I.T. staff and faculty will work with singular focus and commitment towards the success of this endeavour.

Dr. Prachi Gharpure
Principal, S.P.I.T.

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From the Desk of Dean Academics and Head of Electronics Engg. Dept.

Greetings and congratulations to all the students, teaching and supporting staff of Sardar Patel Institute of Technology for getting autonomous status to the institute from the year 2017-18. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Indian Society and Industries.

In the proposed curriculum we have made an attempt to provide opportunity for students to develop themselves as competent engineering graduates with knowledge, skill and ethical behavior required for global career. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. The curriculum model is outcome based that focuses on learning by doing. This is achieved through activity based learning, minor projects, problem solving and innovative styles of pedagogy. Various steps are taken to transform teaching-learning process to make learning a joyful experience for students. Special laboratory based courses are introduced to give more practical exposure to the students.

To create socially responsible citizen curriculum offers courses like Constitution of India, Environmental Studies and Human Health Systems Approach. Also various activity based learning modules like 'Building Automation, Fire Safety and Electronic Security', 'Occupational Safety & Legal Studies for Engineers', 'Technical Presentation Skills', 'Technical Paper and Patent Drafting', 'Engineering Solution for Environmental Problems' and 'Financial Planning, Taxation Policies and Investment' are introduced. For overall development of the learner, various elective courses like Yoga Vidya, Music Appreciation, Dramatics, Industrial and Organizational Psychology, Law for Engineers, French Language, German Language etc. are introduced. To encourage interdisciplinary studies institute level Open Elective courses are offered.

One of the special feature of this curriculum is Skill development programme called SCOPE (Skill Certification for Outcome-Based Professional Education) planned to enhance employability, innovation and research culture in the institute. Every department is offering six domain specific tracks, each track containing six courses. Student will have an opportunity to enroll for more than 140 courses in any of the department of his choice. Some of the courses under SCOPE will be delivered in co-ordination with industries.

We believe that this curriculum will raise the bar of academic standards with the active involvement and cooperation from students, academic and administrative units. Faculty of S.P.I.T. deserves a special appreciation for their relentless efforts in designing curriculum and assessment instruments which will bring transformation in the quality and transparency in assessment of learners.

Looking forward for your active cooperation and constructive feedback to create vibrant and joyful learning environment at Sardar Patel Institute of Technology.

Dr. Surendra Singh Rathod
Professor and Dean Academics

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Scheme for B.E./B.Tech. Electronics Engineering (SEM III)

SEM III

Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits
			L	T	P	Total
BS31	Applied Mathematics I*	BS	3	1		4
EL31	Analog Electronics-I	PC	3	1	--	4
EL32	Circuit Theory*	PC	3	1	--	4
EL33	Digital Circuits*	PC	3	1	--	4
ELL31	Analog Electronics-I Lab	PC	--	--	2	1
ELL33	Digital Circuits Lab*	PC	--	--	2	1
ELL34	Electronics Instruments and Measurements Lab	PC	--	--	4 (2x2)	2
ELL35	HDL Programming Lab*	PC	--	--	2	1
ELL36	Object Oriented Programming Lab*	PC	--	1	2	2
BS32	Human Health Systems Approach (Noncredit)	BS	2	--	--	--
SDX	SCOPE Course	SD	--	--	--	--
ABL1	Building Automation, Fire Safety and Electronic Security (Noncredit)	ABL	--	--	--	--
CEP1	Introduction to CEP (Optional)	CEP	--	--	--	--
BC	Fundamentals of Mathematics (Noncredit) (only for direct second year students)	BC	2	--	--	--
	Total		14	5	12	23

*** Common courses with Electronics & Telecommunication**

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Scheme for B.E./B.Tech. Electronics Engineering (SEM IV)						
SEM IV						
Course Code	**Course Name**	**Group**	**Teaching Scheme (Hrs/week)**			**Credits**
			L	**T**	**P**	**Total**
BS41	Applied Mathematics II*	BS	3	1	--	4
EL41	Analog Electronics-II	PC	3	1	--	4
EL42	Principles of Control Systems*	PC	3	1	--	4
EL43	Computer Organization and Architecture	PC	3	--	--	3
EL44	Fundamentals of Communication Engineering*	PC	3	--	--	3
ELL41	Analog Electronics-II Lab	PC	--	--	2	1
ELL42	Principles of Control Systems Lab*	PC	--	--	2	1
ELL44	Fundamentals of Communication Engineering Lab*	PC	--	--	2	1
ELL45	Electrical Machines Lab	PC	--	--	2	1
ELL46	Computer Methods for Circuit Simulation Lab*	PC	--	--	2	1
LA^	Liberal Arts (Non credit) LA1: Yoga Vidya LA2: Music Appreciation LA3: Dramatics	LA	1	--	--	--
SDX	SCOPE Course	SD	--	--	--	--
ABL2	Occupational Safety & Legal Studies for Engineers (Noncredit)	ABL	--	--	--	--
CEP2	Problem solving module-I (Optional)	CEP	--	--	--	--
	Total		16	3	10	23

*** Common courses with Electronics & Telecommunication**

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Semester III

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
BS31	Applied Mathematics-I	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite course codes		BS11 (Engineering Mathematics I) BS21 (Engineering Mathematics II)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Evaluate Laplace and Inverse Laplace transform of functions using various properties.
	CO2	Solve differential equations with given initial conditions using Laplace and Laplace Inverse.
	CO3	Expand functions in terms of sine and cosine series on the given interval.
	CO4	Find Fourier transforms by applying its various properties
	CO5	Check for a function being analytic using Cauchy-Reimann equations and construct analytic functions.
	CO6	Construct Bilinear Transformations and find images under Conformal mappings

Module No	Module Name	Unit No	Topics	Ref	Hours
1	**Laplace Transform**	**1.1**	Definition of Laplace Transform, LT of e^{at},*sin(at), cos(at), sinh(at), cosh(at), erf(t).*	1,2,3,4	03
		1.2	Properties of Laplace Transform: Linearity, change of scale, first shifting theorem, second shifting theorem, multiplication by t, division by t, Laplace Transform of derivatives and integrals.		06
2	**Inverse Laplace Transform, Special Functions and Applications of Laplace**	**2.1**	Inverse Laplace Transform using Partial fraction method, Convolution theorem (without proof), differentiation and integration property.	1,2,3,4	04
		2.2	Laplace of Heavi-side unit step, dirac-delta function, LT of periodic function		03
		2.3	Applications of Laplace Transforms to find solution of ordinary differential equations and simultaneous differential equations.		03

3	**Fourier Series and Fourier Transforms**	**3.1**	Introduction to Fourier Series, Dirichlet's condition of convergences, Euler's formulae	1,2,3,4	02
		3.2	Fourier series of algebraic, exponential, trigonometric functions ,half range sine and cosine series, Parsevals Identity. Complex form of Fourier series. Differentiation and Integration of Fourier Series.		05
		3.3	Fourier Transforms, Inverse Fourier Transforms and its applications		06
4	**Complex Variable**	**4.1**	Definition of analytic function, Cauchy Reiman equations in Cartesian and polar form. Constructing analytic function by Milne Thompson and analytic method.	1,2,3,4	05
		4.2	Harmonic functions, orthogonal trajectories		02
		4.3	Conformal Mappings		03
				Total	**42 Hrs**

References:

1. Kreyszig, "Advanced Engineering Mathematics, 9th edition", John Wiley
2. H.K.Dass, "Advanced Engineering Mathematics", 28th edition, S.Chand, 2010
3. Grewal B.S., "Higher Engineering Mathematics", 38th edition, Khanna Publication
4. Jain and Iyengar, "Advanced Engineering Mathematics", 4th edition, Narosa Publishing House, Pvt. Ltd, 2014

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL31	Analog Electronics-I	03	01	--	03	01	--	04
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		BS12(Applied Physics I) BS22 (Applied Physics II) ES21 (Basic Electrical Technology)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Describe semiconductor devices through energy band diagrams
	CO2	Analyze the characteristics of semiconductor junctions
	CO3	Differentiate between bipolar and unipolar conduction
	CO4	Discuss working principle of semiconductor devices
	CO5	Discuss working principle of various optoelectronic devices
	CO6	Identify the applications of semiconductor devices

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Carrier Statistics and Transport** Semiconductors, Electron Density, Hole Density, Temperature Dependence of intrinsic concentration, Position of Fermi Level, Computation of n and p	1,4	3
	1.2	Drift current, Diffusion Current, Generation, Recombination and Continuity Equation	1	
2	2.1	**Junction Analysis** **PN Junction Diode:** Basic Structure, Band Diagrams, Zero Applied Bias, Reverse Applied Bias, PN Junction current, Small signal model of PN junction, Generation and recombination of currents, junction breakdown. **Zener Diode:** Breakdown mechanisms, Characteristics, Effect of Temperature, Application as voltage regulator and backward diode	1, 6,7	12
	2.2	**Metal semiconductor and Semiconductor Heterojunctions:** **Schottkey barrier diode:** qualitative characteristics, Ideal junction properties, Nonideal effects on barrier height, V-I characteristics **Metal-semiconductor Ohmic Contacts:** Ideal Non rectifying	1	

		barriers, Tunneling Barrier, Specific contact resistance **Heterojunctions:** Heterojunction materials, Energy Band Diagrams, Two dimensional electron gas		
	2.3	**Diode Circuits:** Simple diode model, Limiter circuits, Rectifiers, Clamper Circuits, Peak Detector and Voltage Doubler	2,4, 5	
3	**3.1**	**Optoelectronics PN junction diodes** **Optical absorption:** Photon absorption coefficient, EHP generation rate **Solar Cells:** The pn junction, heterojunction and amorphous silicon solar cells	1,4, 6	3
	3.2	**Photodetectors:** Photoconductor, photodiode, PIN photodiode, APD (avalanche photodiode), phototransistor **LED:** Generation of Light, Internal Quantum Efficiency, External Quantum Efficiency, LED devices	1,2,6	
4	**4.1**	**Bipolar Devices** BJT: The bipolar transistor action, minority carrier distribution, low-frequency common-base current gain, non-ideal effects, Ebers-Moll Model, Gummel-Poon Model, Hybrid-Pi Model, Frequency Limitations	1,4	12
	4.2	HBT (Heterojunction bipolar transistor): Current gain in HBT, Basic n-p-n HBT structure with band diagram	1	
	4.3	BJT Amplifiers: CE, CB and CC Amplifiers, Multistage Amplifiers	1,2,5	
5	**5.1**	**Field Effect Devices** **JFET:** Construction, operation and device characteristics. V-I relationship and transconductance. Small signal equivalent model, frequency limitation factors and cutoff frequency	1, 3, 4	12
	5.2	**MOSFET:** Two terminal MOS structure, MOSFET construction, Band diagrams under equilibrium and external bias, Threshold Voltage, V-I and CV characteristics, Channel length modulation, Short Channel effects, MOSFET Model		
	5.3	**MESFET:** Device structure, principle of operation, V-I characteristics, High frequency performance **MODFET (i.e. HEMT):** Fundamentals, V-I Characteristics, Cutoff frequency	1, 3	
			Total	**42**

References:

[1] Donald A. Neamen, "Semiconductor Physics and Devices" Tata MCGraw Hill, Third Edition

[2] RL Boylestad and Lous Nashelsky, "Electronic Devices and Circuits" Pentice Hall, second Edition

[3] Sung-Mo Kang,Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata McGraw Hill, Third Edition

[4] Mahesh B. Patil, "Basic Electronic Devices and Circuits," PHI, First Edition

[5] David Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.

[6] S Slivahanan and N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill, Third Edition

[7] S. M. Sze, "Semiconductor Devices: Physics and Technology", Wiley, Second Edition

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL32	Circuit Theory	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ES21 (Basic Electrical Technology)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Analyse the given circuits using theorems and transformation techniques
	CO2	Analyse the given circuit using Graph Theory
	CO3	Analyse the given RL, RC and RLC circuits in time domain
	CO4	Analyse the given RL, RC and RLC circuits in frequency domain
	CO5	Predict the circuits using Foster and Cauer realization methods
	CO6	Explain the concept of two port network, relation between the parameters and their interconnection

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Analysis of DC circuits**: Analysis of circuits with and without controlled sources using generalized loop, node matrix, Superposition, Thevenin, Norton, Maximum Power transfer, Millman theorems	3	10
	1.2	**Analysis of coupled circuits:** Self and mutual inductances, coefficient of coupling, Dot convention, equivalent circuit, solution using loop analysis	1	
2	2.1	**Graph Theory:** Concept of loop, tree, co-tree, incidence matrix, cut set matrix and tie set matrix	4	6
	2.2	Tellegen's theorem, Planar and Non planar graphs, Duality principle	4	
3	3.1	**Time domain analysis of R-L and R-C circuits:** Forced and natural response, time constant, initial and final values **Solution using first order equation for standard input signals:** Transient and steady state time response, solution using universal formula	1,3	12
	3.2	**Time domain analysis of R-L-C circuits:** Forced and natural response, effect of damping	1,3	

		Solution using second order equation for standard input signals: Transient and steady state time response		
	3.3	**Frequency domain analysis of RLC circuits:** S-domain representation, applications of Laplace Transform in solving electrical networks	1,3	
4	**4.1**	**Network Function:** driving point and transfer function, Poles and Zeros, calculation of residues by analytical and graphical method, frequency response	2	6
	4.2	**Positive real functions:** Concept of positive real function, testing for Hurwitz polynomials, testing for necessary and sufficient conditions for positive real functions	2	
	4.3	**Synthesis of RC, RL, LC circuits:** Concepts of synthesis of RC, RL, LC driving point functions.	2	
5	**5.1**	**Parameters:** Open Circuit, Short Circuit, Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions	1	8
	5.2	**Series/parallel connection:** T and Pi representations, interconnection of Two-Port networks	1	
			Total	**42**

References:

[1] A. Chakrabarti, "Circuit Theory", Dhanpat Rai and Co.,New Delhi, Edition 2013

[2] Franklin F Kuo, "Network Analysis and Synthesis", Wiley, Second Edition

[3] M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, Third Edition

[4] D. Roy Choudhury, "Networks and Systems", New Age International Pvt Ltd, Wiley, Second Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL33	Digital Circuits	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ES21 (Basic Electrical Technology)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Explain various logic gates, SOP, POS forms and their minimization with k-map for given combinational circuits.
	CO2	Construct combinational circuits using given MSI devices.
	CO3	Discuss different types of programmable logic devices like PAL, PLA, CPLD and FPGA.
	CO4	Apply the knowledge of flip-flops and MSI to design sequential circuits
	CO5	Design state machines for given state diagrams after state reduction
	CO6	Discuss fault models and testing methods for digital circuits

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Logic Gates:** Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables), Quine Mc'Clusky method and realization.	1,2,3	12
	1.2	**Logic Families:** Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND, Interfacing CMOS to TTL and TTL to CMOS.	1,2,3	
	1.3	**Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, Multiplexer, Demultiplexer, Decoder, Comparator (Multiplexer and Demultiplexer gate level upto 4:1).	1,2,3	
2	2.1	**Sequential Logic:** Latches and Flip-Flops. Conversions of Flip-Flops, Timing Considerations and Metastability	1,2,3	12
	2.2	**Counters:** Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counters Shift Registers, Universal Shift Register	1,2,3	

3	**3.1**	Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques and state assignment, Clocked synchronous state machine design.	4,5	08
	3.2	MSI counters, MSI Shift registers and their applications	4,5	
4	**4.1**	Concepts of PAL and PLA. Introduction to CPLD and FPGA architectures.	4,5	05
5	**5.1**	Fault Models, Stuck at faults, Bridging faults, Controllability and Observability	6	05
	5.2	Path sensitization, ATPG, Design for Testability, Boundary Scan Logic, JTAG and Built in self test.	6	
			Total	**42**

References:

[1] William I. Fletcher, 'An Engineering Approach to Digital Design', PHI., First Edition

[2] R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, Forth Edition

[3] Morris Mano, "Digital Design", Pearson Education, Forth Edition

[4] John F. Wakerly, "Digital Design Principles And Practices, third Edition Updated, Pearson Education, Third Edition

[5] Stephen Brown and Zvonko Vranesic, "Fundamentals of digital logic design with VHDL", McGraw Hill, Second Edition.

[6] B. Holdsworth and R. C. Woods, "Digital Logic Design", Newnes, Forth Edition

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL31	Analog Electronics Lab-I	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			10		10	60

Pre-requisite Course Codes		EL31 (Analog Electronics - I)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Implement the given circuit on breadboard and test it with measuring instrument
	CO2	Obtain characteristics of PN Junction diode, zener diode, BJT and FET to find the various parameters
	CO3	Demonstrate applications of PN junction diode
	CO4	Obtain performance parameters like bandwidth, current gain, voltage gain, input resistance and output resistance of BJT amplifier
	CO5	Follow the procedure for installation and make use of TCAD tool
	CO6	Record the observations of given experiment and arrive at valid conclusions to correlate with theory

Exp. No.	Experiment Details	Ref.	Marks
1	To plot forward and reverse characteristics of semiconductor diode.	1,2	5
2	To plot characteristics of zener diode and observe zener as voltage regulator	1	5
3	To implement clipper and clamper circuits	1	5
4	To implement halfwave and fullwave rectifier circuits	1	5
5	To plot input-output characteristics and calculate hybrid parameters of BJT.	2	5
6	To observe frequency response of BJT amplifier	2	5
7	To plot output and transfer characteristics of FET and calculate transconductance and drain resistance.	1,2	5
8	To design and simulate PN junction diode using Visual TCAD		5
		Total Marks	**40**

References:

[1] RL Boylestad and Lous Nashelsky, "Electronic Devices and Circuits" Pentice Hall, second Edition

[2] Mahesh B. Patil, "Basic Electronic Devices and Circuits," First Edition, PHI

[3] http://www.i-vis.co.jp/pdf/cogenda/Quick_Start_Guide.pdf

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL33	Digital Circuits Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			10		10	60

Pre-requisite Course Codes		EL33 (Digital Circuits)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Follow the given instructions for performing an experiment on the breadboard
	CO2	Construct logic circuits using gate to realize given function
	CO3	Construct logic circuits using MSI ICs to realize given function
	CO4	Validate the design of combinational and sequential logic circuits by hardware implementation
	CO5	Test and troubleshoot given logic circuits using testing instruments
	CO6	Develop an application using concepts of digital circuits

Exp. No.	Experiment Details	Ref.	Marks
1	To implement the combinational logic for given function using basic gates/MSI ICs.	1,2	5
2	To implement TTL and CMOS logic family	1,2	5
3	To implement 4-bit, 5-bit and 8 bit comparator using given MSI	1,2	5
4	To design implement gate level multiplexers and MSI multiplexers	1,2	5
5	To design and implement gate level and MSI circuits of flip-flops	1,2	5
6	To design Mod 4 synchronous up/down counter using JK flip-flop	1,2	5
7	To asynchronous counters, synchronous counters and shift register using given MSI.	1,2	5
8	**Mini-Project:** Design and implement an application using digital circuit concepts.	1,2	5
		Total Marks	40

References:

[1] Datasheets and application notes of LSI and MSI circuits.

[2] R. P. Jain and M. M. S. Anand "Digital Electronics Practice Using Integrated Circuits," TataMc Graw Hill Education

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL34	Electronics Instruments and Measurement Lab	--	--	4	--	--	2	2
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			--		20	60

Pre-requisite Course Codes		EL34 (Electronics Instruments and Measurement)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Describe the working of measuring instruments available in the lab.
	CO2	Find out and verify the manufacturers, make, models, market cost and specifications of the given instrument.
	CO3	Select the suitable test and measuring instrument for the given circuit.
	CO4	Operate the instrument for observing and recording the given signal in time domain and frequency domain.
	CO5	Recognize the importance of calibration of instruments.
	CO6	Validate characteristics of transducer to measure electrical and non electrical quantities.

Teaching Learning Methodology: Role Play Model

a. Instructor:

Responsibilities: Explanation of theoretical background
To provide required sample formats
To guide students in identification of appropriate online material.
Supervision and assessment of overall activity
Summarize the activity

b. First Group of students : Customer

Responsibilities: To finalize specifications of instrument to be purchased
Prepare request for quotations
Prepare the comparative statement
Preparation for purchase order

c. Second Group of students: Manufacturer/Vendor

Responsibilities: To maintain the specifications of the manufactured instruments

To submit quotations including all applicable taxes
To prepare Invoice as per purchase order

d. Third Group of Students: Sales/Service Engineer

Responsibilities: To demonstrate capabilities of various instruments and convince customer to purchase a particular instrument
To prepare Delivery Challan
Install the instruments and prepare Installation Report,
Demonstrate all the functions and uses of the instrument

Exp. No.	Experiment Details	Ref.	Marks
1	Block diagram based working principle of ammeter, voltmeter and galvanometer. Identification of various electronics and electrical components (resistor, capacitor, inductor, diode, PNP/NPN BJTs, FETs, SCR, Fuse etc.) by manual observation as well as with the help of measuring instruments. Finding their specifications, manufacturers and market cost. Measure resistance with a given ammeter, voltmeter and galvanometer.	1	**5**
2	Block diagram based working principle of Cathod Ray Oscilloscope. Interpretation and use of various controls of CRO. Finding their specifications, manufacturers and market cost. Identification of faulty/working probe, component identification etc. with CRO. Various types of accessories (types of probes, their compensation etc.) required with CRO. Measurement of different parameters using CRO and obtain Lissageous patterns.	2	**5**
3	Block diagram based working principle of function generator, signal generator and DSO. Interpretation and use of various controls of function and signal generator. Finding their specifications, manufacturers and market cost. Adjust the various waveforms on a function generator and finding limitations i.e. minimum and maximum output signal parameters values that can be obtained. Obtain the given waveform on function or signal generator and observe its various parameters on DSO.	2	**5**
4	To compare analog oscilloscope with digital storage oscilloscope and note down the advanced features and functions. Obtain a waveform on 5Digital Storage Oscilloscope and store it in different format on your storage device and observe it on PC. Compare the measurements of	2	**5**

	sinusoidal signal on analog CRO with measurement on DSO. Compare features of DSO with different model numbers and find out the difference in cost because of features or added functions.		
5	Introduction to various features and functions of an arbitrary function generator in order to generate common stimulus signals for electronic measurements. Explain the block diagram and basic controls of an arbitrary function generator. Finding specifications, manufacturers, and market cost of AFG. Learn how to generate several basic electronic signals. Learn how to verify the signal's parameters with oscilloscope measurements. Obtain waveforms for a given equation on an Arbitrary Waveform Generator.	2	**5**
6	Explain working principle of energy meter and wattmeter. Identifications of various terminals of energy meter and wattmeter. Selection of current coil and voltage coil while measuring power. Measurement of power factor using wattmeter, ammeter and voltmeter. Selection of wattmeter, ammeter according to load. Finding specifications, manufacturer, and market cost of wattmeter, voltmeter and ammeter.	1	**5**
7	Explain working principle of Multimeter. Compare Analog Multimeter and Digital Multimeter by using it to measure resistance, voltage, frequency. Identify the limitations of both while testing diodes, transistors and capacitors. Compare Branded Analog multimeter and Branded digital analog multimeter.	2	**5**
8	Describe the concept of Q factor and measure parameters for a given RLC circuit on Q meter and also explain the use of frequency meter. Finding specifications, manufacturer, and market cost of Q meter and Freqnency Meter.	3	**5**
9	Differentiate time domain measurement and frequency domain measurement. Obtain analysis for a given signal on Spectrum analyzer for various frequencies. Compare the sinusoidal signal frequency spectrum with different standard signals. Finding specifications, manufacturer, and market cost of spectrum analyzer and vector analyzer.	3	**5**
10	Explain the various antenna parameters and the related test & measuring instruments. Finding specifications, manufacturer, and market cost of VSWR meter,	4	**5**

	Vector network analyzer etc. Record the various parameters for a given antennas with VNA.		
11	Block diagram based working principle of tachometer, lux meter, thermal camera and radiation measurement meter. Identify their specifications in terms of respective unit. Measurement of speed of motor, light intensity in various lab, radiations using related instrument. Compare and comment on measurement at different locations. List different applications where thermal camera can be used. Finding specifications, manufacturer, and market cost of Distortion meter.	3	**5**
12	Block diagram based working principle of LVDT. Identify the specifications of winding machines for LVDT available in the market and design a simple LVDT using a given core and winding coil. Validate the characteristics of LVDT to measure distance upto 10mm	2	**5**
13	Explain specifications of given strain gauge. Compare different types of strain gauges available in the local market. Differentiate the given load cell and strain gauge. Obtain the characteristics of weight vs resistance for a given strain gauge. Suggest a circuit to measure weight using strain gauge or load cell.	1	**5**
14	Comment on the given RTD and LM35 according to the parameters or specifications given in data sheet. Validate the characteristics of RTD and LM35 to measure temperature of a specific range.	2	**5**
15	Design the bridges to measure unknown resistance, inductor and capacitance. Comment on your bridge designed and its limitations.	2	**5**
16	Explain specifications of a given ADC IC and measure the resolution of a given ADC IC by applying an input signal of appropriate value. Note down digital outputs for different analog signal in appropriate range using given logic probe and DSO.	3	**5**
		Assessment Marks	**80**
		Total Term Work Marks (80/2)	**40**

References:

[1] W. Cooper, A. Helfric, Electronic Instrumentation and Measurement Techniques, PHI, 4th edition.

[2] C. S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 9th edition.

[3] A. K. Sawhney, Electrical & Electronic Instruments & Measurement, Dhanpat Rai and Sons, Eleventh ed., 2000.

[4] Constantine A. Balanis, Antenna Theory: Analysis and Design, Wiley.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL35	HDL Programming Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			10		10	60

Pre-requisite Course Codes		EL33 (Digital Circuits)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Write VHDL code to build the given hardware
	CO2	Verify the behavior of given hardware with VHDL simulation tool
	CO3	Write synthesizable VHDL code and perform physical verification on FPGA and CPLD device
	CO4	Write, simulate, synthesize and implement VHDL code with behavioral, dataflow and structural modeling style
	CO5	Interface the external peripherals with FPGA and design a hardware to create an application.
	CO6	Interpret the RTL, synthesis, Floorplan report and optimally utilize the internal resources of given FPGA

Exp. No.	Experiment Details	Ref.	Marks
1	Design, simulate and synthesize 9 bit parity generator using dataflow modeling and carry out physical verification on given FPGA.	1,2,3	5
2	Design, simulate and synthesize ripple carry adder and carry-look ahead adder using structural modeling and carry out physical verification on given FPGA	1,2,3	5
3	Design, simulate and synthesize a stepper motor control hardware using Johnson counter. Use behavioral modeling for designing this hardware. Carry out physical verification on given FPGA	1,2,3	5
4	Write the testbench to verify the given IP.	1,2,3	5
5	Interface ADC/ DAC with FPGA. Give input signal to ADC, digitally amplify the input signal, give amplified data to DAC and observe the amplified output on DSO.	1,2,3	5

6	FPGA implementation of Traffic light controller in VHDL using Finite State Machine	4	**5**
7	Design of Microcomputer using existing IP. Use instantiation for designing the hardware.	2	**5**
8	Mini project as an application of HDL	4	**5**
		Total Marks	**40**

References:

[1] J. Bhaskar, "VHDL Primer", Pearson Education.

[2] Gaganpreet Kaur, "VHDL Basic to Programming", Pearson

[3] Douglas Perry, "VHDL: Programming by Example" McGraw Hill

[4] Application notes by Xilinx and Altera

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL36	Object Oriented Programming Lab	--	1	2	--	1	1	2
		Examination Scheme						
		ISE	ESE			Total		
			Practical		Oral			
		40	10		10	60		

Pre-requisite Course Codes		ES4 (Programming Methodology and Data Structure)
After successful completion of the course, student will be able to		
Course Outcomes for Lab	CO1	Use object oriented programming concepts for a scenario.
	CO2	Apply concept of input output and string handling
	CO3	Demonstrate polymorphism, static and dynamic binding.
	CO4	Apply Inheritance, Abstract Class and Interface to implement scenario.
	CO5	Apply concept of multithreading and exception handling for a scenario.

Exp. No.	Experiment Details	Ref.	Marks
1	Program on I/O using command line arguments, scanner class, BufferedReader etc.	1,2	5
2	Program on Constructor.	1,2,3	5
3	Program on Polymorphism, Run time polymorphism.	1,2	5
4	Program on Inheritance, Abstract Class, Interface.	1,2	5
5	Program on Nested Class, Aggregation, Composition.	1,2,3	5
6	Program on Multithreading.	2,3,4	5
7	Program on String and Exception Handling.	1,2	5
8	Program on Package and access modifiers.	1,2	5
		Total Marks	40

References:

[1] Ralph Bravaco , Shai Simoson , "Java Programing From the Group Up" ,Tata McGraw-Hill.
[2] Herbert Schildt, "Java The Complete Reference", Tata McGraw-Hill.
[3] Jaime Nino, Frederick A. Hosch, 'An introduction to Programming and Object Oriented Design using Java', Wiley Student Edition.
[4] C Xavier, "Java Programming A Practical Approach",Tata McGraw-Hill.

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Pre-requisite Course Codes		Programming Methodology and Data Structures (ES4)
Course Outcomes for Tutorial	CO1	Write programs using object oriented programming paradigm.
	CO2	Solve programs using inheritance and polymorphism
	CO3	Use abstract classes, interface and package to solve problems
	CO4	Apply concepts of multithreading and exception handling to create efficient program.
	CO5	Demonstrate use of string classes

Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1		**BASIC OF JAVA**	**2**	
	1.1	History & features, Difference between JDK,JRE,JVM, Unicode system, Advantages of OOP		3
	1.2	I/O using Scanner class & Command line argument, Object, Class, Constructor , Static Variable, Method & block		
	1.3	Branching & looping		
2		**OOP CONCEPTS**	1,2,4	
	2.1	Inheritance (IS – A), Aggregation & Composition (Has – A)		4
	2.2	Method overloading & overriding, Constructor overloading & overriding, this, super, final keyword		
	2.3	Runtime polymorphism, Static and Dynamic Binding		
3		**ABSTRACT CLASS, INTERFACE, PACKAGE**	1,2	
	3.1	Abstract class & interface, instance of operator		3
	3.2	Package and access modifier		
	3.3	Object class, Nested class		
4		**STRING HANDLING**	1,2	
	4.1	Immutable string ,Methods of String class,		1
	4.2	String comparison, concatenation, substring, toString method		
5		**EXCEPTION HANDLING**	1,2	
	5.1	What & why? Try & catch block, Multiple catch block, Nested try, Finally block		1
	5.2	Throw, Throws keywords, Exception propagation		
	5.3	Custom exception		
6		**MULTITHREADING**	1,2	
	6.1	Life cycle of a – thread, Create thread using, Thread & Runnable class		2
	6.2	Thread methods, schedule, sleep, join, Thread priority, Thread		

		group, Perform multiple task using multiple thread		
	6.3	Thread synchronization		
			Total	**14**

References:

[1] Ralph Bravaco , Shai Simoson , "Java Programing From the Group Up" ,Tata McGraw-Hill.

[2] Herbert Schildt, "Java The Complete Reference", Tata McGraw-Hill.

[3] Jaime Nino, Frederick A. Hosch, 'An introduction to Programming and Object Oriented Design using Java', Wiley Student Edition.

[4] C Xavier, "Java Programming A Practical Approach",Tata McGraw-Hill.

[5] James Holmes "Struts: The Complete Reference" Tata McGraw-Hill.

[6] Jim Keogh, "J2EE: The Complete Reference" Tata McGraw-Hill.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
BS32	Human Health Systems Approach	2	-	-	Non-Credits			
		Examination Scheme						
		ISE1		ISE2	Attendance			Total
		20		20	10			50

Student will be evaluated after completion of 50% syllabus for 20 Marks (ISE1) and at the end of course for 20 Marks (ISE2). Grade equivalent to 'D' (50%-59.99% Marks) or above is considered as 'Satisfactory'. If any of the tasks given is not completed/submitted/shown/evaluated then the corresponding lower grade will be given. Although the grades are given they will not mentioned in final grade card but they are necessary to declare the successful completion of the Non-Credit course.

Pre-requisite Course Codes	--	
After successful completion of the course, student will be able to understand		
Course Outcomes	CO1	Physiology as integrated interdisciplinary Science
	CO2	Physiological significance of balanced diet and exercise in health
	CO3	Significance of cleanliness and hygiene in daily routine
	CO4	Dynamics and homeostasis of human health

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Levels of Organizational Systems**		**1**	**2**
	1.1	Molecular, Cellular and Organ Systems		2
	1.2	Biological Molecules		
	1.3	Biochemistry, Biophysics, Molecular Biology and Bioengineering		
2	**Energy and Molecular Supply Chain Management**		1	**7**
	2.1	Digestive System: Nutrient supply and Balanced Diet		2
	2.2	Respiratory System and effects of Pollution		2
	2.3	Cardiovascular System, Blood Pressure, ECG and Blood Report		2
	2.4	Musculo-skeletal System and exercise Physiology		1
3	**Body Fluid Dynamics**		1	**4**
	3.1	Body fluids		2
	3.2	Kidneys as Filtration Units and their Physiological Functions		
	3.3	Urinary System		1
	3.4	Kidney and Urinary Stones, and Dialysis		1
4	**Control, Coordination and Regulatory Systems**		1	**4**
	4.1	Sense Organs		1

	4.2	Nervous systems		2
	4.3	Endocrine Systems (Pancreas and Diabetes, Thyroid and its functions)		1
5	**Defense Systems**		1	**3**
	5.1	Integumentary System		1
	5.2	Immune System		2
6	**Molecular Biology and Genetical Information**		**2**	**6**
	6.1	Hereditary Molecules: DNA RNA		2
	6.2	Horizontal flow of Genetic Information		2
	6.3	Vertical flow of Genetic Information		2
			Total	**26**

References:

[1] Text book of Anatomy and Physiology for Nurses and allied Health Sciences by Indu Khurana & Arushi

[2] Simplified Course in Molecular Biology by V. K. Agarwal - S. Chand Publication

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Course Code	Course Name	Teaching Scheme			Credits Assigned			
		L	T	P	L	T	P	Total
BC	Fundamental of Mathematics	2	-	-	Non-Credits			
		Examination Scheme						
		ISE1		ISE2	Total			
		20		20	100 (60% Weightage)			
Student will be evaluated after completion of 50% syllabus for 20 Marks (ISE1) and at the end of course for 20 Marks (ISE2). Grade equivalent to 'D' (50%-59.99% Marks) or above is considered as 'Satisfactory'. If any of the tasks given is not completed/submitted/shown/evaluated then the corresponding lower grade will be given. Although the grades are given they will not mentioned in final grade card but they are necessary to declare the successful completion of the Non-Credit course.								

After successful completion of the course, student will be able to		
Course Outcomes	CO1	To find basic derivatives, Integration and limits.
	CO2	To find rank of a matrix and solve system of linear equations using rank.
	CO3	To find partial derivative of a function and apply it to extremise functions.
	CO4	To solve differential equations of first and higher order.
	CO5	To find roots & logarithm of a complex number.

Module No	Module name	Unit No.	Topics	Ref.	Hrs.
1.	Derivatives	1.1	Derivative of functions which are expressed in one of the following form a) product of functions, b) quotient of functions, c) derivatives of trigonometric function	1,2,5,6,7	1
		1.2	Application of Derivatives: Rolls theorem and Mean value theorem	1,2,5,6,7	1
2.	Integration	2.1	Indefinite integrals-methods of integration, substitution method.	1,2,5,6,7	1
		2.2	Evaluation of definite integral 1) bysubstitution, 2) integration by parts,	1,2,5,6,7	1
3.	Basic of Matrices	3.1	Rank of Matrix, Normal form	1,2,3,4,6	1
		3.2	Consistency and solution of simultaneous linear homogeneous and Non-homogeneous equations. Linear Dependence & independence vectors	1,2,3,4,6	1

4.	Partial Differentiation	4.1	Partial derivatives of first and higher order, Chain Rule & Composite function	1,2,3,4,7	1
		4.2	Euler's theorem on homogeneous functions with two and three independent variables	1,2,3,4,7	1
		4.3	Application of partial derivatives: Maxima and Minima of functions of two variables.	1,2,3,4,7	1
5.	Differential Equations of first & higher order	5.1	Exact Differential Equation,	1,2,3,4,	3
		5.2	Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax},sin(ax+b),		
		5.3	cos(ax+b), x^m, $e^{ax}V$, xV.		
6.	Indeterminate forms	6.1	Indeterminate forms, L- Hospital Rule	7	1
7.	Basics of Complex Numbers	7.1	Roots of complex numbers by De'moivre's Theorem	1,2,3,4	1
		7.2	Relation between circular and hyperbolic function		1
		7.3	Logarithm of complex numbers.		1
				Total	**16**

References:-

[1] Dr.B.S.Grewal," Higher Engineering Mathematics" by Khanna Publication, New Delhi, 42ndEdition.

[2] H.K. Das, " Advanced Engineering Mathematics,"by S.ChandPublication.New DelhiTwelfth Revised Edition, 2004

[3] Erwin Kreyszig," Advanced Engineering Mathematics,"by John Wiley Eastern Limited, UK Ninth Edition,

[4] Shanti Narayan, P. K. Mittal," A Text book of Matrices," by S. Chand publication, New Delhi, Eleventh Edition.

[5] Maharashtra state board of secondary and higher secondary education,Pune, Edition 2017.

[6] George B. Thomas, Ross L Finney," Calculus and Analytical Geometry by NarosaPublishing House, Mumbai,Ninth Edition.

[7] P.N.Wartikar and J.N.Wartikar," A text book of Applied Mathematics, Vol – I and II by

[8] VidyarthiGrihaPrakashan, Pune. Ninth Revised Edition,2004.

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Semester IV

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
BS41	Applied Mathematics-II	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite Course Codes		BS11 (Engineering Mathematics I) BS21 (Engineering Mathematics II)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	To diagonalise a given matrix and calculate functions of a square matrix
	CO2	To reduce a given quadratic form to simpler forms
	CO3	To apply the concept of complex analysis to evaluate integrals
	CO4	To evaluate line integrals and surface integrals.
	CO5	To calculate expectation, variance and moments of a random variable
	CO6	To apply the concepts of matrices to real life problems

Module No	Module Name	Unit No	Topics	Ref	Hours
1.	**Linear Algebra: Matrix Theory**	**1.1**	Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors	1,2,3,7	03
		1.2	Cayley-Hamilton theorem and its applications.		01
		1.3	Similarity of matrices, Diagonalisation of matrix		02
		1.4	Application of diagonalisation of matrices to find functions of a square matrix and to solve a system of ODE		02
		1.5	Quadratic forms over real field, Singular Value Decomposition		05
		1.6	Application to find google page rank		02
2.	**Complex Variables: Integration**	**2.1**	Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula	1,2,3,4	05
		2.2	Region of Convergence, Taylor's and Laurent's series		02

		2.3	Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem		04
		2.4	Applications of Residue theorem to evaluate real Integrals of different types		03
3.	**Vector Integration: Line and Surface Integrals**	**3.1**	Line and Surface Integrals, Circulation of a vector, Greens theorem in a plane, Gauss divergence theorem, Stokes theorem	1,2,3,4	06
4.	**Probability: Random Variables**	**4.1**	Discrete and continuous random variables (Single and Joint), probability density function, cumulative density function, expectation, variance. Moments and Moment generating function.	1,2,3,4,5,6	07
				Total	42 Hrs

References:

[1] Kreyszig, "Advanced Engineering Mathematics, 9th edition", John Wiley
[2] H.K.Dass, "Advanced Engineering Mathematics", 28th edition, S.Chand, 2010
[3] Grewal B.S., "Higher Engineering Mathematics", 38th edition, Khanna Publication
[4] Thomas & Finney,"Calculus& Analytic Geometry", 9th edition, Addison Wesley.
[5] Kishor S. Trivedi, "Probability & Statistics with reliability", 2nd edition, Wiley India
[6] Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists"
[7] H Anton and C Rorres," Elementary Linear Algebra Application Version", 6th edition, John Wiley & Sons, 2010

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL41	Analog Electronics-II	03	01	--	03	01	--	04
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% weightage)			

Pre-requisite Course Codes		EL31 (Analog Electronics - I)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Illustrate DC and AC analysis of single stage FET and MOSFET amplifier circuits
	CO2	Analyze multistage amplifier circuits
	CO3	Describe effect of negative feedback on amplifier parameters for different negative feedback topologies
	CO4	Discuss the working of different oscillator circuits.
	CO5	Calculate parameters for MOSFET based differential amplifier.
	CO6	Describe the working and calculate parameters for different power amplifier circuits.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**DC Circuit Analysis:** **Junction Field Effect Transistor (JFET):** Self bias, Voltage divider bias, Design and Analysis of Biasing Circuits **Metal-Oxide Field Effect Transistor (MOSFET):** Common-Source circuits, DC load line and region of operation, Common-MOSFETs configurations, Analysis and Design of Biasing Circuits	1,2	06
	1.2	**AC Analysis:** **JFET Amplifiers:** Small-Signal Equivalent Circuit, Small-Signal Analysis **MOSFET Amplifiers:** Graphical Analysis, load line and Small-Signal parameters, AC Equivalent Circuit, Small-Signal Model. Common-Source, Source Follower, Common-Gate	1,2	04
2	2.1	**Multistage Amplifiers:** Multistage (CS-CS), (CS-CE) cascode (CS-CG) Amplifiers & Darlington pair.	3,5	04
	2.2	**Frequency analysis of amplifiers:** Effect of capacitors (coupling, bypass, load) on frequency response of JFET and MOSFET Amplifiers, High frequency hybrid-pi equivalent circuits of MOSFET, Miller Effect and Miller capacitance, unity gain	1,3	06

		bandwidth, Low and high frequency response of single stage (CS,CG, CD) and multistage (CS-CS).		
3	**3.1**	**Feedback amplifiers:** Types of Negative Feedback, block diagram representation, Effect of negative feedback on Input impedance, Output impedance, Gain and Bandwidth with derivation, feedback topologies (analysis of different feedback circuits is not expected).	4,5	04
	3.2	**Oscillators:** Positive feedback and principle of oscillations, RC oscillators: Phase shift, Wien bridge, LC Oscillators: Hartley, Colpitts and clapp, Tunned Oscillator (no derivations), Twin T Oscillator (no derivations), Crystal Oscillator (BJT circuits analysis).	1,4, 5	06
4	**4.1**	**MOSFET Differential Amplifiers:** DC Transfer characteristics, Small signal Analysis, differential and common mode gain, CMRR, differential and common mode input impedance.	1	04
	4.2	**MOSFET Constant Current Sources:** Two transistor current source, current relationship, output resistance. Improved three transistor current source, Cascode current source, Wilson and Widlar current source	1	04
5	**5.1**	**Power amplifiers:** 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.	1,2	06
			Total	**42**

References:

[1] Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, Second Edition.

[2] Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar," Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

[3] David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.

[4] S. Salivahanan, N. Suresh Kumar,"Electronic Devices and Circuits",Tata McGraw Hill, Third Edition

[5] Jacob Millman,Christos C Halkias, and Satyabratata TIT,"Millman's Electronic Devices and Circuits",McGrawHill, Third Edition

[6] Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage Learning, Second Edition

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL42	Principles of Control System	03	01	--	03	01	--	04
		Examination Scheme						
		ISE	MSE		ESE			
		10	30		100 (60% Weightage)			

Pre-requisite Course Codes		BS11 (Engineering Mathematics - I) BS21 (Engineering Mathematics - II) BS31 (Applied Mathematics - I) EL32 (Circuit Theory)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Classify different types of Control systems and formulate mathematical modeling of the given system.
	CO2	Illustrate the Transient and steady state behavior of given system for standard test inputs..
	CO3	Analyze the stability of systems in time domain and frequency domain.
	CO4	Justify the concept of Controllability and observability using State variable model
	CO5	Apply the control theory to design the compensators to enhance stability of system
	CO6	Evaluate the system performance with the use of Compensators & Controllers

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to control system:** Definition of system, Notion of feedback, Open loop and closed loop systems; feedback and feedforward control structure; Examples of control systems.	1,2	10
	1.2	**Dynamic Response:** Standard test signals; Transient and steady state behavior of first and second order systems; Generalized error coefficients, steady state errors in feedback control systems and their types.	1,2	
	1.3	**Control System Modeling:** Types of models Impulse response model, State variable model, Transfer function model, Modeling of electrical systems, translational and rotational mechanical systems.	1,2	
2	2.1	**Representation of Control System: Block** diagram representation of systems, Block diagram reduction methods, Closed loop transfer function, signal flow graph. Mason's gain rule	1,2	10

	2.2	**State Space Analysis:** Concepts of state space, State equations, State transition matrix, properties of state transition matrix, Solution of homogeneous systems.	1,2	
	2.3	**Controllability and Observalibity:** Concept of controllability, Controllability analysis of LTI systems, Concept of observability, Observability analysis of LTI systems using Kalman approach, pole placement using state feedback PBH test	3,4	
3	**3.1**	**Time Domain System Stability Analysis :** Concepts of Stability Concept of absolute, relative and robust stability	1,2	08
	3.2	Routh-Hurwitz stability criteria	1,2	
	3.3	**Root Locus Analysis:** Root-locus concepts; General rules for constructing root-locus; Root-locus analysis of control systems.	1,2	
4	**4.1**	**Frequency Domain System Stability Analysis:** Relation between time and frequency response	1,2	08
	4.2	**Bode Plot:** Magnitude and phase plot, Method of plotting Bode plot; Stability analysis by using Gain and phase margins on the Bode plots	1,2	
	4.3	Polar plots, Nyquist stability criterions; Nyquist plot; Gain and phase margins.	1,2	
5	**5.1**	**Compensators & Controllers:** Types of compensators, Realization of basic compensators –cascade compensation in time domain and frequency domain, Design of lag, lead, lag-lead compensator using Bode plot and Root locus.	1,2	06
	5.2	**Controllers**: Concept of ON/OFF controllers; Concept of P, PI, PD and PID Controllers.	1,2	
	5.3	**Advanced Control Systems:** Introduction to Robust Control, Adaptive control and Model predictive control, Neuro- fuzzy controllers, Design of Real life applications of control system	3,4	
			Total	**42**

References:

[1] I. J. Nagrath, M. Gopal, "Control Systems Engineering", New Age International, Fifth Edition.

[2] M. Gopal, "Control Systems: Principle and design", Tata McGraw Hill, First Edition.

[3] Ogata.K, "Modern Control Engineering", Prentice Hall of India, Fifth edition.

[4] Richard C. Dorf and Robert H. Bishop, "Modern Control System", Pearson, Eleventh Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL43	Computer Organization and Architecture	03	--	--	03	--	--	03
		Examination Scheme						
		ISE	MSE	ESE				
		10	30	100 (60% Weightage)				

Pre-requisite Course Codes		EL33 (Digital Circuits)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Describe basic structure of computer.
	CO2	Apply arithmetic algorithm for solving problems.
	CO3	Compare different processor architectures.
	CO4	Describe the memory mapping techniques.
	CO5	Apply I/O concept for simulating I/O device operations.
	CO6	Analyze different parallel processing and pipelining concepts.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview of Computer Architecture & Organization:**		
	1.1	Fundamentals of Computer Design : Introduction with Classes of Computers, Defining Computer Architecture, Trends in Technology, Introduction of Computer Organization and Architecture, Basic organization of computer and block level description of the functional units, Evolution of x86 Computers, Von Neumann model, Harvard Model, Embedded system, ARM architecture	1,4	5
	1.2	Performance Issues: Designing for performance, Multicore, GPGPU, Amdahl's Law	1,4	2
2		**Data Representation and Arithmetic Algorithms:**		
	2.1	Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation	5,6	2
	2.2	Integer Data computation: Addition, Subtraction. Multiplication: Signed multiplication, Booth's algorithm.	5,6	2
	2.3	Division of integers: Restoring and non-restoring division	5,6	2
3		**Processor Organization and Control Unit:**		
	3.1	CPU Architecture, Register Organization , ISA categories: Complex Instruction Set Computing ISA Features, Reduced Instruction Set Computing ISA Features. Instruction	2,4	4

		formats, basic instruction cycle. Instruction interpretation and sequencing.		
	3.2	Control Unit:Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nano programming.	2,3	4
	3.3	RISC and CISC: Introduction to RISC and CISC architectures and design issues.	3	1
4		**Memory Organization:**		
	4.1	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics.	3	3
	4.2	Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory.	2,3	3
	4.3	Virtual Memory: Concept, Segmentation and Paging, Page replacement policies. LRU, FIFO	4,5	4
5		**I/O Organization and Introduction to Parallel Processing:**		
	5.1	Buses: Types of Buses , Bus Arbitration, BUS standards	5,6	3
	5.2	I/O Interface, I/O channels, I/O modules and IO processor, Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.	2,5,6	4
	5.3	Introduction to parallel processing concepts, Flynn's classifications, pipeline processing, Pipeline stages, Hazards	5	3
			Total	**42**

References:

1. Carl Hamacher, ZvonkoVranesic and Safwat Zaky, "*Computer Organization*", 5th edition, Tata McGraw-Hill, 2011.
2. John P. Hayes, "*Computer Architecture and Organization*", 3rd edition, Tata McGraw-Hill, 2012.
3. William Stallings, "*Computer Organization and Architecture: Designing* for *Performance*", 9th edition, Pearson, 2012.
4. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", 2nd edition, Tata McGraw-Hill, 2010.
5. Dr. M. Usha, T. S. Srikanth, *"Computer System Architecture and Organization"*, 1st edition, Wiley India, 2012.
6. Nicholas P Carter Adapted by Raj Kamal, "*Computer Architecture and Organization*", 2nd edition, Schaum's Outline, Tata McGraw Hill,2010.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL44	Fundamentals of Communication Engineering	03	--	--	03	--	--	03
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		EL31 (Analog Electronics - I) EL32 (Circuit Theory)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Infer principle of working of various sub systems of analog communication
	CO2	Analyze the performance parameters of analog and pulse modulations
	CO3	Apply concepts of Signals and systems to Analog Communication
	CO4	Analyze principle of working of receivers.
	CO5	Characterize noise and interpret effect of noise on modulations
	CO6	Compare the different analog communication systems.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Amplitude Modulation** Introduction to communication system, Need for modulation, Amplitude Modulation, Definition, Time domain and frequency domain description, power relations in AM waves, Generation of AM waves, square law Modulator, Types of modulators. DSB-SC, time domain and frequency domain description, Generation of DSB-SC Modulated waves, Frequency Division Multiplexing Detection of AM Waves: Square law detector, Envelop detector	1,2	06
	1.2	Single Side Band (SSB):-Principle, Filter method, phase shift method and third method Independent side band (ISB) and Vestigial Side Band (VSB) principles and transmitters	1,2	04
	1.3	Comparison and Applications of different AM Systems	1,2	01
2	2.1	**Angle Modulation** Frequency modulation (FM): Basic concepts, Mathematical analysis of FM, Time and frequency domain representation, FM generation methods-Varactor diode modulator, FET reactance	1,2	06

		modulator, Direct FM transmitter, Indirect FM Transmitter		
	2.2	FM demodulation: Balance slope detector, Foster-Seely discriminator, ratio detector, Phase lock loop(PLL) FM demodulator	1,2	03
	2.3	Comparison of AM, FM , Applications of FM	1,2	01
3	**3.1**	**Noise** Resistive (Thermal) Noise Source, White Noise, Narrowband Noise-In phase and quadrature phase components and its Properties, noise figure, and noise temperature, Noise Figure of cascaded networks.	1,2	06
	3.2	Effect of noise on AM and FM, Pre Emphasis and De-Emphasis	1	01
4	**4.1**	**Radio Receivers** Types of receivers, TRF, Super heterodyne receiver, AM and FM receivers	1,3	04
	4.2	Receiver parameters, and choice of IF, Simple AGC, delayed AGC	1,3	04
5	**5.1**	**Pulse Modulation** Review of Sampling theory, Generation Detection and applications: PAM, PWM, PPM	1,5	03
	5.2	Generation, Detection and applications : PCM, Delta modulation, adaptive delta modulation, TDM	1,2	03
			Total	**42**

References:

[1] Wayne Tomasi "Electronics communication systems" Pearson education, Third edition.
[2] Taub and Schilling "Principles of communication systems", Tata McGraw Hill, Third Edition.
[3] Kennedy and Davis "Electronics communication system", Tata McGraw Hill, Fifth Edition.
[4] B.P. Lathi "Modern Digital and analog Communication system" OXFORD, Third edition.
[5] R.P. Sing and S.D. Sapre, "Communication systems Analog and Digital ", Tata McGraw Hill, Fifth Edition.
[6] Simon Haykin, Michel Moher, "Introduction to Analog and Digital Communication", Wiley, Second edition.
[7] Dennis Roddy and John Coolen, "Electronic Communication", Prentice Hall, Third Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL41	Analog Electronics Lab-II	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			10		10	60

Pre-requisite Course Codes		EL41 (Analog Electronics -II)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Observe the frequency response of single stage amplifier circuits by hardware implementation
	CO2	Observe the frequency response of multistage amplifier circuits by hardware implementation
	CO3	Implement and observe the working of low frequency and high frequency oscillators.
	CO4	Analyze the given differential amplifier circuit
	CO5	Realize the effect of negative feedback on circuit parameters.
	CO6	Examine the given circuit for the possible faults.

Exp. No.	Experiment Details	Ref.	Marks
1	Obtain bandwidth and gain for the given single stage CS amplifier	1,2	5
2	Obtain frequency response of cascode amplifier	1,2	5
3	Design RC phase shift oscillator for 1KHz frequency.	1,2	5
4	Obtain frequency of oscillation for Colpitt's and Hartley oscillator.	1,2	5
5	Analyze effect of negative feedback on gain and bandwidth for current series negative feedback amplifier.	1,2	5
6	Compare theoretical and observed differential gain, common mode gain and CMRR for the given differential amplifier circuit.	1,2	5
7	Identify the circuit and possible faults in it for the desired output for given hardware	1,2	5
8	Simulate Class A, Class B and Class AB power amplifier circuits using given simulation tool.	1,2	5
		Total Marks	40

References:

[1] Datasheets of components

[2] Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, Second Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL42	Principles of Control Systems Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE			Total	
				Practical		Oral		
		40		--		20	60	

Pre-requisite Course Codes		EL42 (Principles of Control Systems)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Examine working principle and application of given control system components.
	CO2	Develop a program using suitable programming language for time and frequency domain analysis of a given system.
	CO3	Demonstrate the dynamic behavior of the system in time domain and frequency domain.
	CO4	Experiment the effect of compensator on the performance of control system.
	CO5	Identify and demonstrate any control system for real life application.

Exp. No.	Experiment Details	Ref.	Marks
1	To plot Synchro characteristics and Synchro transmitter-receiver as an error detector.	1	5
2	To plot Speed torque characteristic of DC servo motor.	1	5
3	To plot characteristics of Potentiometer and its loading effect for different conditions of load.	1	5
4	To determine the line and load regulation characteristics of AC servo voltage stabilizer at different line and load conditions and observe the mechanism of AC voltage stabilization as an example of closed control system.	1	5
5	Using Linear System I Trainer Kit obtain the frequency response of first order and second order system.	1	5
6	Using Linear System II Trainer Kit obtain the time response of closed loop RLC circuit with integrator circuit and study the effect of Lead, Lag Compensator on its time response. Compare these results with mathematical expressions derived for the system.	1	5

7	a) Develop a program to define the given closed loop transfer function of system and plot their poles & zeros on s-plane. b) Develop a program to find the step response of a given second order control system and obtain its time domain parameters from this step response. Compare these results with mathematical calculations. c) Develop a program for a given control system described by its state space equation to find solution in terms of state transition matrix, zero input response, zero state response, complete response. d) Develop a program for a given control system described by its state space equation to find system is controllable or not, observable or not, to find rank of matrix and using rank comment on system controllability and observability e) Develop a program to obtain the root locus of a system described by its Transfer Function with unity feedback, Comment on the stability of this given control system. Compare these results with mathematical calculations. f) Develop a program to find gain margin and phase margin of the system described by its Transfer Function with unity feedback. Comment on the stability of this given control system. Compare these results with mathematical calculations.	2,3,4	**5**
8	**Mini-Project:** Identify the model of control system for real life application and demonstrate controlling action for the same. Use appropriate software platform.	1,2,3,4	**5**
Total Marks			**40**

References:

[1] Lab manuals

[2] www.mathworks.com

[3] www.scilab.org

[4] www.ni.com/labview

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL44	Fundamentals of Communication Engineering Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			--		20	60

Pre-requisite Course Codes		EL44 (Fundamentals of Communication Engineering)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Implement the circuit and observe the working principle of analog modulation techniques
	CO2	Implement the circuit and analyze the working principle of analog demodulators
	CO3	Make use of simulation software to study given communication circuits
	CO4	Implement circuits for analog pulse modulation techniques like PAM, PPM and PWM to observe modulated waveforms
	CO5	Implement the circuit for generation of natural sampling and its effect on reconstruction of the wave.
	CO6	Work in a team to implement the given communication circuit

Exp. No.	Experiment Details	Ref.	Marks
1	Simulation and implementation of double sideband full carrier for various modulation index	1,2	5
2	Implement the frequency modulation circuit to obtain FM waveforms and calculate modulation index	1	5
3	Analyze effect of pre-emphasis and de-emphasis on FM waveforms	1	5
4	Implementation of natural sampling and reconstruction of waveforms	1	5
5	Implementation and detection of pulse amplitude modulation.	2	5
6	Implementation of pulse width modulation	2	5
7	Implementation of pulse position modulation.	1,2	5
8	**Mini-Project:** Demonstrate the working of given communication circuits using simulation tools like TINA/Matlab/Scilab/LabVIEW.	1,2, 3	5
		Total Marks	**40**

References:

[1] Wayne Tomasi "Electronics communication systems" Pearson education, Third edition, 2001.

[2] Kennedy and Davis "Electronics communication system", Tata McGraw Hill. Fourth Edition.

[3] B.P. Lathi "Modern Digital and analog Communication system" Third edition, OXFORD

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL45	Electrical Machines Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			--		20	60

Pre-requisite Course Codes		EL45 (Electrical Machines)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Validate speed torque characteristics of ac motor and dc motor using simulation software and available machines in the laboratory.
	CO2	Design a driver circuit for a given stepper motor and DC motor.
	CO3	Compare three phase squirrel cage induction motor, three phase wound rotor induction motor and single phase induction motor and do the connection to control their speed.
	CO4	Identify different parts of the given starters and do the connections of the starters for the respective motors.
	CO5	Discuss and design the experiment to find the efficiency of motor on given motor-generator set.
	CO6	Use Expeyes hardware and python programming to observe the output current waveform and its FFT response.

Exp. No.	Experiment Details	Ref.	Marks
1	To construct the voltage waveforms for corresponding input current of three phase squirrel cage induction motor using current sensor and EXPEYES for different values of input voltage.	4	5
2	To validate the characteristics of speed control using Armature Voltage Control and Flux Control method for a given DC motor.	1,2	5
3	To validate the characteristics of armature and field winding of a given DC machines	2	5
4	To plot three phase sinusoidal signal using MATLAB and observe the the phase PWM signal. Implement the same using Python programming	2	5
5	To validate the Torque vs speed characteristics of a given DC motor.	2	5

6	A. Discuss and implement a circuit to find the efficiency of a given DC motor and DC generator set. Observe the current waveforms using Expeyes hardware and Python programming. B. Discuss and implement a circuit to perform the load test on three phase induction motor using given Motor-Generator set. Observe the current waveforms and its FFT using Expeyes hardware and Python programming.	1,4	**5**
7	Identify the fault in the given driver circuit to control the speed of the DC motor also state the steps followed.	1,3	**5**
8	Demonstrate the given starters and do the connections with the respective motors. Explain the need of starters.	1	**5**
		Total Marks	**40**

References:

[1] D. P. Kothari and I J Nagarath, "Electrical Machines", McGrawHill publications, Fourth edition

[2] Sailendra Nath Bhadra, "Electric Machinery Experiment laboratory practices and simulation study", Narosa

[3] Gopal K. Dubey, "Fundamental of Electrical Drives", Narosa, second edition.

[4] Mueller John Paul, "Beginning programming with Python for Dummies, Wiley publication.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL46	Computer Methods for Circuit Simulation Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		40			--		20	60

Pre-requisite Course Codes		Programming in C BS31 (Mathematics) EL32 (Circuit theory)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Illustrate a network in terms algebraic equations
	CO2	Apply Numerical techniques to solve linear and non linear algebraic equations
	CO3	Perform DC and Transient analysis on Electrical networks
	CO4	Analyze the given circuit using Monte Carlo

Exp. No.	Experiment Details	Ref.	Marks
1	Formulation of Linear algebraic Equations for Network using Modified Nodal Analysis and Apply Gaussian Elimination and L U decomposition methods for Solution	1,3,4	5
2	Apply Indirect methods (Gauss-Seidel and Gauss Jacobi) to find Solution of Linear algebraic Circuit Equation	1,3,4	5
3	Formulation of Non-Linear algebraic Equations for Network and Applying Newton – Raphson method to solve them	2,3,4	5
4	Applying Newton – Raphson method for solving a MOSFET based Non-Linear algebraic Circuit Equations	1,3,4	5
5	Transient simulation using Forward Eular, Backward Eular and Trapezoidal method. Verification of Stability in each method.	2,3,4	5
6	Solution of differential circuit equations using linear multistep methods	1,3,4	5
7	Solution of differential circuit equations using trapezoidal ringing	1,3,4	5
8	Perform Monte-Carlo Analysis on given circuit	1,2,3,4	5
		Total Marks	40

References:

[1] F. N. Najm, *Circuit Simulation,* Wiley-IEEE Press, 2010

[2] M.B. Patil, V. Ramanarayanan, V. T. Ranganathan, *Simulation of Power Electronic Circuits*, Narosa

[3] E. Balagurusamy, *Numerical Methods*, TATA McGRAW HILL

[4] R. Raghuram, *Computer Simulation of Electronic Circuits,* New Age International

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
LA1	Yoga-Vidya	1	-	-	Non-Credits			
		Examination Scheme						
		ISE1		ISE2	Attendance			Total
		20		20	10			50

Student will be evaluated after six sessions for 20 Marks (ISE1) and at the end of last session for 20 Marks (ISE2). Grade equivalent to 'D' (50%-59.99% Marks) or above is considered as 'Satisfactory'. If any of the tasks given is not completed/submitted/shown/evaluated then the corresponding lower grade will be given. Although the grades are given they will not mentioned in final grade card but they are necessary to declare the successful completion of the Non-Credit course.

Pre-requisite Course Codes	---	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Student will be able to perform various techniques of Yoga
	CO2	Student will be able to follow healthy habits to improve immune system
	CO3	Student will be able to describe the importance of Yoga in one's life
	CO4	Student will be able to make resolution to practice techniques of Yoga

Through this course, students will get an all-round experience of how Yoga can benefit their body, breath, emotions along with relaxation techniques to maintain a calm and balanced state of mind.

Day No.	Topics	Hrs.
1	What is Yoga, why Yoga? Techniques: warm up stretches for hands, legs, neck; Sukhasana, Padmasana	1
2	Introduction to Ashtanga Yoga Techniques: Talasana, Utkatasana, Konasana 2	1
3	Asana classification and importance of different types of Asanas Techniques: Sthita-prarthanasana, Ekpadasana, Garudasana	1
4	Yogendra rhythm- breathing pattern Techniques: Parvatasana, Yashtikasana	1
5	Forward bending and abdominal compression Techniques: Konasana 3, Yogamudra	1
6	Shuddhi Kriyas- Prevention of diseases by improving immune system Techniques: Jalaneti, Kapalabhati	1

7	Yogic Aahar Techniques: Vajrasana, Pavanmuktasana	1
8	Relaxation and it's importance Techniques: Shavasana	1
9	Spine and it's importance in Yoga Techniques: Bhujangasana, Makarasana, Vakrasana	1
10	Pranayama Techniques: Basic techniques	1
11	Attitude training Techniques: connecting techniques to concepts.	1
12	Pranayama Techniques: Traditional Pranayama	1
13	Yogachara- The Yoga way of living Techniques: Games	1
14	Revision	1

Books Recommended:

[1] Sadashiv Nimbalkar, "Yoga for Health & Practices", Yoga Vidya Niketan,Mumbai.

[2] Swami Satyananda Saraswati, "Asana Pranayama Mudra Bandha", Yoga Publications Trust, Munger, Bihar, 2008

[3] Dr.H.R.Nagendra, Dr.R.Nagarathna, "New Perspectives in Stress Management", Vivekananda Yoga Research Foundation, Bangaluru

[4] Books from The Yoga Institute, Santacruz:
a) Yoga Cyclopedia Vol 11
b) Yoga of caring
c) Insights through Yoga
d) Growing with Yoga

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
LA2	Music Appreciation	1	-	-	Non-Credits			
		Examination Scheme						
		ISE1		ISE2	Attendance			Total
		20		20	10			50

Student will be evaluated after six sessions for 20 Marks (ISE1) and at the end of last session for 20 Marks (ISE2). Grade equivalent to 'D' (50%-59.99% Marks) or above is considered as 'Satisfactory'. If any of the tasks given is not completed/submitted/shown/evaluated then the corresponding lower grade will be given. Although the grades are given they will not mentioned in final grade card but they are necessary to declare the successful completion of the Non-Credit course.

Pre-requisite Course Codes		---
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Appreciate North Indian Hindustani Music
	CO2	Appreciate the classical music in films

Topics	Hrs.
1. Broad perspective of North Indian of Hindustani Music i.e. a - Classical Vocal b - Semi-Classical Vocal, c - Instrumental - Plucked, Bowed & Wind d - Percussion, e - Families of Musical Instruments. 2. Performance scenario of vocal, instrumental and percussion 3. Film Music where classical music is used	14

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
LA3	Dramatics	1	-	-	Non-Credits			
		Examination Scheme						
		ISE1		ISE2	Attendance			Total
		20		20	10			50

Student will be evaluated after six sessions for 20 Marks (ISE1) and at the end of last session for 20 Marks (ISE2). Grade equivalent to 'D' (50%-59.99% Marks) or above is considered as 'Satisfactory'. If any of the tasks given is not completed/submitted/shown/evaluated then the corresponding lower grade will be given. Although the grades are given they will not mentioned in final grade card but they are necessary to declare the successful completion of the Non-Credit course.

Pre-requisite Course Codes		---
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Understand an Art of Theatre.
	CO2	Express their thoughts.
	CO3	Create and visualize new ideas.
	CO4	Perform impressively.

Day No.	Topics	Hrs.
1	Lalitkala (Forms of Art)	1
2	Drama – Show and Text	1
3	Techniques – Abhinay (Acting)	1
4	1. Vachik Abhinay (Reading)	1
5	2. Angik Abhinay (Expressions)	1
6	3. Satvik Abhinay	1
7	Digdarshan (Direction)	1
8	Nepathya (Settings)	1
9	Veshbhusha (Drapery)	1
10	Natyabhasha (Dialogs and Language)	1
11	Kaal and Avakash (Time and Space)	1
12	Natya Rasa (Theory of Rasa)	1
13	Natya Rasa (Theory of Rasa)	1
14	Aswad prakriya	1
	Total	14

References:

[1] An Actors prepare – Stanislavsky (English)

[2] A building a Character – Stanislavsky(English)

[3] Natyashastra – Bharatmuni (English And Marathi)

[4] Abhinaysadhana- K. Narayan Kale (Marathi)

[5] Natyavimarsh-K. Narayan Kale (Marathi)

[6] Jagatik Rangabhumicha Itihas – Kru. Ra. Sawant (Marathi)

[7] Marathi Rangabhumicha Itihas - Shri. Na. Banahatti (Marathi)

[8] Lalitkalamimansa- Go. Chi. Bhate(Marathi)

[9] Sahitya Adhyapan Ani Prakar- va. la. Kulakarni Gauravgranth(Marathi)

[10] Vachik Abhinay- Dr. Shriram Lagoo (Marathi)

[11] Rangnayak- Arwind Deshpande

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'Activity Based Learning'

ABL1: Building Automation, Fire Safety and Electronic Security

This is non-credit activity conducted in semester III for all the branches of engineering. It is compulsory for all the students to appear for this activity.

This is one day event involving following activities:

1. Invited Talks on the related topics
2. Poster Presentation
3. Fire/Safety Drills
4. Design competition in building automation, fire safety and security.

This event shall be conducted in association with Fire and Security Association of India (FSAI).

ABL2: OCCUPATIONAL SAFETY & LEGAL STUDIES FOR ENGINEERS

Engineering is the branch of science and technology concerned with design, building and the use of engine, machines and structures. In this fast moving world scenario, it is seen that the field of Engineering has travelled a very long distance of time space. In the modern parlance, this field must be properly knitted with the other two important dimensions—SAFETY & LAW. An Engineer must have adequate knowledge of these vital subject if he ever wishes to establish himself in this Industrial world.

The following activities have been designed to meet up with the growing expectations with the concerned topic. Students are requested to actively participate in those activities based learning to catch up with the realities of the industrial world.

Hence, the activities are divided into 5 parts—MOOT COURT, DEBATE, ELOCUTION, PRESENTATION & ROLE PLAY

1) ***MOOT COURT:***
   It is a process in which participants take part in simulated court proceedings, usually involving drafting memorials or memoranda and participating in oral argument. It is just a dummy

presentation of the actual court proceedings. It will have a pair of counsel from the defendant as well as the prosecution side. The case write up will be given to both the sides well in advance. They need to study the case along the lines of actual law pertaining to the case which will be more or less company law, intellectual property laws, banking laws, insurance laws or negotiable instrument laws. Both sides will have a researcher who will work along with his respective team to unearth any backdated supportive cases. The sides has to come in common consensus to work on issues which should not be more than five. Based on those issues both sides will present their case turn by turn with the permission of the judge. Judge can consist of persons ranging from 1 to 3. The issues should be dealt with in the book called memorial which should be prepared by both the sides. The prosecution will start the case followed by the defendants. Nobody can criss-cross each other's time of presentation. The judge/s have to control the whole proceedings properly. The judge has the power to give permission for rebuttal as per his own whims. In the end he will pass the judgment based on law.

2) ***DEBATE:***

Debates will have topics based on safety and law based and the pair of participants need to stand for or against the motion.

3) ***ELOCUTION:***

Same will be the case with elocution but it will be extempore and the participants will have to present their insights on the topic given on the spot.

4) ***PRESENTATION:***

A PPT presentation will have topics based on legal laws and students need to prepare the same.

The list of topics are:

Sale deed, WILL, Gift Deed, Agreement, Power of attorney, MOU(Memorandum of Understanding), Non-Disclosure agreements, Affidavit, Charter, Partnership deed, Copyrights Transfer Agreement, Franchise Termination, Lease purchase contract, Letters Patent, Legal Threat, Promissory Note, Share Certificate, Share transmission.

5) ***ROLE PLAY:***

This activity is a group activity whereby they have to work as a team and enact some situation pertaining to law or safety in the Industrial premises. It's a fun activity whereby they camouflage themselves stepping into the shoes of the role that they will be performing to create an awareness amongst the audience of what to do in case they find themselves in same situations in near future.

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Competitive Examinations Preparation (CEP): (Extra credits=2)

Salient Features of CEP:

- It is optional module
- Motivation, mentoring and preparation of students to pursue higher education
- Modules as per national level technical competitive examination **GATE**
- Motivation, mentoring and preparation of students to join public sector or government organizations like BARC, DRDO etc.
- Motivation, mentoring and preparation of students to join top ranking technical institutes in country like IISc and IIT.
- Module design as per the courses studies in that semester or prior semester by considering syllabus of GATE examination
- Help to sharpen the problem solving skills of students and concerned teachers
- Course mentors will be allotted at the start of academic year
- Two (2) extra credits will be given if
    1. Student submit **Valid Gate Score card**.
    2. Must pass CEP1 to CEP6 in modal question papers given by the faculty
    3. Maintains regular contact with CEP course teachers

CEP Courses:

Semester III:
CEP1: Introduction to CEP

One hour introduction session to entire class about CEP.

Student shall be assigned as 'Teaching Assistant' to Engineering Mathematics Course –I.
Student shall maintain regular contact with the semester III course teachers (once in a week per course). Teacher shall maintain the attendance of the student. Teacher shall mentor student and give assignments with GATE level problems to solve. At least TWO assignments per course shall be submitted by the student.

After End Semester Examination student shall appear for the Model Test paper based on the pattern of the actual GATE Examination. This paper shall be based on the contents of Semester-I and Semester-III courses. The negative marking is applicable as per GATE pattern.
The student shall obtain minimum 10 marks to continue registration in CEP module for next semester onwards.

Semester IV:
CEP2: Problem solving module-I

Student shall be assigned as 'Teaching Assistant' to Engineering Mathematics Course–II and Basics of electrical Engineering.
Student shall maintain regular contact with the semester IV course teachers (once in a week per course). Teacher shall maintain the attendance of the student. Teacher shall mentor student and give assignments with GATE level problems to solve. At least TWO assignments per course shall be submitted by the student.

After End Semester Examination student shall appear for the Model Test paper based on the pattern of the actual GATE Examination. This paper shall be based on the contents of Semester-II and Semester-IV courses. The negative marking is applicable as per GATE pattern.
The student shall obtain minimum 10 marks to continue registration in CEP module for next semester onwards.

Semester V:
CEP3: Problem solving module-II

Student shall be assigned as 'Teaching Assistant' to Semester III courses.
Student shall maintain regular contact with the semester V course teachers (once in a week per course). Teacher shall maintain the attendance of the student. Teacher shall mentor student and give assignments with GATE level problems to solve. At least TWO assignments per course shall be submitted by the student.

After End Semester Examination student shall appear for the Model Test paper based on the pattern of the actual GATE Examination. This paper shall be based on the contents of Semester-V courses. The negative marking is applicable as per GATE pattern.
The student shall obtain minimum 10 marks to continue registration in CEP module for next semester onwards.

Semester VI:
CEP4: Problem solving module –III

Student shall be assigned as 'Teaching Assistant' to Semester IV courses.

Self Learning: Numerical Ability and Verbal Ability

Student shall maintain regular contact with the semester VI course teachers (once in a week per course). Teacher shall maintain the attendance of the student. Teacher shall mentor student and give assignments with GATE level problems to solve. At least TWO assignments per course shall be submitted by the student.

After End Semester Examination student shall appear for the Model Test paper based on the pattern of the actual GATE Examination. This paper shall be based on the contents of Semester VI courses and self learning module on numerical ability and verbal ability. The negative marking is applicable as per GATE pattern.
The student shall obtain minimum 10 marks to continue registration in CEP module for next semester onwards.

Semester VII:
CEP5: Problem solving module-IV

Student shall be assigned as 'Teaching Assistant' to Semester V courses.

Self Learning: Contents not covered in any semester of study

Student shall maintain regular contact with the semester VII course teachers (once in a week per course).Teacher shall maintain the attendance of the student. Teacher shall mentor student and give assignments with GATE level problems to solve.
At least TWO assignments per course shall be submitted by the student.

After End Semester Examination student shall appear for the Model Test paper based on the pattern of the actual GATE Examination. This paper shall be based on the contents of entire syllabus of GATE Examination. The negative marking is applicable as per GATE pattern.
The student shall obtain minimum 10 marks to continue registration in CEP module for next semester onwards.

Semester VIII:
CEP6: Problem solving module-V

At the start of the semester student shall appear for the TWO Model Test papers based on the pattern of the actual GATE Examination. This paper shall be based on the contents of entire syllabus of GATE Examination. The negative marking is applicable as per GATE pattern.

Student shall submit 'Valid GATE Score Card' after declaration of GATE result.

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Mapping with Syllabus for GATE Exam (Semester-wise)

Semester – I
Engineering Mathematics-I : basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness. partial derivatives, maxima and minima, Taylor series, Vectors in plane and space, vector operations, gradient, divergence and curl,
Semester-II
Engineering mathematics –II: multiple integrals, Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems. single and multi-step methods for differential equations
Basics of Electrical Engineering : Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors
Semester-III
Applied Mathematics-I: Gauss's, Green's and Stoke's theorems, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.
Circuit Theory: Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for Networks
Analog Electronics-I: Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT amplifiers
Digital Circuits: Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines;

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Semester-IV
Applied Mathematics-II: line, surface and volume integrals, Analytic functions, Mean, median, mode and standard deviation, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability
Analog Electronics-II: MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power circuits, Sinusoidal oscillators: criterion for oscillation
Principles of Control System: Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.
Fundamentals of Communication Engineering: Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications;
Semester V:
Continuous Time Signal System: Fourier series and Fourier transform representations, sampling theorem and applications filtering of random signals through LTI systems;
IC Technology: Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.
Design with Linear Integrated Circuits: Simple op-amp circuits; Active filters; single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation. Data converters: sample and hold circuits, ADCs and DACs
Computer Organisation & Architecture: Semiconductor memories: ROM, SRAM, DRAM
ElectroMagnetic Engineering: Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays
Semester VI:
Discrete Time Signal System: Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques

Semester VII:
Elective: Random processes: autocorrelation and power spectral density, properties of white noise; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.
Not covered in any Semester
Engineering Mathematics: Linear Algebra: Vector space Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals Solution of nonlinear equations, convergence criteria. Combinatorial probability Correlation and regression analysis
Digital Circuits: 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.
Electromagnetics: Basics of radar; Light propagation in optical fibers.

Self Learning Module: General Aptitude

I. Verbal Ability

1. Grammar
2. Nouns, Pronouns, Articles
3. Verbs, Auxiliaries, Modals
4. Adjectives, Adverbs
5. Prepositions, Conjunctions
6. Active/ Passive Voice, Direct/ Indirect Speech
7. Verbal phrases
8. Sentence Completion
9. Vocabulary
10. Synonyms
11. Antonyms
12. Analogy
13. Reverse Analogy
14. Verbal Reasoning
15. Critical Reasoning

16. Logical Reasoning

II. Numerical Ability

I. Quantitative Aptitude:

1. Simple Equations
2. Ratio-proportion-variation
3. Numbers
4. Percentage, Profit and Loss
5. Simple Interest and Compound Interest
6. Average, mixtures and Alligations
7. Time and Work
8. Time and Distance
9. Indices, Surds, Logarithms
10. Quadratic Equations
11. Inequalities
12. Progressions
13. Permutations and Combinations
14. Data Interpretation

II. Reasoning

1. Number and Letter Series
2. Analogies
3. Odd man out (Classification)
4. Coding and Decoding
5. Blood relations
6. Venn Diagrams
7. Seating Arrangements
8. Puzzles
9. Clocks and Calendars