Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Revision: SPIT-3-18

Bachelor of Engineering/Technology (B.E./B.Tech)
in
Electronics Engineering
(Program Code: UEL)

Third Year Engineering
(Sem. V and Sem. VI)
Effective from Academic Year 2018 -19

Board of Studies Approval: 13/12/2017

Academic Council Approval: 20/01/2018

Dr. Surendra Rathod	*Dr. Surendra Rathod*	*Dr. Prachi Gharpure*
Head of Department	*Dean Academics*	*Principal*

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

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Scheme for B.E./B.Tech Electronics Engineering (SEM V/ SEM VI)						
SEM V						
Course Code	**Course Name**	**Group**	**Teaching Scheme (Hrs/week)**			**Credits**
			L	**T**	**P**	**Total**
EL51	Linear Integrated Circuits	PC	3	1	--	4
EL52	Micro-Architectures	PC	3	1	--	4
EL53	Signals and Systems	PC	3	1	--	4
EL54	Electromagnetic Engineering	PC	3	1	--	4
ELL51	Linear Integrated Circuits Lab	PC	--	--	2	1
ELL52	Micro-Architectures Lab	PC	--	--	2	1
ELL53	Signals and Systems Lab	PC	--	--	2	1
ELL55	Instrumentation Lab	PC	--	1	2	2
ELP56	Action Research Project I	PR	--	--	2	1
MEC^	Mandatory Elective Course MEC3:Industrial and Organizational Psychology MEC4: Law for Engineers	MEC	2	--	--	2
SDX	SCOPE Course (Optional)	SD	--	--	--	--
ABL3	Creative Thinking, Diversity and Workplace Etiquette (Noncredit)	ABL	--	--	--	--
CEP3	Problem solving module-II (Optional)	CEP	--	--	--	--
	Total		12	5	10	24
SEM VI						
Course Code	**Course Name**	**Group**	**Teaching Scheme (Hrs/week)**			**Credits**
			L	**T**	**P**	**Total**
EL61	VLSI Design	PC	3	1	--	4
EL62	Power Electronics	PC	3	--	--	3
EL63	Digital Communication	PC	3	--	--	3
ELL61	VLSI Design Lab	PC	--	--	2	1
ELL62	Power Electronics Lab	PC	--	--	2	1
ELL63	Fundamentals of Operating System Lab	PC	--	1	2	2
ELL64	Signal Processing Lab	PC	--	--	2	1
ELP65	Action Research Project II	PR	--	--	2	1
HSS61	Advance Communicative English	HSS	2	2	--	3
OE^	Open Elective @	OE	1@	--	2@	2@
SDX	SCOPE Course (Optional)	SD	--	--	--	--
ABL4	Technical Paper and Patent Drafting (Noncredit)	ABL	--	--	--	--
CEP4	Problem solving module-III (Optional)	CEP	--	--	--	--
MEC^	Mandatory Elective Course MEC1:French Language MEC2:German Language	MEC	2	--	--	2
	Total		13+1@	4	10+2@	21+2@

@OE1: Consumer Electronics (ETRX)
OE2: Robotic Vision (ETRX)
OE3: Cyber Security and Digital Forensics (EXTC)
OE4: Internet of Things (EXTC)
OE5:Fundamentals of Computational Intelligence (COMP)
OE6: Fundamentals of Data Structures and Algorithms (COMP)
OE7:Software Testing (IT)
OE8:Database Management Systems (IT)

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Evaluation Scheme

B.E./B.Tech Electronics Engineering (SEM V)					
Course Code	**Course Name**	**Marks**			
		ISE	**MSE**	**ESE**	**Total**
EL51	Linear Integrated Circuits	20	20	60	100
EL52	Micro-Architectures	20	20	60	100
EL53	Signals and Systems	20	20	60	100
EL54	Electromagnetic Engineering	20	20	60	100
ELL51	Linear Integrated Circuits Lab	40	--	20	60
ELL52	Micro-Architectures Lab	40	--	20	60
ELL53	Signals and Systems Lab	40	--	--	40
ELL55	Instrumentation Lab	40	--	--	40
ELP56	Action Research Project I	40&	--	20	60
MEC^	Mandatory Elective Course MEC3:Industrial and Organizational Psychology MEC4: Law for Engineers	ISE1= 20	ISE2= 20	Attendance= 10	50
ABL3	Creative Thinking, Diversity and Workplace Etiquette (Noncredit)	--	--	--	--
	Total				**750**
B.E./B.Tech Electronics Engineering (SEM VI)					
Course Code	**Course Name**	**Marks**			
		ISE	**MSE**	**ESE**	**Total**
EL61	VLSI Design	20	20	60	100
EL62	Power Electronics	20	20	60	100
EL63	Digital Communication	20	20	60	100
ELL61	VLSI Design Lab	40	--	--	40
ELL62	Power Electronics Lab	40	--	20	60
ELL63	Fundamentals of Operating System Lab	40	--	--	40
ELL64	Signal Processing Lab	40	--	--	40
ELP65	Action Research Project II	40&	--	20	60
HSS61	Advance Communicative English	100	--	--	100
OE^	Open Elective @	40	10	20	70
MEC^	Mandatory Elective Course MEC1:French Language MEC2:German Language	ISE1= 20	ISE2= 20	Attendance= 10	50
ABL4	Technical Paper and Patent Drafting (Noncredit)	--	--	--	--
	Total				**800**

@OE1: Consumer Electronics (ETRX)
OE2: Robotic Vision (ETRX)
OE3: Cyber Security and Digital Forensics (EXTC)
OE4: Internet of Things (EXTC)
OE5:Fundamentals of Computational Intelligence (COMP)
OE6:Fundamentals of Data Structures and Algorithms (COMP)
OE7:Software Testing (IT)
OE8:Database Management Systems (IT)

& Phase-I:10 Phase-II:10 Phase-III:10 Phase-IV:10

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Semester V

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL51	Linear Integrated Circuits	03	01	--	3	1	--	4
		Examination Scheme						
		ISE		MSE	ESE			Total
		20		20	60			100

Pre-requisite Course Codes		ES11: Basic Electrical & Electronics Engineering EL31: Analog Electronics-I EL32: Digital Circuits EL41: Analog Electronics-II
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Discuss fundamentals of operational amplifier IC
	CO2	Analyze the various applications and circuits based on particular linear integrated circuit
	CO3	Design linear and non-linear applications using operational amplifier IC
	CO4	Design and analysis of circuits and applications with data converter ICs, voltage regulator ICs and special purpose ICs
	CO5	Design and develop the complete block diagram and circuit diagram for typical applications using integrated circuits

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Fundamentals of Operational Amplifier**		06
	1.1	Functional Block Diagram of op amp, DC and AC characteristics of an op-amp, Ideal op-amp	1,3,5	
	1.2	Single Supply op-amp Vs Dual Supply op amp, Noise analysis circuits	1,3,5	
2		**Linear Applications of Operational Amplifier**		08
	2.1	Inverting and non Inverting Amplifier,Adder, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier	1,3,5	
	2.2	**Converters:** Current to voltage and voltage to current converters	1,3,5	
	2.3	**Active Filters:** First order filters, second order active finite and infinite gain low pass, high pass, band pass and band reject filters	1, 3	
3		**Non-Linear Applications of Operational Amplifier**		08
	3.1	**Comparators:** Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector	1,3,5	
	3.2	**Schmitt Triggers:** Inverting Schmitt trigger, non-inverting Schmitt trigger with adjustable threshold levels	1,3,5	

	3.3	**Waveform Generators:** Square wave and triangular wave generator with duty cycle modulation	3, 5	
	3.4	**Precision Rectifiers:** Half and full wave precision rectifiers and their applications, Peak detectors, sample and hold circuits, logarithmic converters and antilog converters	1,3,5	
	3.5	**Sine Wave Oscillators:** RC phase shift oscillator, Wien bridge oscillator	3,4	
4		**Data Converters**		**04**
	4.1	Performance parameters of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC, flash ADC	3,6	
	4.2	Performance parameters of DAC, binary weighted register DAC, R/2R ladder DAC, inverted R/2R ladder DAC	3,6	
5		**Special Purpose Integrated Circuits**		**08**
	5.1	Functional block diagram, working, design and applications of Timer 555	3,5	
	5.2	Functional block diagram, working and applications of VCO 566, PLL 565 and multiplier 534	3,5	
6		**Voltage Regulators**		**08**
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators	1,3,5	
	6.2	Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, functional block diagram and working of LT1070 monolithic switching regulator	1,3,5	
			Total	**42**

ISE Evaluation:

1) Assignment: Applications using Integrated Circuits: Case Studies: LED Temperature Indicator, Digital DC Motor Speed Control, Appliance Timer, Electronic Security System: Siren/Alarm, Process Parameter monitoring and Control System**(CO1** to **CO5)(**10 **Marks)**

This is group activity. Students will form a group of minimum 5 students. Each group will be given the problem statement from the case studies listed above but not limited to these. Students will develop the block diagram of the system first, then design each block using ICs and discrete components. Simulate the complete block diagram using any circuit simulator like TINA, Multisim or Proteus. The duration of this activity is a complete semester but evaluation will be done in Phases and rubrics designed. In the first phase students will develop the block diagram for the given problem statement. In the second phase students will develop the circuit diagram and simulate each of the circuit diagrams and test it for input-output relationship. In the third phase students will interface all the designed circuits to obtain final input-output relationship of the system. Hardware implementation is optional.

2) Four Quizzes based on COs. (CO1 to CO5) (10 Marks)

Tutorial

Tutorials will be based on Design and analysis of the circuits using Integrated Circuits.

1) Tutorial 1 and 2: Problems based on fundamentals of operational amplifier IC.
2) Tutorial 3 to 6: Design and Analysis of circuits using op-amp (Linear and Non Linear Circuits).
3) Tutorial 7 to 10: Design and analysis of circuits and applications with data converter ICs, voltage regulator ICs and special purpose ICs.

Recommended Books:

1. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", TataMcGraw Hill, 3rd Edition.
2. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits ", Pearson, 4thEdition.
3. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age InternationalPublishers, 4th Edition.
4. David A. Bell, "Operation Amplifiers and Linear Integrated Circuits", Oxford UniversityPress, Indian Edition.
5. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall,4th Edition.
6. R. P. Jain, "Modern Digital Electronics," Tata McGraw Hill, 3 rd Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL52	Micro-Architectures	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE	ESE		Total	
		20		20	60		100	

Pre-requisite Course Codes		EL33: Digital Circuits EL43: Computer Organization and Architecture
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Describe the architecture, modes and interrupt structure of 16-bit microprocessors.
	CO2	Compare microprocessors based on their architectural features and correlate with computer organization.
	CO3	Explain the architectural features of 8-bit microcontroller.
	CO4	Apply addressing modes and write assembly as well as C program for the given task.
	CO5	Effectively utilize the on chip hardware resources available in the microcontroller.
	CO6	Compare various 8-bit and 16-bit microcontrollers based on their architectural features and select suitable microcontroller for the given application.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Microprocessors**		12
	1.1	Architecture of 16 bit microprocessor, Segmentation and Pin Diagram.	1,2	
	1.2	Maximum and Minimum modes module design	1,2	
	1.3	Interrupt Structure of 8086,8086 instructions and assembler directives with addressing modes, System design (I/O and memory interfacing).	1,2	
	1.4	Comparative Study of microprocessors and microarchitectures with respect to their important features from the perspective of computer organization:INTEL (X86, Pentium, Celeron, Core 2, Core i3, Core i5 and Core i7) and AMD (Am86, K5, K10, Zen Core).	1,2	
2		**8051 Architecture**		04
	2.1	Overview of 8051 Family	3	
	2.2	8051 block diagram	3	
	2.3	Pin Description of 8051	3	

3		**8051 Programming in C**		12
	3.1	Addressing Modes	3	
	3.2	Data Types, Time Delay, Logic Operations and Data Conversion	3	
	3.3	I/O Programming	3	
	3.4	Timer Programming	3	
	3.5	Interrupt Programming	3	
	3.6	Serial Port Programming	3	
4		**8051 Interfacing**		04
	4.1	LCD and Keyboard Interfacing	4	
	4.2	ADC, DAC and Sensor Interfacing	4	
	4.3	Motor Control: Relay, PWM, DC and Stepper Motors	4	
5		**Comparative study of microcontrollers**		10
	5.1	Architectural features and development tools: Intel, Atmel (AVR), TI (MSP430), Microchip (PIC)	4	
	5.2	Architectural features and development tools for ARM: NXP (LPC 2148) and Cypress Semiconductor (PSoC)	4	
	5.3	Comparative study of Architectural features and development tools of Single board microcontrollers: Arduino,Rasberry-Pi and Intel Galilio.	4	
	5.4	Mixed Signal Microcontrollers from Silicon Labs:8-bitC8051F02xand EFM32 Giant Gecko GG Series 32-bit microcontroller.	4	
			Total	**42**

Recommended Books:

[1] Douglas Hall,"Microprocessor and Interfacing", TMH Publication

[2] John Uffenbeck, "8086/8088 family: Design Programming and Interfacing",Pearson Education.

[3] Muhammad Ali Mazidi, Janice G. Mazidi and R. D. McKinlay"The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson.

[4] User Manuals

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL53	Signals & Systems	03	01	--	03	01	--	04
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	BS31: Applied Mathematics I BS41: Applied Mathematics II	
At the end of the course students will be able to		
Course Outcomes	CO1	Perform Operations on Signals
	CO2	Classify Signals and Systems
	CO3	Analyze System in Transform Domain
	CO4	Apply DFT Properties and Illustrate FFT algorithms

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	**Continuous Time Signal**	1,2	6
	1.1	Mathematical Representation of Signal: Unit Impulse Signal, Unit Step Signal, Unit Ramp Signal, Complex Exponential Signal and Sinusoidal Signal.		
	1.2	Classification : Deterministic and Non deterministic signals, Periodic and Aperiodic Signals, Even, Odd and Neither Even nor Odd signals, Causal, Anti-causal and Both Sided Signals, Energy, Power and Neither Energy nor Power Signal.		
	1.3	Signal Operation : Linear & Circular Convolution, Correlation		
	1.4	Spectral Analysis using Continuous Time Fourier Transform		
2	2	**Discrete Time Signal**	1,2	6
	2.1	Mathematical Representation of signal: Unit Impulse Signal, Unit Step Signal, Unit Ramp Signal, Complex Exponential Signal, Sinusoidal Signal		
	2.2	Classification : Deterministic and non deterministic signals, Periodic and Aperiodic Signals, Even, Odd and Neither Even nor Odd signals, Causal, Anti-causal and Both Sided Signals, Energy, Power and Neither Energy nor Power Signal.		
	2.3	Signal Manipulation: Folding, Shifting, Time Scaling, Addition, Multiplication, Decimation, Interpolation by zeros.		
3	3	**Z-Transform**	1,2	4
	3.1	Forward Z-Transform, Region of Convergence, Inverse Z-transform	3,4	
	3.2	Properties of Z-Transform: Scaling & Linearity, Time Shift, Time		

		Reversal, Differentiation, Convolution & Correlation Property		
	3.3	Initial Value Theorem, Final value Theorem		
4	4	**Discrete Time System**	2,3	12
	4.1	Introduction of System, Classification of Systems: Static and Dynamic Systems, Linear and Non-Linear Systems, Time Invariant and Time Variant Systems, Causal and Non-causal Systems, Stable and unstable Systems.		
	4.2	Impulse Response and Step Response, Transfer Function, Differential Equation, Realization Diagram, Frequency response, Stability.		
	4.3	Zero State Response, Zero Input Response, Transient response, Steady State Response		
5	5	**Discrete Fourier Transform**	2,3	6
	5.1	DTFT and Inverse DTFT, DFT and Inverse DFT, Relation between DFT and DTFT		
	5.2	Properties of DFT : Scaling & Linearity, Periodicity, Time Shift, Frequency Shift, Time Reversal, Symmetry, Convolution,		
	5.3	Spectral Analysis using DFT, Computations in DFT		
6	6	**Fast Fourier Transform**	2,3	6
	6.1	Radix-2 Decimation In Time FFT (DIT-FFT) for N=2, 4, 8, Inverse DIT-FFT, Computations in FFT, Convolution using FFT		
	6.2	Linear filtering methods : Overlap Add Method, Overlap Save Method		
	6.3	Spectral Analysis using FFT		
			Total	**42**

Tutorials:

Tutorials will be based on;

1. Operations on Continuous Time
2. Operations on Discrete time signals
3. Z-Transform and Analysis of Discrete Time System using ZT
4. Discrete Fourier Transform
5. Fast Fourier Transform

Recommended Books:

[1] A. NagoorKani, "Signals & Systems", McGraw Hill Education (India) Pvt Ltd, Fourteenth Edition.

[2] S.Salivahanan, AVallavaraj, C Gnanapriya, "Digital Signal Processing", Tata McGraw Hill, First Edition.

[3] John Proakis and DimitrisMonolakis,"Digital Signal Processing", Pearson Publication,Fourth Edition.

[4] Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, "Signals andSystems", Second Edition, PHI learning.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL54	Electromagnetic Engineering	03	01	--	03	01	--	04
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	BS31 Applied Mathematics I BS41 Applied Mathematics II EL34 Electronic Instruments and Measurement Lab	
Course Outcomes	CO1	Apply basic laws of electromagnetic and Maxwell's equations
	CO2	Illustrate the behavior of EM waves and travelling of waves in free space as well as media.
	C03	Solve problems related to the propagation of electromagnetic waves
	CO4	Discuss the types of antennas and their parameters
	CO5	Discuss types of radio wave propagation

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	Coordinate system transformation and vector calculus	1,3	03
	1.1	Cartesian, cylindrical and spherical coordinate		
	1.2	Del Operator, Gradient of scalar, Divergence of a vector and Divergence Theorem, Curl of a Vector and Stoke's Theorem, Laplacian Theorem, Classification of a Vector Field		
2	2	Transmission Lines	2	08
	2.1	Power frequency lines: Representation, losses and efficiency in power lines, effect of length, calculation of inductance and capacitance		
	2.2	Radio frequency lines: Representation, propagation constant, attenuation constant, phase constant, group velocity, input impedance, characteristic impedance, reflection coefficient, standing wave ratio, VSWR, ISWR, S-parameters		
	2.3	Smith Chart: Impedance locus diagram, impedance matching		
3	3	Basic Laws of Electromagnetic and Maxwell's Equation	1,2	08
	3.1	Coulomb's law, Gauss's law, Bio-Savart's law, Ampere's law, Poisson's and Laplace equations		
	3.2	Boundary conditions for static electric and magnetic fields		
	3.3	Maxwell's Equations: Integral and differential form for static and time varying fields and its interpretation.		
4	4	Uniform Plane Equation and Power Balance	1,2	08
	4.1	Wave equation: Derivation and its solution in Cartesian co-ordinates.		
	4.2	Solution of wave equations: Partially conducting media, perfect		

		dielectrics and good conductors, Concept of Skin Depth		
	4.3	Electromagnetic Power: Poynting Vector and power flow in free space and in dielectric, conducting media		
	4.4	Polarization of wave: Linear, Circular and Elliptical		
	4.5	Propagation in different media: Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media		
5	5	Fundamentals of Antenna	1,2	06
	5.1	Magnetic vector potential and Electrical Scalar Potential, Hertzian dipole, monopole and dipole, Antenna Parameters: Radiation intensity, directive gain, directivity, power gain, beam width, band width, gain and radiation resistance of current element		
	5.2	Half-wave dipole and folded dipole: Reciprocity principle, effective length and effective area		
6	6	Electromagnetic Field Computation	6	06
	6.1	Finite Difference Method (FDM): Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method		
	6.2	Method of Moment (MOM): Field calculations of conducting wire, parallel conducting wires		
	6.3	Finite Element Method (FEM): triangular mesh configuration, finiteelement discretization, element governing equations, assembling allequations and solving resulting equations.		
7	7	Radio wave propagation	4,5	03
	7.1	Ground, Space, Surface and Sky wave propagation		
	7.2	Measures of Ionosphere propagation		
			Total	42

Recommended Books:

[1] Matthew N.D. Sadiku, "*Principles of Electromagnetics*", Oxford International Student 4th Edition, 2007

[2] R.K. Shevgaonkar, "*Electromagnetic Waves*", TATA McGraw Hill Companies, 3rd Edition, 2009.

[3] W.H. Hayt, and J.A. Buck, "*Engineering Electromagnetics*", McGraw Hill Publications, 7th Edition, 2006

[4] Edward C. Jordan and Keth G. Balmin, "*Electromagnetic Waves and Radiating Systems*", Pearson Publications, 2nd Edition, 2006

[5] J.D. Kraus, R.J. Marhefka, and A.S. Khan, "*Antennas & Wave Propagation*", McGraw Hill Publications, 4th Edition, 2011

[6] Jian-Ming Jin, "Theory and computation of Electromagnetic Field" , Wiley publication, 2nd Edition, 2015

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Tutorials on Electromagnetic Engineering

Sr. No	Suggested List of Topics	No. of hours
1	Numerical problems on "Coordinate system transformation and Vector calculus"	01
2	Numerical problems on "Transmission line"	02
3	Numerical problems on "Basic laws of Electromagnetics"	01
4	Numerical problems on "Boundary conditions"	01
5	Numerical problems on "Maxwells equation in differential and integral form"	01
6	Numerical problems on "Wave equation"	02
7	Numerical problems on "Poynting Vector"	01
8	Numerical problems on "Polarization and propagation of EM waves"	02
9	Numerical problems on "Antenna fundamentals"	01
10	Numerical problems on "Electromagnetic Field Computation"	02
	Total	**14**

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL51	Linear Integrated Circuit Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			--		20	60

Pre-requisite Course Codes		ES11: Basic Electrical & Electronics Engineering EL31: Analog Electronics-I EL32: Digital Circuits EL41: Analog Electronics-II
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Validate electrical characteristics of given ICs.
	CO2	Design, debug and test electronic circuit using ICs like op-amp 741, IC 555, IC 566, IC723, etc.
	CO3	Validate the simulation results with experimental results for the given circuit using Analog System Trainer Kit by Texas Instruments.
	CO4	Validate circuits by simulation using modern tools available like ngspice and LTspice, TINA, Multisim.
	CO5	Design, develop and troubleshoot the complete electronic system for typical applications like speed control of DC Motor, Temperature control, development of signal conditioning circuits for various transducers.
	CO6	Infer data sheet of the given IC.

Exp. No.	Suggested List of Experiments	Ref.	Marks
1	To measure (a) Input bias current, (b) Input offset current,(c)Input offset voltage & (d) Slew rate of the given Op-Amp IC 741.	1,2, 3	5
2	Design, Implement and analyze Schmitt Trigger Circuit using Op-Amp IC 741.	1,2	5
3	Design, Implement and analyze Square Wave Generator Circuit using Op-Amp IC 741.	1,2	5
4	Design, Implement and analyze MonostableMultivibrator Circuit using IC 555 and its operation as divide by N frequency.	1,2	5
5	Design, Implement and analyze Inverting Adder Circuit using Op-Amp IC 741.	1,2	5
6	Design, Implement and analyze Voltage Regulator Circuit using IC 723.	1,2	5
7	a) Design, Simulate and analyze the given problem statement (circuit) using Circuit Simulation S/W preferably NI-Multisim/TINA/SPICE. b) Implement and analyze this Circuit using Op-Amp (TL802): Analog	1,2,5	5

	System Trainer Kit - TEXAS INSTRUMENTS. (Please refer to the extra sheet attached for problem statement).		
8	TSC: Trouble Shooting Competition	TSC Manual	5
		Total	40

References:

[1] DLIC Laboratory Manual

[2] D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age InternationalPublishers, 4th Edition.

[3] David A. Bell, "Operation Amplifiers and Linear Integrated Circuits", Oxford UniversityPress, Indian Edition.

[4] Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall,4th Edition.

[5] Analog System Trainer, Texas Instruments Laboratory Manual

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL52	Micro-Architectures Lab	--	--	2	--	--	2	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		20		60

Pre-requisite Course Codes		EL52 (Principles of Microprocessors and Microcontrollers)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Implement an instruction set of 8086 microprocessor to execute the given task on given platform
	CO2	Program and interface 8-bit microcontroller
	CO3	Program and interface 16-bit microcontroller
	CO4	Program and interface ARM based microcontrollers

Exp No.	Experiment Details	Ref.	Marks
1.	Write a program to execute the given task on 8086 platform.	1	5
2.	Write a program to study interfacing of 8086 to various peripherals	1	5
3.	Programming and Interfacing of 8-bit 8051 Microcontroller (e.g. 898S51/52)	2	5
4.	Programming and Interfacing for utilization of various on-chip resources of 8-bit 8051 Microcontroller (e.g. 89S51/52)	2	5
5.	Programming and Interfacing for utilization of various on-chip resources of 16-bit Microcontroller (e.g. MSP430)	3	5
6.	Programming and Interfacing of 16-bit Microcontroller (e.g. MSP430)	3	5
7.	Programming and Interfacing of ARM based microcontrollers (e.g. PSoC)	4	5
8.	Programming and Interfacing for utilization of various on-chip resources of ARM based microcontrollers (e.g. PSoC)	4	5
	Total		40

Recommended Books:

[1] Douglas Hall,"Microprocessor and Interfacing", TMH Publication

[2] Muhammad Ali Mazidi, Janice G. Mazidi and R. D. McKinlay "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson.

[3] Uses manuals and application notes from Texas Instruments

[4] User manuals and application notes from Cypress Semiconductor

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL 53	Signals & Systems Lab	--	--	02	--	--	01	01
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	EL54: Signals & Systems	
At the end of the course students will be able to		
Course Outcomes	CO1	Examine sampling and reconstruction
	CO2	Analyze System performance in frequency domain
	C03	Adapt open source tools for signal processing application
	CO4	Evaluate Linear filtering using fast FFT

Expt. No.	Suggested Topics for Experiments	Ref.	Marks
1	Sampling and Reconstruction	2,3	5
2	Convolution time domain operation	2,3,4	5
3	Correlation time domain operation	2,3,4	5
4	Zero State Response of IIR System	2,3,4	5
5	Zero State Response of FIR System	2,3,4	5
6	Frequency Response of System	2,3,4	5
7	Discrete Fourier Transform	2,3,4	5
8	Fast Fourier Transform	2,3,4	5
9	Energy evaluation in time and frequency domain	2,3,4	5
10	Linear Filtering using FFT	2,3,4	5
	Eight Experiments Total Marks		40

References

[1] Vinay Ingle & John Proakis, "Digital Signal Processing using MATLAB", Cengage Learning, 2012

[2] A. NagoorKani, "Signals & Systems", McGraw Hill Education (India) Pvt Ltd,14th Ed.

[3] S.Salivahanan, AVallavaraj, C Gnanapriya, "Digital Signal Processing", Tata McGraw Hill, 1stEdition.

[4] John Proakis and DimitrisMonolakis, "Digital Signal Processing", PearsonPublication, 4th Ed.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL55	Instrumentation Lab	--	01	02	--	01	01	02
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes		ELL34: Electronics Instruments and Measurement
At the end of the course students will be able to		
Course Outcomes	CO1	Describe the applications of different sensors, transducers, relays, contactors
	CO2	Design a pneumatic control system using PLC.
	CO3	Manipulate the hydraulic system using simulation software.
	CO4	Operate the PLC to control external circuit.
	CO5	Recognize the symbols used in pneumatic and hydraulic system.
	CO6	Obtain the PID characteristics

During tutorials, theoretical concepts required for performing the following experiments shall be taught. Content delivery for tutorials can be done through videos, ppt, animations, chalk & board and simulation software's. Teacher can use any assessment method for assessing the attainment of learning outcomes.

Sr. No.	Suggested List of Experiments	CO	Marks
1	Design hydraulic system which drives motor, pump, valves and hydraulic cylinders using SIM hydraulic simulation software.	2	5
2	Perform and experiment to identify the fault in the given digital flow indicator using Turbine Sensor and estimate the cost of each component with specification.	1	5
3	Design the Pneumatic circuit to operate the following. a. 5/3 way hand lever valve b. 5.2 way push button valve c. 5/2 way single solenoid valve d. 5/2 way double solenoid valve e. Cylinder and 5/2 way direction control valve f. Connection of contactors with self holding g. Automatic return control of a double acting cylinder	2,5	5

4	Perform an experiment to Simulate ladder diagram with PLC. Design basic gates using ladder diagram. Interface lamp and motor to PLC.	4	5
5	Design a PLC based pneumatic control circuit To operate double acting cylinder using 5/2 double solenoid valve with push button. To operate single acting cylinder using 5/2 single solenoid valve with push button.	2,4	5
6	Design a PLC based pneumatic control circuit To operate single acting cylinder using 5/2 single solenoid valve with timer base. To operate double acting cylinder using 5/2 double solenoid valve with sensors.	2,4	5
7	To design and simulate PID controller for process control application of plant/ Temperature control system using PLC / SCADA/ HMI	6	5
8	Demonstrate and perform an experiment on flow control with virtual lab set up.	3	5
	Total		40

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELP56	Action Research Project-I	--	--	2	--	--	2	1
		Examination Scheme						
		ISE			MSE		ESE	Total
		Phase-I:10 Phase-II:10 Phase-III:10 Phase-IV:10			--		20	60

Pre-requisite Course Codes	All the Courses till Vth Semester.

Action research is an opportunity to make a difference in the experience of education in its own way. It is an attempt of scientific study of the problem in surrounding in order to guide, correct and evaluate the actions and decisions about it. Action research is based on small research project correlating scientific knowledge and day to day experience which encourages development of scientific attitude to solve real life problems among students.

The Objectives of Action Research are:

- ✓ To make students sensitive towards societal issues
- ✓ To learn scientific principles from day-to-day experiences
- ✓ To develop psychotechnological skills through observation, classification, statement of hypothesis etc.
- ✓ Development of communication, organizational skills and maturity through discussion, presentation etc.
- ✓ To develop ability to correlate science, technology and society
- ✓ To apply engineering knowledge and propose innovative, sustainable solutions to the real life challenges

Steps of action research:

- ✓ Keen observation of the surrounding/society
- ✓ Identification of the problem
- ✓ Analysis of the problem
- ✓ Collection of relevant information by formulating research questions
- ✓ Suggesting plan of action
- ✓ Conducting experiments
- ✓ To draw conclusion
- ✓ To find the possible solution to rectify the problem

- ✓ To execute experiments and remedial measures wherever possible

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them.

Students must ensure that problem to be solved in manageable in one semester.

Teachers must follow the below mentioned principles:

- ✓ Make student confront problem solving
- ✓ Develop methods and techniques of handling problems. Teach how to use the methods and not directly give solution to the problem.
- ✓ Empasize positive thinking
- ✓ Lead the students to the peak of their powers for improvement of better learning.

Criteria of a good project:

- ✓ Appropriate idea, clear understanding and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Efforts taken towards implementation
- ✓ **Desirability, Feasibility and Viability in real life**

The H/W and S/W resources required to complete the Action Research Project I may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on • Learning additional skills • Development of ability to define and design the problem and lead to its accomplishment with proper planning • Learn the behavioral discipline by working in a team. The team may be maximum three (03) students.

Evaluation:

Project report should be submitted on A-4 size pages. Use both printing. Report must carry project title, student details, certificate and acknowledgements. Other sections of the report shall be decided by the department based on projects. But it must have introduction, necessity of project, objectives, hypothesis ("If I do….then I may get…."), plan, observations, analysis of results, conclusion and references along with other sections related to technology.

The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. ISE marks will be based on the performance of the individual student in four phases of evaluation. The

evaluation of the Phase-I will be based on presentation of the market/literature survey, problem definition and project title finalization. Evaluation of Phase-II will be based on circuit/algorithm design, purchase of H/W and S/W resources, simulation/testing of circuit/algorithm. Phase-III evaluation will consist of PCB design, PCB making/verification of algorithm and testing of circuit/algorithm. Phase-IV evaluation is based on demonstration, poster presentation, technical report and paper writing during Action Research Project I contest.

The ESE marks will be based on demonstration in front of the expert appointed by the Department. In the ESE examination each individual student would be assessed for his/her contribution in selecting the originality of the problem statement, understanding and knowledge gained about the task completed through presentation/demonstration, work done, and preparing the technical report/poster/technical paper of the project in the standard format provided by the Department.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MEC3	Industrial and Organizational Psychology	2	-	-	2	-	-	2
		Examination Scheme						
		ISE1		ISE2	Attendance		Total Marks	
		20		20	10		50	

Pre-requisite Course Codes		---
Course Objectives	CO1	To impart knowledge and understanding of the basic concepts in and various facets of Industrial and Organizational Psychology
	CO2	To create awareness about the role and importance of Psychological factors and processes in the world of work
	CO3	To create a foundation for higher education and a professional career in Industrial Psychology and Organizational Behavior

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Theories of Employee Motivation**	1, 2	**05**
	1.1	What is motivation? Work motivation theories, need theories		
	1.2	Other Theories - Reinforcement theory, expectancy theory and self-efficacy theory; Justice theories, goal-setting theory, control theory and action theory		
2		**Feelings about Work: Job Attitudes and Emotions**	1,2	**07**
	2.1	The nature of job satisfaction; how people feel about their jobs; the assessment and antecedents of job satisfaction		
	2.2	Potential effects of job satisfaction; organizational commitment and emotions at work		
3.		**Productive and Counterproductive Work Behavior**	1,2	**05**
	3.1	Productive work behavior: ability, motivation, personal characteristics and task performance; environmental conditions and task performance; organizational constraints; organizational citizenship behavior (OCB)		
	3.2	Counterproductive work behavior: withdrawal – absence, lateness, turnover; aggression, sabotage, and theft; labor unrest and strikes.		
4.		**Leadership and Power in Organizations**	1,2	**06**
	4.1	What is leadership? Sources of influence and power; abuse of supervisory power: sexual and ethnic harassment		
	4.2	Approaches to the understanding of leadership; women in leadership positions; cross-cultural issues in leadership		
5.		**Organizational Development and Theory**	1,2	**05**
	5.1	Organizational Development		
	5.2	Organizational Theories		

Total	**28**

Books Recommended:

1. Spector, P. E. (2012). Industrial and Organizational Psychology: Research and Practice. Singapore: John Wiley & Sons Pte. Ltd. (Indian reprint 2015)
2. Schultz, D., & Schultz, S. E. (2010). Psychology and Work Today.(10th ed.). Pearson Prentice Hall

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MEC4	Law for Engineers	2	-	-	2	-	-	2
		Examination Scheme						
		ISE1		ISE2	Attendance			Total Marks
		20		20	10			50

Pre-requisite Course Codes		---
Course Outcomes	CO1	Student will be able to recognize the importance of the legal system, and the controls it exerts on the activities of engineers in practice.
	CO2	Student will be able to express the details of what the individual's responsibilities are to ensure legal behaviour in engineering practice.

This course is a survey of legal topics relevant to engineers, including basic of legal system, labor law, intellectual property, torts, and contracts. This is an introductory course, emphasizes on legal principles that can provide engineers with the ability to recognize legal issues that are likely to arise in the engineering profession.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	General Principles of Contract under Indian Contract Act, 1872.	1	4
	1.2	**Introduction to Human Rights.** Enforcement of Human Rights in India including Supreme Court, High Courts, Statutory Commissions– NHRC, NCW, NCM, NC-SC/ST etc.	1	
2	2.1	**Right to Information Act, 2005**: Evolution and concept; Practice and procedures; Official Secret Act, 1923; Indian Evidence Act, 1872.	1	4
	2.2	**Information Technology**– legislation and procedures, Cyber crimes – issues and investigations.	1	
3	3.1	**Labor Laws:** Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmens Compensation Act, 1923.	1	12
	3.2	Apprentices Act, 1961. Bonded Labor System (Abolition) Act, 1976. Child Labor (Prohibition and Regulation) Act, 1986. Contract Labor (Regulation and Abolition) Act, 1970.	2,3	
	3.3	Employees' Provident Funds and [Miscellaneous Provisions] Act,	2,3	

		1952. Employees' State Insurance Act, 1948. Equal Remuneration Act, 1976. Factories Act, 1948. Fatal Accidents Act, 1855. Industries (Development and Regulation) Act, 1951. Maternity Benefit Act, 1961. Minimum Wages Act, 1948. Payment of Bonus Act, 1965. Payment of Gratuity Act, 1972. Payment of Wages Act, 1936. Trade Unions Act, 1926.		
4	4.1	Law relating to Intellectual property Law relating to Copyright in India. Law relating to Trademarks under Trademark Act, 1999. Law relating to Patents under Patents Act, 1970.	1	4
5	5.1	**Corporate Law**: Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions; Law and multinational companies – International norms for control, FEMA 1999, Corporate liability, civil and criminal. Election provisions under Indian Constitution (Art.324–329): Representation of Peoples Act and Prevention of Corruption Act, 1988;	1	4
			Total	**28**

Books Recommended:

[1] Nikita Agarawal and Rishi Kumar, "Laws for Engineers," Genius Publications.

[2] P. L. Malik Handbook of Labour and Industrial Law, Eastern Book Company

[3] Industrial labour and general laws, The Institute of Company Secretaries of India

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ABL3: Creative Thinking, Diversity and Workplace Etiquette

I. Creative Thinking:

Organizations thrive on innovative ideas and new answers to old problems. To become successful not only these approaches be fresh, they must also be sound. This activity shall inspire students to push them for critical thinking and decision making. Students may be asked to provide innovative solutions to specific issues within the organization to meet business needs. Through this activity students shall learn how to step out of their comfort zone, able to isolate problems, recognize differences between left brain and right brain thinking, and apply creative thinking techniques to business problems.

II. Diversity:

Nowadays students are becoming global and degree from an accredited institute is considered as 'Educational Passport' hence it is necessary to include training on diversity. Training on working in a culturally diverse team to prepare students for an international work is required. A better understanding of others can improve communication, encourage engagement, reduce inappropriate behavior and increase the strength of a team. A strategy of inclusion can also help employees realize their full workplace potential. Activities shall be planned for diversity awareness, unconscious bias, generational differences, communicational style preferences and tactics for managing heterogeneous teams. Igniting thought provoking questions and conversations related to diversity in race, gender, culture, age and other observable differences shall be fundamental to this activity. Activity shall also address cognitive biases which are influences that cause us to make decisions based on information outside of logic and rational thinking for example behavioral partiality and social favoritism.

III. Workplace Etiquette:

Organizations expect that employees are aware of workplace expectations and etiquette. While the use of good business etiquette will not make up for technical knowledge in the workplace but bad manners and poor etiquette can cost both employees and organizations for which they work. This activity shall focus on ins and outs of business etiquette by managing technology and social media effectively. Activity shall be based on Cell phone etiquette, Email etiquette, social media etiquette, board meeting etiquette, sales meeting etiquette, business dressing and dining skills, international manners along with exceptional etiquette like hosting corporate guests, interacting with public or customers and business networking.

Methodology:

Guest lectures by professionals shall be arranged on Creative Thinking, Diversity and Workplace Etiquette. At least one lecture on each topic shall be taken. Assessment shall be based on performance in following activities:

1. Short Film Making
2. Skit Performance
3. Poster Presentation
4. Project Presentation
5. Physical Model Presentation
6. Scientific Case Study

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Semester VI

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL61	VLSI Design	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		ES11: Basic Electrical & Electronics Engineering EL31: Analog Electronics-I EL32: Digital Circuits EL41: Analog Electronics-II
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Distinguish between technologies and MOSFET models
	CO2	Analyze MOSFET based circuits like inverters, logic circuits and semiconductor memories
	CO3	Design MOSFET based logic circuits with different design styles
	CO4	Design data path for adders, multipliers and shifters
	CO5	Discuss issues in VLSI Clocking and System Design

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Technology Trend**		04
	1.1	**Technology Comparison:** Comparison of BJT, NMOS and CMOS technology	1	
	1.2	**MOSFET Scaling:** Types of scaling , MOSFET capacitances	1	
2		**MOSFET Inverters**		10
	2.1	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters, CMOS Latch-up	1	
	2.2	**Logic Circuit Design:** Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter	1	
3		**MOS Circuit Design Styles**		10
	3.1	**Design Styles:** Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino, NORA, Zipper, C^2MOS	1,7	
	3.2	**Circuit Realization:** SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, decoder using above design styles	1,7	
4		**Semiconductor Memories**		06
	4.1	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits),	1,2	

		Flash (mechanism, NOR flash, NAND flash)		
	4.2	**Peripheral Circuits:** Sense amplifier, decoder	1,2,3	
5		**Data Path Design**		**06**
	5.1	**Adder:** Bit adder circuits, ripple carry adder, CLA adder	7	
	5.2	**Multipliers and shifter:** Partial-product generation, partial-product accumulation, final addition, barrel shifter	7	
6		**VLSI Clocking and System Design**		**06**
	6.1	**Clocking:** CMOS clocking styles, Clock generation, stabilization and distribution	2,5,6	
	6.2	**Low Power CMOS Circuits:** Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling	5,6	
	6.3	**IO pads and Power Distribution:** ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme	5,6	
	6.4	**Interconnect:** Interconnect delay model, interconnect scaling and crosstalk	5,6	
			Total	**42**

References:

[1] Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design", Tata McGraw Hill, Third Edition.

[2] Jan M. Rabaey, AnanthaChandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, Second Edition.

[3] Etienne Sicard and Sonia DelmasBendhia, "Basics of CMOS Cell Design", Tata McGraw Hill, First Edition.

[4] Neil H. E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, Third Edition.

[5] Debaprasad Das, "VLSI Design", Oxford, First Edition.

[6] Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Circuit Design", Wiley, Student Edition.

[7] John P. Uyemura, "Introduction to VLSI Circuits and Systems", Wiley, Student Edition, 2013.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL62	Power Electronics	3	--	--	3	--	--	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		Analog Electronics-I (EL31) Analog Electronics-II(EL41)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Interpret tradeoffs involved in power semiconductor devices.
	CO2	Analyze different types of controlled rectifiers
	CO3	Analyze different types of inverters
	CO4	Analyze DC-DC convertors (choppers)
	CO5	Analyze AC-AC converters

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview of Power Semiconductor Devices**		
	1.1	Principle of operation, characteristics, rating and applications of**:** SCR**,** TRIAC, GTO, MOSFET and IGBT	2	12
	1.2	Basic Gate Drive circuits for SCR, GTO, MOSFET and IGBT	2, 3	
	1.3	Reliability and protection of Thyristor.	3, 7	
2		**Line CommutatedConverters**		10
	2.1	Operation and performance analysis of Single-phase Half wave controlled rectifier, Full wave (bridge) Controlled rectifier, Semi-converter, Dual converter with R and R-L load.	1, 4	
	2.2	Operation and performance analysis of three-phase half controlled and fully controlled rectifiers with R load.	1, 4	
3		**Inverters**		10
	3.1	Operation and performance analysis of Single-phase half /full bridge voltage source inverters with R and R-L load, three phase bridge inverters (120^o and 180^o conduction mode) with R and R-L load	1, 5	
	3.2	Single phase inverters using PWM techniques, harmonic neutralization of inverters, applications of inverters.	5	
4		**Choppers**		06
		Basic principle of step up and step down chopper, operation of four quadrant chopper. Buck, Boost, Buck-Boost, Cuk regulators, Applications of chopper.	1, 5	

5		**AC Voltage Controllers and Cycloconvertors**		04
	5.1	Principle of On-Off control, principle of phase control, single phase bidirectional control with R and RL load.	1, 5	
	5.2	Introduction, single phase Cycloconverters, applications.	1, 5	
			Total	**42**

Recommended Books:

[1] M. H. Rashid, "Power Electronics", Prentice-Hall of India, Third Edition.

[2] Ned Mohan, "Power Electronics", Undeland, Robbins, John Wiley Publication, Third Edition.

[3] Ramamurthy, "Thyristors and Their Applications", East-West Press, Third Edition.

[4] VedamSubramanyam, "Power Electronics", New Age International, Second Edition.

[5] M.D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw Hill, Second Edition.

[6] P. C. Sen, "Modern Power Electronics", Wheeler Publication, Second Edition.

[7] Alok Jain, "Power Electronics and its Applications", Penram International Publishing (India) Pvt. Ltd, Second Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL 63	Digital Communication	3	--	--	3	--	--	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	EL44: Fundamentals of Communication Engineering EL54: Signals and Systems	
Course Outcomes	At the end of the successful completion of the course students will be able to	
	CO1	Model various entities of digital communicationsystem mathematically
	CO2	Identify source and channel coding techniques
	CO3	Explain techniques to enhanced transmission efficiency of the system
	CO4	Describe digital modulation formats and its properties
	CO5	Demonstrate the use of error control and spread spectrum techniques in wired

Module No.	Unit No.	Topics	Ref.	Total Hrs.
1	1.1	Information theory and source coding: Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and it's properties.	1,2,3	06
	1.2	Source Coding, Shannons Source Coding Theorem, Shannon-Fano, Huffman coding, information and channel capacity, channel coding theorem, channel capacity theorem.		
2	2.1	Pulse Shaping for Optimum Transmission : Line codes and their desirable properties, Concept of inter-channel and inter-symbol interference, eye pattern.	1,2,3	08
	2.2	Concept of equalizer to overcome ISI, Nyquist criterion for distortionless transmission, Duo-binary encoding and modified duo-binary encoding.		
3	3.1	Digital Modulation Techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK), Modulation, Quaternary Phase Shift Keying QPSK), Mary PSK, Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying	1,2,3	12

		(MSK)		
	3.2	Comparison between bandwidth and bit rate, applications of digital modulation schemes		
4	4.1	Error Control Systems: Types of error control, error control codes, linear block codes, generator matrix, systematic linear block codes, parity check matrix,	1,2,4	12
	4.2	Cyclic codes: Algebraic structure of cyclic codes, binary cyclic code properties, encoding in systematic form, circuits for dividing polynomials, systematic encoding with shift register and error detection.		
	4.3	Convolution Codes: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram		
5	5.1	Spread Spectrum Modulation: Need for spread spectrum modulation, pseudo noise sequence generation, direct-sequence spread spectrum (DSSS)	1,2,4	04
	5.2	Processing gain and jamming margin, frequency–hop spread spectrum (FHSS)		
			Total	42

References

[1] Taub Schilling AndSaha, "Principles Of Communication Systems", Tata Mc-Graw Hill, Third Edition.

[2] Simon Haykin, "Communication System", John Wiley And Sons, Fourth Edition

[3] Amitabha Bhattacharya, "Digital Communication", Tata Mcgraw Hill, Edition 2006

[4] John G. Proakis, "Digital Communications", Mcgraw Hill, Fifth Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL61	VLSI Design Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			--		--	40

Pre-requisite Course Codes		ELL33 Digital Circuits Lab
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Make use of simulation tools to verify characteristics of MOSFET based circuits
	CO2	Set-up simulation environment for VLSI circuit simulation
	CO3	Observe characteristics of MOSFETS via simulation
	CO4	Discuss tradeoffs in VLSI circuits by observing simulation results
	CO5	Validate design of MOSFET based circuits
	CO6	Reproduce the given abstract of the IEEE paper

Exp. No.	Suggested List of Experiments	Ref.	Marks
1	To Analyze NMOS and PMOS Transistor characteristics.	1,2	5
2	To simulate Resistive Load Inverter and CMOS Inverter, verify the VTC. Compare both the topologies. Comment on the Noise Margins.	1,2	5
3	Implement CMOS NAND, NOR, AND, OR using Static CMOS Logic.	1,2	5
4	Design and Implement given Boolean equation using different CMOS Logic styles.	1,2	5
5	Simulate Pseudo NMOS Inverter and comment on the result.	1,2	5
6	Simulate 6 Transistor SRAM and check the read and write stability	1,2	5
7	Design and Implement given equation using Pseudo NMOS ,Domino Logic and C^2MOS Logic	1,2	5
8	Simulate Clocked JK and D Flip Flop using Static CMOS Logic.	1,2	5
		Total Marks	40

References:

[1] Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition.

[2] Etienne Sicard and Sonia DelmasBendhia, "*Basics of CMOS Cell Design*", Tata McGraw Hill, First Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL62	Power Electronics Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			--		20	60

Pre-requisite Course Codes		ELL34 Electronics Instruments and Measurements Lab
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Analyze performance of power semiconductor switches and their firing circuits.
	CO2	Evaluate different performance parameters of rectifiers
	CO3	Design a Voltage Source Inverters using a simulation tool.
	CO4	Design DC-DC converters for given specifications.
	CO5	Evaluate different performance parameters of AC Voltage controller.

Exp. No.	Experiment Details	Ref.	Marks
1	To plot SCR Characteristics and analyze different Firing Circuits	3	5
2	To plot IGBT/MOSFET Characteristics and analyze different Firing Circuits	2	5
3	To analyze Single phase Line Commuted Semi-converter	1	5
4	To analyze Single phase Line Commuted Full Converter	1	5
5	To model a 3 Phase Voltage Source Inverter using a simulation tool	6	5
6	To design the Buck Converter for given specifications.	2	5
7	To design the Boost Converter for given specifications.	2	5
8	To design AC Voltage controller using TRIAC	5	5
		Total Marks	40

Recommended Books:

[1] M. H. Rashid, "Power Electronics", Prentice-Hall of India, Third Edition.
[2] Ned Mohan, "Power Electronics", Undeland, Robbins, John Wiley Publication, Third Edition.
[3] Ramamurthy, "Thyristors and Their Applications", East-West Press, Third Edition.
[4] VedamSubramanyam, "Power Electronics", New Age International, Second Edition.
[5] M.D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw Hill, Second Edition.
[6] P. C. Sen, "Modern Power Electronics", Wheeler Publication, Second Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL63	Fundamentals of Operating System Lab	--	1	2	--	1	1	2
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			--		--	40

Pre-requisite Course Codes		ESL14: Programming Methodology and Data Structures Lab ELL36: Object Oriented Programming Lab EL43: Computer Organization and Architecture
After successful completion of the course, student will be able to:		
Course Outcomes	CO1	To understand OS and install, configure the system
	CO2	To explain memory management and Scheduling algorithms
	CO3	To discuss File and Disk Management
	CO4	To create user and set user policy and to install software packages
	CO5	To outline Kernel Services and Synchronization
	CO6	To configure network and server and write shell scripts

Module No.	Unit No.	Suggested List of Experiments	Ref.	Hrs.
1	1.1	**OS Fundamentals** Operating system objectives and functions, Evolution of OS, Characteristics of modern OS, Basic concepts: Processes, Files, System calls, Shell, Kernel architectures: Monolithic, Micro-kernel, Layered, Kernel mode of operations.	1,4,6	2
2	2.1	**Booting Process** Using the System(Booting and login), User Management	4	2
3	3.1	**Memory Management** Memory Management Requirements, Memory Partitioning, Virtual memory: Paging; Segmentation; Page replacement policies, page faults	4,5,6	2
4	4.1	**Multiprocessor and Real-Time Scheduling**: Multiprocessor Scheduling,Real-Time Scheduling, Linux Scheduling, UNIX processScheduling	1,5	2
5	5.1	**File System Management** Files-System Structure, File System implementation, Directory implementation, Allocation Methods contiguous allocation, linked list allocation, indexed allocations, Free space management.	1,5	2

6	**6.1**	**Disk Management** Disks Scheduling Algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, Disk Management	1,5	2
7	**7.1**	**Kernel Services and Compilations** Kernel Synchronization, Kernel Service Requests, Synchronization Primitives, Kernel Data Structures, Race Condition Prevention, Kernel Wrapper Routines	6	2
			Total	**14**

References:

[1] William Stallings, Operating Systems: Internals and Design Principles, 8th edition, Pearson Education Limited, 2014
[2] John Muster, "Introduction to Unix and Linux", Tata McGraw Hill
[3] Roderick W. Smith, "LPIC-1"
[4] Andrew S. Tanenbaum, Herbert Bos, "Modern Operating System", 4th edition, Pearson
[5] Silberschatz, Galvin, Gagne, "Operating System Concepts", 8 Edition, Wiley Student Edition
[6] Daniel Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publication
[7] Sumitabha Das, "UNIX, concepts and applications", 4th edition, Tata McGraw Hill
[8] Michael Palmer, "Guide to UNIX Using Linux", Fourth Edition, Cengage Learning
[9] William E. Shotts Jr, "The Linux Command Line: A Complete Introduction", 1st Edition,No Starch Press, Inc

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELL 64	Signal Processing Lab	--	--	02	--	--	01	01
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	EL53: Microprocessor and Microcontrollers EL54 : Signals & Systems ELL54: Signals & Systems Lab	
At the end of the course students will be able to		
Course Outcomes	CO1	Compare various DSP processors
	CO2	Implement Fast Fourier Transform Algorithm
	C03	Demonstrate Real Time Signal Processing using DSP Processor
	CO4	Develop Signal Processing Application

Expt. No.	Suggested List of Experiments	Ref.	Marks
1	Comparison of fixed point & floating point DSP processors	5,6	5
2	Demonstration of DSP processor tools & development platform – Code Compose Studio and TMS320 SDK board	5,6	5
3	Generation of harmonic oscillator using code composer studio	1,2	5
4	DSP peripheral initialization & experimentation	1	5
5	Measurement of degree of similarity using Correlation Algorithm OR Hardware Implementation of Convolution Algorithm	3,4	5
6	Hardware Implementation of Discrete Fourier Transform OR Hardware Implementation of Fast Fourier Transform	3,4	5
7	Linear FIR filtering using Overlap Add Method or Overlap Save Method	3,4	5
8	Application development	4,7	5
		Total Marks	40

References:

[1] B. Venkatramani& M. Bhaskar, "Digital Signal Processors", McGraw Hill Education (India) Pvt Ltd, 2nd Edition 2012

[2] Vinay Ingle & John Proakis,"Digital Signal Processing using MATLAB ", Cengage Learning, 2012

[3] S.Salivahanan, AVallavaraj, C Gnanapriya, "Digital Signal Processing", Tata McGraw Hill, First Edition.

[4] John Proakis and DimitrisMonolakis, "Digital Signal Processing", PearsonPublication, Forth Edition.

[5] Web references:

[6] Technical Reference Manual, Texas Instrumenthttp://www.ti.com/lit/ug/spruh79c/spruh79c.pdf

[7] Digital Signal Processorshttp://www.ti.com/processors/dsp/overview.html?

[8] Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing"http://www.dspguide.com/pdfbook.htm

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELP65	Action Research Project-II	--	--	2	--	--	2	1
		Examination Scheme						
		ISE			MSE		ESE	Total
		Phase-I:10 Phase-II:10 Phase-III:10 Phase-IV:10			--		20	60

Pre-requisite Course Codes	All the Courses till Vth Semester.

Action research is an opportunity to make a difference in the experience of education in its own way. It is an attempt of scientific study of the problem in surrounding in order to guide, correct and evaluate the actions and decisions about it. Action research is based on small research project correlating scientific knowledge and day to day experience which encourages development of scientific attitude to solve real life problems among students.

The Objectives of Action Research are:

- ✓ To make students sensitive towards societal issues
- ✓ To learn scientific principles from day-to-day experiences
- ✓ To develop psychotechnological skills through observation, classification, statement of hypothesis etc.
- ✓ Development of communication, organizational skills and maturity through discussion, presentation etc.
- ✓ To develop ability to correlate science, technology and society
- ✓ To apply engineering knowledge and propose innovative, sustainable solutions to the real life challenges

Steps of action research:

- ✓ Keen observation of the surrounding/society
- ✓ Identification of the problem
- ✓ Analysis of the problem
- ✓ Collection of relevant information by formulating research questions
- ✓ Suggesting plan of action
- ✓ Conducting experiments

- ✓ To draw conclusion
- ✓ To find the possible solution to rectify the problem
- ✓ To execute experiments and remedial measures wherever possible

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them.

Students must ensure that problem to be solved in manageable in one semester.

Teachers must follow the below mentioned principles:

- ✓ Make student confront problem solving
- ✓ Develop methods and techniques of handling problems. Teach how to use the methods and not directly give solution to the problem.
- ✓ Empasize positive thinking
- ✓ Lead the students to the peak of their powers for improvement of better learning.

Criteria of a good project:

- ✓ Appropriate idea, clear understanding and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Efforts taken towards implementation
- ✓ **Desirability, Feasibility and Viability in real life**

The H/W and S/W resources required to complete the Action Research Project I may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on • Learning additional skills • Development of ability to define and design the problem and lead to its accomplishment with proper planning • Learn the behavioral discipline by working in a team. The team may be maximum three (03) students.

Evaluation:

Project report should be submitted on A-4 size pages. Use both printing. Report must carry project title, student details, certificate and acknowledgements. Other sections of the report shall be decided by the department based on projects. But it must have introduction, necessity of project, objectives, hypothesis ("If I do….then I may get…."), plan, observations, analysis of results, conclusion and references along with other sections related to technology.

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The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. ISE marks will be based on the performance of the individual student in four phases of evaluation. The evaluation of the Phase-I will be based on presentation of the market/literature survey, problem definition and project title finalization. Evaluation of Phase-II will be based on circuit/algorithm design, purchase of H/W and S/W resources, simulation/testing of circuit/algorithm. Phase-III evaluation will consist of PCB design, PCB making/verification of algorithm and testing of circuit/algorithm. Phase-IV evaluation is based on demonstration, poster presentation, technical report and paper writing during Action Research Project II contest.

The ESE marks will be based on demonstration in front of the expert appointed by the Department. In the ESE examination each individual student would be assessed for his/her contribution in selecting the originality of the problem statement, understanding and knowledge gained about the task completed through presentation/demonstration, work done, and preparing the technical report/poster/technical paper of the project in the standard format provided by the Department.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
HSS61	Advance Communicative English	2	2	--	2	1	--	3
		Examination Scheme						
		ISE*			MSE		ESE	Total
		100			--		--	100

* ISE will be evaluated on the basis of marks scored in tutorials, out of 100.

Pre-requisite Course Codes		The learners will be able to
Course Outcomes	CO1	Acquire skills for succeeding in job placements and competitive exams
	CO2	Encourage reading and evaluating critically
	CO3	Develop proficiency in the use of spoken and written communication for professional purposes
	CO4	Communicate using social media

Module No.	Unit No.	Topics	Ref.	Hrs.
1 Placement Skills	1.1	Verbal Ability skills for competitive exam		3
	1.2	Resume Writing& Cover Letter		2
	1.3	Group Discussions		3
	1.4	Team Building skills / Work		2
	1.5	Case studies / pitching a startup		2
	1.6	Interview skills		2
2 Critical Thinking Skills	2.1	Understanding news coverage and critical analysis of the same		2
	2.2	Critical Writing Skills – Argumentative Writing		2
3 Communication through social media	3.1	Sourcing information through digital media		2
	3.2	Oral and written communication using social media. Vlog and Blog		4
	3.3	Corporate communication using social media like messenger applications, etc.		2
TOTAL				26

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Tutorial No.	Tutorial Details	Ref.	Marks
1	Aptitude Test – Verbal Ability		10
2	Resume Writing		10
3	Cover Letter		10
4	Group Discussion		20
5	Presentation		20
6	Mock Interview		10
7	Social media writing		20
	TOTAL MARKS		**100**

Reference Books:

1. Michael McCarthy and Felicity O'Dell. *English Vocabulary in Use.* India: Cambridge University Press, 1999.
2. John Eastwood. *Oxford Practice Grammar.* India: Oxford, 1999.
3. Geoffrey Leech, Et al. *English Grammar for Today.* UK: Palgrave, 2005.
4. Malhotra, Ankur. *Campus Placement: A comprehensive guide.* McGraw Hill Education, 2016
5. Hayes, John. *Interpersonal Skills at Work.*McGraw Hill Education, 2002
6. Alda, Alan. *If I Understood You, Would I Have This Look on My Face? My Adventures in the Art and Science of Relating and Communicating*. Random House. 2017
7. West, Steven. *Critical Thinking Skills: Practical Strategies for Better Decision making, Problem-Solving and Goal Setting*.
8. Isaac, William. *Dialogue: The art of thinking together*. Crown Business. 2008
9. Chambers, Harry. *Effective Communication Skills for Scientific and Technical Professionals Paperback.* Basic Books. 2000
10. Hamper, Robert J. & Baugh, L. Sue. *Handbook for writing proposals*. McGraw-Hill Education. 2010

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'Activity Based Learning'

ABL4: Technical Paper and Patent Drafting

This is non-credit activity conducted in semester VI for all the branches of engineering. This course aims to encourage students to study advancement in engineering developments, prepare a technical paper based on the research topic and give holistic insight on the various aspects of patents that would be relevant to them. Attendance and participation are an integral part of the course

A. Technical Paper Drafting:

Invited talks and workshop on latex shall be conducted to impart the knowledge in technical paper drafting and presentation.

The primary learning outcomes expected are:

- Knowledge about importance of paper publication
- Key parts of a technical paper and drafting related issues
- Submission and review process of paper
- Paper presentation related issues
- Ethical issues

Students will have to give the presentation of the topics and submit the technical paper based on IEEE format. Students are expected to prepare and present a topic on engineering/ technology, for the duration of about 8 to 10 minutes. Group of two or three students will present the topic and will submit the technical paper based on the topic. Each student will be evaluated based on the presentation and draft of technical paper.

B. Patent Drafting:

Invited talks and workshop shall be conducted to impart the knowledge in patent drafting.

The primary learning outcomes expected are:

- Knowledge about Intellectual Property & Patents
- Patent Searching
- Patent Drafting
- Patent Commercialization & Case Studies

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MEC1	French Language	2	-	-	2	-	-	2
		Examination Scheme						
		ISE1		ISE2	Attendance			Total Marks
		20		20	10			50

Pre-requisite Course Codes		---
Course Outcomes	CO1 Self introduction	Student will be able to Introduce themselves in a meeting and converse with people from different countries. Speak about themselves, their professions, their family, family names, first names, nationalities, ages. Have a discussion on the whereabouts and identities of people they interact with such as their nationalities, the countries they come from, the languages they speakGreet people and take leave
	CO2 General Topics	Student will be able to Count numbers from 0 to 69 To know how to talk about dates, seasons, time of the day, days of the week and months of the year. Know how to describe a noun using qualitative adjectives. ask price of something
	CO3 Dialogue with professor or any other interlocutor	Student will be able to Communicate in class and understand instructions such as :repeat/answer/listen/look/tick the rightanswer/write/underline/close/how is it pronounced/how is it written/how does one say/work in groups/I don't know/I do not understandrequest for directions using interrogatives like where/who speaks/to whom/whyshare /to give personal information: telephone numbers/ date of birth/ postal address/filling out documents and ability to comprehend the details on important identity papers such as passports or registration forms.
	CO4 Exposure to French Culture Life and Social Norms.	Student will be able to get from the Airport in France to his destination in city. To understand directions. To move around the city understanding road signs, maps. Will be acquainted with French Culture and hence understand their behaviour and communicate appropriately with them.

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Module No	Unit No	Topics	Ref	Hrs
1.	1.1	Alphabet		15mins
	1.2	Accents		30 mins
	1.3	Greetings: Good morning/ good afternoon/ good evening/ good night		15 mins
	1.4	Verb conjugation Ētre" (To be)		30 mins
	1.5	Gender : Masculine Feminine		30 mins
2.	2.1	Articles: Definite article:le / la / l'/ les Indefinite article :un/une/des Articles: Definite article:le / la / les		60 mins
	2.1	List of some Masculine and Feminine Nouns		30 mins
	2.2	List of Qualitative Adjectives (Describing big/small/adventurous/timid/pessimist/optimist)		30 mins
3.	3.1	Adjectives of colour and the rules: de quellecouleur?		60 mins
	3.2	Agreement of Number and Gender of the qualifying adjective with the noun		60mins
4.	4.1	3 groups of verbs depending on how they end. Conjugation of Regular "ER"		45 mins
	4.2	List of: commonly used "ER" and "ER" verbs used for student teacher communication.		15 mins
	4.3	Conjugation of "ALLER" which is an Irregular "ER" verb.		60mins
5.	5.1	Conjugation of Reflexive ER verb S'APPELER'		60 mins
	5.2	Conjugation of GER / CER verbs that are tricky		60 mins
6.	6.1	Frequently used expressions (thank you/glad to meet you/ sorry/please)		30 mins
	6.2	Singular and Plural		90 mins
7.	7.1	Nationalities		30 mins
	7.2	Languages		30 mins
	7.3	Days of the week		30 mins
	7.4	Months of the year		30 mins
8.	8.1	Forms of Membership/Admission/Candidature/registration "Formularizedinscription" Hotel Reservation		60 mins
	8.2	Dialogue development from arriving at the Airport to getting to your destination by Metro/RER/Taxi/Bus Directions to move		60 mins

		around the city / Metro Maps / Reaching Hotel or Youth Hostel		
9.	9.1	Theory for the 10 marks Project work. Paris, the capital of 1.Topography/Geography 2.History 3.Transport 4.Political and Financial / 5.Gastronomy 6. Current Affairs 7.Culture –Fashion/Literature/Art/Theatre/Films 8. Trade and Service Industries 9. Tourism and Monuments10. Ecological concerns		120 mins
10.	10.1	Professions		30 mins
	10.2	Family relations		30 mins
	10.3	Number counting: 0 to 69 Cardinal numbers Question: Combien de		60 mins
11	11.1	Possessive adjective: Mon/Ma/Mes Ton/Ta/Tes Son/Sa/Ses Notre/Notre/Nos Votre/Votre/Vos Leur/Leur/Leurs		120 mins
12.	12.1	Verb conjugation "AVOIR" to haveUsed to express age		120 mins
13.	13.1	Verb Conjugation of "FAIRE – to make / to do / to describe weather conditions Comment fait-ilaujourdhui? Quel temps fait-il? Il fait beau / Il fait chaud / Il fait froid / Il fait frais / Il fait du vent		60 mins
	13.2	Seasons: L'été /L'hiver / L'automne /Le printemps		60 mins
14.	14.1	Weather Comment fait-ilaujourdhui? Quel temps fait-il? Il fait beau / Il fait chaud / Il fait froid / Il fait frais / Il fait du vent		60 mins
	14.2	Ordinal Numbers		60 mins
			Total	**28 hours**

References:

1. ALTER EGO – Méthode de Français A1 (PUBLICATION: HACHETTE FRANÇAIS LANGUE ÉTRANGÈRE)
2. Annie Berthet / Catherine Hugot / Véronique M. Kizirian / Beatrix Sampsonis / Monique Waendendries
3. NOUVEAU TAXI: Méthode de Français - HACHETTE
4. GRAMMAIRE PROGRESSIVE DU FRANCAIS – NiveauDébutant- MaïaGrégoire – CLE International
5. OUI, JE PARLE FRANCAIS – 1 Méthode de Français MANAK BOOKS Prochy Master
6. A Revision French Grammar and Composition Book – BLACKBURN AND MORRIS
7. BLACKIE & SON PUBLISHERS PVT. LTD.
8. G. MAUGER – COURS DE LA LANGUE ET DE CIVILISATION FRANÇAISES

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		L	T	P	L	T	P	Total
MEC2	German Language	2	-	-	2	-	-	2
		Examination Scheme						
		ISE1		ISE2	Attendance			Total Marks
		20		20	10			50

Pre-requisite Course Codes		---
Course Outcomes	CO1	Student will be able to able to greet the other person, say good bye, introduce oneself and the partner, to be able to talk about the others, to be able to count upto 20, make use of knowledge of numbers as regards understanding telephone numbers, to be able to recognize alphabets, speak about countries and languages
	CO2	Student will be able to speak about hobbies, take leave of someone, name the days of the week, to be able to talk about work, jobs, and office timings, to be able to count beyond 20, to be able to talk about seasons, to be able to register own data on internet site
	CO3	Student will be able to name places and important buildings like the marketplace, to be able to ask questions regarding places, to be able to relate texts to a picture story, ask for things, name the means of public transport, ask for directions
	CO4	Student will be able to identify food items and to talk about them, to be able to write a shopping list, understand conversations in a supermarket, understand W-questions
	CO5	Student will be able to understand time, plan time table as per required time, to be able to speak about family, to excuse oneself for being late, to be able to fix an appointment telephonically
	CO6	Student will be able to plan something together, to be able to speak about birthday, to understand and draft an invitation, to be able to order and pay food items in a restaurant, to be able to talk about routine events, understand event information on radio

Module No.	Topics	Ref.	Hrs.
1	Guten Tag!	1,2	4
2	Freunde, Kollegen und ich	1,2	5
3	In der Stadt	1,2	5
4	GutenAppetit!	1,2	4
5	Tag fuer Tag	1,2	5
6	ZeitmitFreunden	1,2	5
Total			28

Books Recommended:

[1] NetzwerkA1:Authors - Stefanie Dengler, Paul Rausch, Helen Schmitz, Tanja Sieber

[2] Studio D A1:Authors - Funk, Kuhn, Demme

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE1	Consumer Electronics	1	--	2	1	--	1	2
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			10		20	70

Pre-requisite Course Codes		ES1: Basic Electrical and Electronics Engineering
After successful completion of the course, student will be able to		
Course Outcomes	CO1	List and classify devices used in consumer products based on their specifications, identify sub-systems of consumer electronic products,also choose and use proper interface standard for a given consumer electronic product
	CO2	Illustrate working principle of consumer electronic products and carry out basic tests to identify their correct operation.
	CO3	Experiment with Haptics, Multitouch devices, Device interconnects and peripherals and also suggest modification in consumer electronic product using modern tools to enhance user experience
	CO4	Assemble subsystem of Television set and analyze technology used in audio systems.
	CO5	Demonstrate working principal of Healthcare and home electronics consumer products.
	CO6	Demonstrate working principal consumer electronic products used in Occupational safety.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	**Introduction to consumer Electronic.**	4	02
	1.1	Haptics and Multi-touch Devices: Introduction to Touch panel, Capacitive Touch screen, Light pen.		
	1.2	Displays for Consumer Electronics: OLED Display, Alphanumeric Display, LED Display, LCD Display.		
	1.3	Miscellaneous Devices: Mice, Trackballs, Virtual Reality.		
	1.4	Gaming Devices; Joystick.		
2	2	**Device Interconnects and Peripherals.**	3	02
	2.1	Introduction to Serial Interfaces, RS-232, I2C, SPI, USB.		
	2.2	Introduction to ZIG-BEE Standards, WI-FI, Bluetooth, Thunderbolt, JTAG and various Interconnection standards.		

3	**3**	**Interactive and Immersive TV.**	1	02
	3.1	Introduction to Television, PAL TV System, NTSC TV System, SECAM TV System.		
	3.2	Advanced Television System: 3D TV, High Definition TV, Digital Satellite TV, 4K TV, Plasma Displays.		
4	**4**	**Audio System Technologies and Home electronics.**	1	02
	4.1	Introduction to Audio system and major components of Audio System, Microphone, Loudspeaker, HI-FI, Stereophony, Public Address System, Noise Cancelling Headphones.		
	4.2	Introduction to Home Electronics, Microwave Oven, Refrigerator, Air Conditioning System, Washing Machine.		
5	**5**	**Healthcare Electronics.**	6	02
	5.1	Wearable Devices: Activity Trackers Smart Watch, Smart Glass.		
	5.2	Fitness Devices: Blood Pressure Monitor, Digital Weighing Scale, Digital Glucometer.		
	5.3	Biomedical Devices: ECG Sensor, EKG Sensor, EMG Sensor, Respirators.		
6	**6**	**Consumer Electronics used in Occupational Safety.**	2	02
	6.1	Printers, Scanners, Projection System.		
	6.2	Bio-metric Devices: Finger Print Scanner, IRIS Scanner.		
	6.3	Security Devices: CCTV, Electronics Lock, Video Intercom System, Door bell.		
7	**7**	**New and Emerging Technologies.**	5	02
	7.1	E-platforms for Selecting Consumer Electronics.		
	7.2	E-payments.		
			Total	**14**

Teaching Learning Methodology in Laboratory: 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 the overall 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.	Suggested List of Experiments	Ref.	Marks
1	Experiment on Haptics and Multi-touch devices.	4	**5**
2	Experiment on Device interconnects and Peripherals (USB and Bluetooth).	3	**5**
3	Experiment on assembly of parts used in Television set.	1	**5**
4	Experiment on Audio system technology.	1	**5**
5	Experiment on Home electronics Consumer products.	2	**5**
6	Experiment on Wearable and fitness devices.	6	**5**
7	Experiment on Biomedical data acquisition devices.	5	**5**
8	Experiment on occupational safety in electronic devices.	2	**5**
	Assessment Marks		**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

[1] S. P. Bali, "Consumer Electronics", Pearson Education, 1st Edition, 2005.

[2] Peter H. Gregory, "*Biometrics for Dummies*", Wiley Publishing Inc., 2008.

[3] N. Mathivanan, "*PC Based Instrumentation: Concepts and Practices*", Prentice Hall Learning India Pvt. Ltd., 1st Edition, 2007.

[4] Deborah Morley, "*Understanding Computers: Today and Tomorrow*", Course Technology, 16th Edition, 2016.

[5] N. Jilovec, "*E-Business: Thriving in Electronics Marketplace*", 29th Street Press, 1st Edition, 2000.

[6] Sanjay Mishra, "Wearable Android: Android Wear and Google FIT App Development" , Wiley Blackwell publication, 1st Edition, 2015.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE2	Robotic Vision	1	--	2	1	--	1	2
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			10		20	70

Pre-requisite Course Codes		EL 42: Principle of Control Systems
At the end of the course students will be able to		
Course Outcomes	CO1	Discuss the fundamentals of Robotics
	CO2	Apply direct and inverse kinematics algorithms
	CO3	Justify the need of vision algorithms

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	**Fundamentals of Robotics**		4
	1.1	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames		
	1.2	Transformation matrix, inverse Transformation matrix,		
	1.3	Screw Transformation, Link co-ordinates		
2	2	Forward and Inverse kinematic equation, D-H Representation		4
	2.1	The Arm Matrix		
3	3	**Introduction to Robot Vision**		3
	3.1	Image Representation, Edge Detection		
	3.2	3D image to 2D image Transformation		
	3.3	Stereo Vision		
4	4	Edge Detection , Template Matching,		3
	4.1	Object detection and recognition		
	4.2	Object Classification		
		Total		14

Expt. No.	Suggested List of Experiments	Ref.	Marks
1	Identify the types of robot based on configuration and application.	1,2	5
2	Using the information based on length of links and no. of joints, specified angles verify the DH algorithm for forward kinematics and also to determine the maximum and minimum position of links.	1,2	5
3	Design a robots drive system and its end effectors for a given	1,2,3	5

	application.		
4	Verify the transformation (Position and orientation) with respect to gripper and the coordinate system using any simulation software.	1,2	5
5	Estimation of accuracy, repeatability and resolution of a given robotic manipulator.	1,2	5
6	Robot programming exercises (Point-to-point and continuous path programming)	1,2,3	5
7	Edge detection		4
8	Object Detection		4
9	Object recognition using Template Matching		4
10	Vision based Application development		4
	Eight Experiments Total Marks		40

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

[1] Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of IndiaFourth edition [ISBN-81-203-1047-0]

[2] Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E.

[3] Mittal R.K. & J. Nagrath, "Robotics and Control",TataMcGraw Hill, 2003 [ISBN 0-07-048293-4]

[4] Milan Sonka, Vaclav Hlavac and Roger Boyle,"Image Processing, Analysis and Machine Vision", Second Edition, Thomson Brooks/Cole 2004[ISBN: 981-240-061-3]

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE3	Cyber Security and Digital Forensics	1	-	2	1	-	1	2
		Examination Scheme						
		ISE		MSE	ESE			Total
		40		10	20			70

Pre-requisite Course Codes		Computer Basics, Networking basics
Course Outcomes	CO1	Identify and classify various cybercrimes with respect to organizational weaknesses in order to mitigate the security risk and estimate the impact on society and world
	CO2	Analyze the results of vulnerability scans of vulnerability assessment and generate report with penetration testing
	CO3	Apply Information Security Standards compliance during software design and development
	CO4	Interpret and apply Indian IT laws in various legal issues
	CO5	Describe the concept of Digital forensics and use various tools and techniques used for digital forensics investigations
	CO6	Integrate advanced security solutions and manage, provide policies, standards, procedures, guidelines, policy framework, assess and mitigate risk

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Cyber Security**	1,2	1
	1.2	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime,	1,2	1
	1.3	Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	1,2	1
2	2.1	**Cyber offenses & Cybercrimes:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector,Credit Card Frauds in Mobile and Wireless Computing Era, Security,Challenges Posed by Mobile Devices	1,2	1
	2.2	Tools and Methods Used in Cybercrime: Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks,Identity Theft (ID Theft)	1.2	1
3	3.1	**Security Risk Assessment and Risk Analysis:** Risk Terminology, Laws, Mandates, and Regulations,Risk	7,8, 10	1

		Assessment Best Practices,The Goals and Objectives of a Risk Assessment, Best Practices for Quantitative and Qualitative Risk Assessment.		
	3.2	**Vulnerability Assessment and Penetration Testing (VAPT):** VAPT An Overview,Goals and Objectives of a Risk and Vulnerability Assessment,	7,8, 10	1
	3.3	Vulnerability Assessment Phases-Discovery,Exploitation/Analysis , Reporting Penetration Testing Phases-Discover/Map,Penetrate Perimeter,Attack Resources, Network and Web VAPT Process	7.8, 10	1
4	**4.1**	**Cyber Security Laws and Legal Perspectives**	1,2, 4,6	1
	4.2	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	1,2, 4,6	1
	4.3	Information Security Standard compliances: SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI-DSS	1,2, 4,6	1
5	**5.1**	**Digital Forensics:** Need for forensics, Cyberforensics and Digital Evidence	1,2	1
	5.2	Digital Forensics Life cycle, Computer forensics investigation, setting-up forensics laboratory, Special Tools and Techniques, Forensics Auditing and Compliance Requirements,Antiforensics	1,2	1
	5.3	Forensics of Hand-held devices,Tool-kits for Hand-held device forensics,Techno-Legal Challenges with Evidence from Hand-held Devices	1,2	1
			Total	**14**

Teaching Learning Methodology in Laboratory: Role Play Model

a) Instructor:

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

b) First Group of students : Offensive and Defensive

Responsibilities: To define cybercrime and classification of cybercrimes
List the tools and methods used in cybercrimes
Prepare the list best cybersecurity practices

c) Second Group of students: Vulnerability Assessor and Penetration Tester (VAPT)

Responsibilities: To assess the vulnerabilities of systems (OS,Network infrastructure etc)
To carry out penetration testing and reporting
To abide by regulatory compliance and security standards

d) Third Group of Students: Forensic Investigator (FI)

Responsibilities: To setup laboratory for forensics
To use tools and techniques of digital forensics
To preserve the evidence
Demonstrate the forensic investigation process

Exp. No	Experiment Details	Refer	Marks
1	Network commands and utilities	13,15	5
2	Install and configure Virtual Environment	14	5
3	Information Gathering,Sniffing and scanning	13,15	5
4	Vulnerability Scanning and Vulnerability Assessment	13,15	5
5	Penetration Testing using Metasploit	16	5
6	Firewalls and Intrusion Detection System (IDS)	13	5
7	Encryption Tools	13	5
8	Forensics Tools and Utilities	13	5
	Assessment Marks		**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

Recommended Books:

[1] Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi.

[2] The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi

[3] The Information technology Act, 2000; Bare Act- Professional Book Publishers, NewDelhi.

[4] Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

[5] Nina Godbole, Information Systems Security, Wiley India, New Delhi

[6] Kennetch J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.

[7] Michael Gregg & David Kim,Inside Network Security Assessment: Guarding Your IT Infrastructure, Pearson Publication

[8] M. L. Srinivasan, CISSP in 21 Days - Second Edition PACT Publication

[9] Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, Pearson Publication

[10] Douglas J. Landoll, The Security Risk,Assessment Handbook-Second Edition ,Auerbach Publications

[11] Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in

[12] https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

[13] Open Source Security Tools: A Practical Guide to Security Applications by Tony Howlett, Pearson Education

[14] https://www.virtualbox.org

[15] Hands-On Information Security Lab Manual by Michael Whitman, Cengage publication

[16] https://www.offensive-security.com/metasploit-unleashed/

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE4	Internet of Things	1	-	2	1	-	1	2
		Examination Scheme						
		ISE		MSE	ESE		Total	
		40		10	20		70	

Pre-requisite Course Codes		
Course Outcomes	CO1	Describe IoT value chain structure (device, data cloud), application areas, IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules.
	CO2	Describe the Architectural Overview of IoT, Reference Architecture and Real World Design Constraints and various IoT Protocols (Datalink, Network, Transport, Session, Service)
	CO3	Apply the concepts of big data analytics, Internet of things and implement smart systems.

Module No.	Unit No.	Topics	Ref.	Hrs.
1[CO1]	1.1	**Internet of Things:** Internet of Things Promises–Definition–Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device.	1,2,3	1
	1.2	**Seven Generations of IoT sensors to Appear**:Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–IoT Generation Roadmap.	1,2,3	1
	1.3	**Technological Analysis:** Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module. IoT Development Examples: ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks - Focus on Wearable Electronics	1,2,3	2
2[CO2]	2.1	**IoT Architecture and Protocols:** IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge	5,6,8	2

		Management.		
	2.2	**IoT Data Link Layer & Network layer Protocols:** PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART,Z-Wave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.	7,8	1
	2.3	**Transport & Session Layer Protocols:**Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	7,8	2
	2.4	**Service Layer protocols & Security:** Service Layer - oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer.	7,8	1
3[CO3]	**3.1**	Data Analytics for IoT Introduction	8,9	1
	3.2	**Apache Hadoop** MapReduce Programming Model Hadoop MapReduce Job Execution MapReduce Job Execution Workflow Hadoop Cluster Setup **Using Hadoop MapReduce for Batch Data Analysis** Hadoop YARN **Apache Spark** **Using Apache Storm for Real-time Data Analysis** REST-based approach WebSocket-based approach **Structural Health Monitoring Case Study**	8,9	3
Total				**14**

Recommended Books:

[1] Editors Ovidiu Vermesan Peter Friess,'Internet of Things – From Research and Innovation to Market.

[2] N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

[3] Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024',Yole Développement Copyrights ,2014

[4] Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014

[5] Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI

[6] Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
[7] Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications
[8] Arshdeep Bahga and Vijay Madisetti Internet of Things: A Hands-on Approach
[9] Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.

Instructional Method and Pedagogy: At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc. Attendance is compulsory in lecture and laboratory which carries 40 marks in overall evaluation. One internal exam will be conducted as a part of internal theory evaluation. Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation. Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of 10 marks in the overall internal evaluation. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. Experiments shall be performed in the laboratory related to course contents.

Exp. No	Experiment Details	Ref	Marks
1	Introduction to DHT11 Temperature and Humidity measurement, Ultrasonic Sensor,PIR Motion sensor. Introduction to Actuators (DC Motor, Servo Motor and Relay). Introduction to Bluetooth Technology.	1,2, 3,4	5
2	Outdoor Temperature & Humidity Monitoring using DHT11. Motion Detection using PIR sensor. Distance Measurement using Ultrasonic Sensor. Practical with Servo Motor and Relay. Interfacing HC-05 Bluetooth Device with Arduino,Raspberry Development Board.. Home automation using Voice Commands & Bluetooth.	1,2, 3,4	5
3	Introduction to NodeMCU (ESP8266-12E). Introduction to NodeMCU firmware. NodeMCU as Server and Client. NodeMCU as an Access Point. Mobile Communication using Sim800 (GSM/GPRS Module) Introduction to various Notification Servers.	1,2, 3,4	5

4	Control of equipment using ESP8266+NODE MCU Webserver. Automatic Phone/Email Notification based on Event trigger using IFTTT. NodeMCU as an Access Point. Mobile Weather Station using NodeMCU. Home automation using Sim 800 using Mobile Communication.	1,2, 3,4	5
5	Introduction to IOT Cloud Platforms and API TCP /IP/HTTP Protocol Client and Server Communication. Introduction Smart Bridge, ThingSpeak, Google Firebase IOT Cloud . Uploading sensor data to Cloud using API's. Data Visualization, Data Analytics, Plugins, Import & Export Sending and Receiving Data from IOT Cloud using ESP8266 Introduction to MIT App Inventor.	1,2, 3,4	5
6	Sending and Receiving Data from IOT Cloud using ESP8266 Uploading Temperature & Humidity data to ThingSpeak Cloud & Ubidots cloud using wifi.Building Mobile Application using MIT App Inventor.	1,2, 3,4	5
7	Prototyping and Building. Use cases: Smart City Smart Water Smart Environment Smart Health (Remote) Smart Waste Management Smart Agriculture Smart Safety Smart Supply Chain & Logistics Smart Manufacturing / Industrial Iot	1,2, 3,4	5
8	Prototyping and Building. Use cases: Smart City Smart Water Smart Environment Smart Health (Remote) Smart Waste Management Smart Agriculture Smart Safety Smart Supply Chain & Logistics Smart Manufacturing / Industrial Iot	1,2, 3,4	5
Assessment Marks			**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

1.Raspberry Pi IoT Projects: Prototyping Experiments for Makers by John C. Shovic.
2.Internet of Things with ESP8266 by Marco Schwartz
3.IoT: Building Arduino-Based Projects by Brian Russell, Peter Waher, and Pradeeka Seneviratne.

4. Designing the Internet of Things by Adrian McEwen and Hakim Cassimally.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE5	Fundamentals of Computational Intelligence	1	--	2	1	--	1	2
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			10		20	70

Course Overview (Theory):

This open elective course is designed to introduce the concepts of computational intelligence and its application. It is structured to give students an overview of three fundamental topics which form the basis of Computational Intelligence: neural networks, fuzzy logic, natural language processing, and statistics. Students will be able to understand the working of different types of models according to different types of training. Fuzzy logic is included to enable students to design their own fuzzy control systems using all the various concepts taught. They will also learn about the basics and steps involved in Natural Language Processing which can be employed in most applications. To learn about which method fits their data set best, they will be introduced to the application of statistics to computational intelligence. Thus this open elective is focus on inspiration, design, theory, and practical aspects of implementing procedures to solve real-world problems.

The concepts taught in the theory must be implemented in the form of various problem statements in the practical. There will be four experiments based on supervised learning, CNN, Fuzzy controllers and model-fit calculation techniques. Emphasis is given to the mini-project which carries a high weightage. Students are required to implement most of the concepts learned throughout the practical in the mini-project by selecting a suitable problem statement. The mini-project will be graded at two stages. Special emphasis is given to the mini-project at the end of the practical sessions which will be based on computational intelligence.

Pre-requisite Course Codes	Mathematics, Probability ,Programming languages - Java/C++	
Course Outcomes	CO1	Identify suitability of different learning types for different scenarios.
	CO2	To study Neural Networks and Convolutional Neural Networks
	CO3	To design fuzzy controllers for various applications.
	CO4	To study Natural Language Processing
	CO5	To apply computational intelligence technique to solve real world problems.

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Module No.	Unit No.	Topics	Ref.	Hrs.
1	**1**	**Introduction to Computational Intelligence** : Concepts	1,6	0.5
2	**2**	**Basics of Artificial Neural Networks and Convolutional Neural Networks**	1,2,7,8	2.5
	2.1	Short History of Neural Networks, Rosenblatt's Neuron, Types of Learning (Supervised, Unsupervised, Reinforcement), Activation Functions.		
	2.2	Basic terminologies and architecture of ANN		
	2.3	Basic architecture of CNN		
3	**3**	**Fuzzy Controllers**	1,2,3,7,8	04
	3.1	Crisp Logic, Fuzzy logic, Fuzzy Membership functions and operators		
	3.2	Fuzzy Inference System and its types, Fuzzification ,Defuzzification, Designing Fuzzy logic control systems.		
4	**4**	**Basics of Natural Language Processing**	4	
	4.1	Basic terminologies and steps involved in NLP		
	4.2	Applications of NLP		
5	**5**	**Statistics in Computational Intelligence**	5	03
	5.1	Calculation of standard deviation, root mean square, mean absolute error etc for measuring the fitness of a model		
			Total	**14**

Exp. No.	Suggested List of Experiments	Ref.	Marks
1	Experiment on Supervised Learning (Back Propagation Neural Network)	1,2,7,8	**5**
2	Experiment on studying different CNN architectures	1,2	**5**
3	Experiment on designing a Fuzzy Controller	2,3,6,7,8	**5**
4	Experiment on measuring fit and error parameters for a model	5	**5**
5	Mini project	Online References	**20**
		Assessment Marks	**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

[1] Russell Eberhart and Yuhui Shi - Computational Intelligence: Concepts to Implementations (2007)
[2] FakhreddineKarray and Clarence de Silva - Soft Computing and Intelligent Systems Design (2004)
[3] AndriesEngelbrecht - Computational Intelligence: an Introduction (2007)
[4] Ela Kumar - Natural Language Processing (2013)

[5] Peter Bruce and Andrew Bruce - Practical Statistics for Data Scientists (2017).
[6] James M. Keller, Derong Liu, David B. Fogel, Fundamentals of Computational Intelligence: NeuralNetworks, Fuzzy Systems, and Evolutionary Computation, IEEE Press series on Computational Intelligence,Wiley Publication, July 2016.
[7] S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
[8] Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE6	Fundamentals of Data Structures and Algorithms	1	--	2	1	--	1	2
		Examination Scheme						
		ISE			MSE		ESE	Total
		40			10		20	70

Pre-requisite Course Codes	ES4- Programming Methodology and Data Structures	
After successful completion of the course student will be able to		
Course Outcomes	CO1	Implement various operations of nonlinear data structures.
	CO2	Apply the concepts of Trees to a given problem.
	CO3	Analyze time and space complexity of an algorithm
	CO4	Apply divide and conquer strategy to solve problems

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Data Structures** Introduction, Review of Stack, Queue and Linked List.	1,2	01
2	2.1	**Searching And sorting:** Searching : Linear Search, Binary Search. Sorting: Insertion sort, Merge sort.	1,2	03
3	3.1	**Introduction to Algorithms** Algorithm development, Performance analysis, space and time complexity.	3,4	02
4	4.1	**Growth of function** Big –Oh ,Omega , Theta notation Analysis of insertion sort.	3,4	03
5	5.1	**Divide and Conquer Approach** Analysis of Merge sort	3,4	01
6	6.1	**Binary Trees** Representation, Binary Search Tree and its operations, Binary Tree Traversal, AVL Tree, B-tree	1,2	04
			Total	**14**

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Exp. No.	Suggested List of Experiments	Ref.	Marks
1	Implementation of Linked List for a given scenario.	1,2	**5**
2	Implementation of Binary Search for a given scenario.	1,2	**5**
3	Implementation of Merge Sort for a given scenario.	1,2,3	**5**
4	Implementation of Tree Traversal for a given scenario.	1,2	**5**
5	Develop an application to explore the uses of an AVL tree	1,2	**5**
6	Develop Search application using B-Tree.	1,2	**5**
7	Sorting of 2 lacs elements using Insertion and Merge sort and do the analysis of algorithms.	3,4	**10**
	Total Marks		**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

Recommended Books:

(1) Data Structures APsedocode Approach with C, Richard F. Gilberg&Behrouz A. Forouzan, second edition, CENGAGE Learning.

(2) Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G. Sorenson.

(3) Thomas H.Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press, Massachusetts, 2009.

(4) Horowitz E, Sahni S andS.Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Galgotia Publications, New Delhi, 2010

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE7	Software Testing	1	-	-	1	--	--	1
		Examination Scheme						
		ISE		MSE		ESE	Total	
		40		10		20	70	

Pre-requisite Course Codes		---
At the end of the lab students will be able to		
Course Outcomes	OE7.1	Analyze the principles in software testing to prevent & remove bugs.
	OE7.2	Design effective test cases suitable in testing.
	OE7.3	Describe the variety of ways to test software and indicate the trade-offs between various testing techniques.
	OE7.4	Implement various test cases.
	OE7.5	Apply the software testing techniques in commercial environments.
	OE7.6	Able to use software testing methods and modern software testing tools for their testing projects.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Introduction to Software Testing**		2	2
	1.1	Software Quality		
	1.2	Verification and Validation		
	1.3	Failure, Error, Fault and Defect		
	1.4	Test Case		
	1.5	Test levels		
	1.6	Software Testing Life Cycle		
2.	**Black-Box Testing**		1	4
	2.1	Boundary Value Analysis		
	2.2	Equivalence class testing		
	2.3	State table based testing		
	2.4	Cause-effect graphing based testing		
	2.5	Error guessing		
3.	**White Box Testing**		1	4
	3.1	Need of White box Testing		
	3.2	Logic coverage criteria		
	3.3	Basis path testing		
	3.4	Graph matrices		
	3.5	Loop testing		

	3.6	Data flow testing		
	3.7	Mutation testing		
4.	**LEVELS OF TESTING**		3	4
	4.1	Unit testing		
	4.2	Integration Testing		
	4.3	System Testing		
	4.4	Acceptance testing		
	4.5	Performance testing		
	4.6	Regression Testing		
	4.7	Ad-hoc testing, Alpha, Beta Tests		
			Total	**14**

Exp. No.	Suggested List of Experiments	Ref.	Marks
1	Write the test cases for any known application.	1	5
2	Create a test plan document for any application.	1	5
3	Design Test case using boundary value analysis.	1	5
4	Design a test cases using equivalent class partitioning.	1	5
5	Study of testing tool, Win runner.	2,3	5
6	Study of test management tool, Test Director.	2,3	5
7	Test Automation using Selenium IDE.	2,3	5
8	Test Automation using Selenium Web driver.	2,3	5
		Total	**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

1. Naresh Chauhan , "*Software Testing Principles and Practices*", Oxford Higher Education.
2. Kshirasagar Naik and Priyadarshi Tripathy, "*Software Testing and quality assurance theory and practice*", Wiley Publication.
3. Srinivasan Desikan and Gopalaswamy Ramesh, "*Software Testing – Principles and Practices"*, Pearson education, 2006.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OE8	Database Management Systems	1	-	2	1	--	1	2
		Examination Scheme						
		ISE		MSE		ESE	Total	
		40		10		20	70	

Pre-requisite Course Codes		---
At the end of the course students will be able to		
Course Outcomes	OE8.1	Design a database for real world system, choose real world problem and map it to the solution using database techniques.
	OE8.2	Construct a database using SQL.
	OE8.3	Create normalized database using functional dependencies.
	OE8.4	Analyze the effect of transaction over the database.
	OE8.5	Build secure and normalize database using SQL constructs.
	OE8.6	Apply the connectivity techniques of database.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction Database Concepts and ER Modeling** Characteristics of databases, File system V/s Database system, Users of Database system, DBMS system architecture, Database Administrator.	1,2,3	2
	1.2	Introduction to ER model, Benefits of Data Modeling, Types of Models, The Entity-Relationship (ER) Model, Generalization, Specialization and Aggregation, Mapping of ER to Relational model.		2
2	2.1	**SQL** Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Views in SQL, Trigger.	1,2	5
3	3.1	**Normalization** Design guidelines for relational schema, Function dependencies, Normal Forms- 1NF, 2 NF, 3NF.	1,2,3	3
4	4.1	**Transactions Management**: Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability.	1,2,4	2
			Total	**14**

Exp. No.	Suggested List of Experiments	Ref.	Marks
1	Identify the real world problem which can be mapped to the database using database concept. Design E-R model for the same.	1	5
2	Perform database administration DCL commands.	1,2	5
3	Build a database with related data using SQL.	2	5
4	Perform Data Manipulation using SQL.	2	5
5	Perform various nested queries on database.	2	5
6	Perform TCL operations over database.	2	5
7	Examine integrity of database using triggers.	2	5
8	Perform database connectivity using JDBC on a table.	1,2	5
		Total	**40**

ISE Evaluation: Continuous evaluation of experiments for 40 Marks

MSE Evaluation: Subjective evaluation for 10 Marks based on theory for one hour duration

ESE Evaluation: Subjective evaluation for 20 Marks based on theory for one hour duration

References:

1. Korth, Slberchatz, Sudarshan, "*Database System Concepts*", 7th Edition, McGraw – Hill, 2010.
2. Elmasri and Navathe, "*Fundamentals of Database Systems*", 5th Edition, PEARSON Education, 2015.
3. G. K. Gupta, "*Database Management Systems*", McGraw – Hill, 2011.
4. Peter Rob and Carlos Coronel, "*Database Systems Design, Implementation and Management"*, 8th Edition, Thomson Learning, 2007.
5. Sharaman Shah, "*Oracle for Professional*", SPD, 2008.
6. Dr. P.S. Deshpande , " *SQL &PLSQL for oracle*" Black Book, 2007.