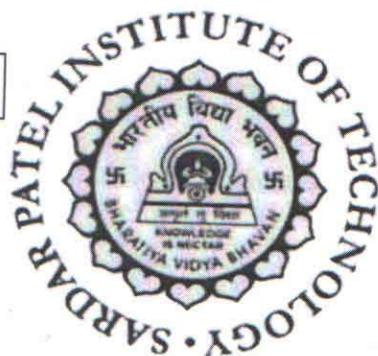


Bharatiya Vidya Bhavan's  
**Sardar Patel Institute of Technology**  
(Autonomous Institute Affiliated to University of Mumbai)

Revision: SPIT-3-18



**Bachelor of Engineering/Technology (B.E./B.Tech)**  
**in**  
**Electronics and Telecommunication Engineering**  
(Program Code: UET)

**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. Y. S. Rao  
Head of Department

Dr. Surendra Rathod  
Dean Academics

Dr. Prachi Gharpure  
Principal

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



# Sardar Patel Institute of Technology

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

Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits Total
			L	T	P	
ET51	Digital Communication	PC	3	--	--	3
ET52	Microprocessor and Microcontroller	PC	3	--	--	3
ET53	Fundamentals of Antenna	PC	3	1	--	4
ET54	Random Signal Analysis	PC	3	1	--	4
ETL51	Digital Communication Lab	PC	--	--	2	1
ETL52	Microprocessor and Microcontroller Lab	PC	--	--	2	1
ETL53	Antenna Lab	PC	--	--	2	1
ETL54	Statistical and Computational Lab	PC	--	--	2	1
ETL55	Photovoltaic Lab	PC	--	--	2	1
ETP56	Product Design 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			14	2	12	22



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## Semester-VI:

Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits Total
			L	T	P	
ET61	Discrete Time Signal Processing	PC	3	1	--	4
ET62	Computer Communication Networks	PC	3	1	--	4
ET63	Embedded Systems & RTOS	PC	3	--	--	3
ETL61	Discrete Time Signal Processing Lab	PC	--	--	2	1
ETL62	Computer Communication Networks Lab	PC	--	--	2	1
ETL63	Embedded and Operating Systems Lab	PC	--	--	2	1
ETL64	RF systems and Design Laboratory	PC	--	1	2	2
ETP65	Product Design 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			11+1@	5	10+2@	22+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>B.E./B.Tech Electronics and Telecommunication Engineering (SEM V)</b>					
Course Code	Course Name	Marks			
		ISE	MSE	ESE	Total
ET51	Digital Communication	20	20	60	100
ET52	Microprocessor and Microcontroller	20	20	60	100
ET53	Fundamentals of Antenna	20	20	60	100
ET54	Random Signal Analysis	20	20	60	100
ETL51	Digital Communication Lab	40	--	--	40
ETL52	Microprocessor and Microcontroller Lab	40	--	--	40
ETL53	Antenna Lab	40	--	--	40
ETL54	Statistical and Computational Lab	40	--	20	60
ETL55	Photovoltaic Lab	40	--	--	40
ETP56	Product Design 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)	--	--	--	--
<b>Total</b>					<b>730</b>
<b>B.E./B.Tech Electronics and Telecommunication Engineering (SEM VI)</b>					
Course Code	Course Name	Marks			
		ISE	MSE	ESE	Total
ET61	Discrete Time Signal Processing	20	20	60	100
ET62	Computer Communication Networks	20	20	60	100
ET63	Embedded Systems & RTOS	20	20	60	100
ETL61	Discrete Time Signal Processing Lab	40	--	20	60
ETL62	Computer Communication Networks Lab	40	--	--	40
ETL63	Embedded and Operating Systems Lab	40	--	--	40
ETL64	RF systems and Design Laboratory	40	--	--	40
ETP65	Product Design 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)	--	--	--	--
<b>Total</b>					<b>760</b>

@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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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET51	Digital Communication	3	-	--	3	-	--	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		20	20	60	100			

Pre-requisite Course Codes	ETC405 Signal and System, ETC502 Analog Communication,	
Course Outcomes	CO1	Ability to describe various entities of digital communication system
	CO2	Solve problems to interpret various concepts
	CO3	Analyzematheematically various source coding methods/modulation/demodulation /error correction codes
	CO4	Compare various modulation/demodulation /error correction codes
	CO5	Determine the behavior of signals in time and frequency domain at various stages of digital communication system
	CO6	Justify modulation/demodulation/Bit rate/ Bandwidth requirements in various applications

Module No.	Unit No.	Topics	Ref.	Hrs.
1	<b>Information theory and source coding</b>		1,2,4	05
	1.1	Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and it's properties.		
	1.2	Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding,		
2	<b>Baseband Modulation and Transmission</b>		1, 2	06
	2.1	Inter-symbol interference, Nyquist criterion for zero ISI, raised cosine filters, correlative coding.		
3	<b>Bandpass Modulation and Demodulation</b>		1,2,6	12
	3.1	Generation, detection, signal space diagram, Power spectrum, bandwidth efficiency, and Probability of error analysis from signal space of: Frequency Shift Keying (FSK)Modulation, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK) Introduction to OFDM		



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<b>4</b>		<b>Baseband Detection</b>	1, 3	05
	<b>4.1</b>	Integrate and dump receiver, Optimum filter ,Matched filter		
<b>5</b>		<b>Error Control Systems</b>	1,5	10
	<b>5.1</b>	Shannon's Channel Capacity theorem and its trade off. Linear block codes: encoding and decoding 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		
	<b>5.2</b>	Convolution Codes: Graphical representation for encoding and decoding using code tree, trellis, state diagram, Viterbi decoding		
<b>6</b>		<b>Applications</b>	1,5,6	04
	<b>6.1</b>	Bandwidth, bit rate analysis of QAM application to WLAN / ADSL/DVB G-FSK application to DECT / Bluetooth/ remote Metering/Caller ID MSK application to GSM mobile standard		
			<b>Total</b>	<b>52</b>

## Reference Books:

1. H. Taub, D. Schilling, and G. Saha, "Principles of Communication Systems," Tata Mc-Graw Hill, New Delhi, Third Edition, 2012.
2. Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.
3. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009
4. Lathi B P, and Ding Z., "Modern Digital and Analog Communication Systems," Oxford University Press, Forth Edition, 2009.
5. T L Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
6. Sanjay Sharma, "Digital Communication," Katson Books, Seventh Edition,2015.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET52	Microprocessors and Microcontrollers	3	--	--	3	--	--	3
		<b>Examination Scheme</b>						
		<b>Theory Marks</b>						
		ISE		MSE		ESE		Total
20		20		60		100		

Pre-requisite Course Codes		ET33 (Digital Circuits)
After successful completion of the course, the students will be able to		
<b>Course Outcomes</b>	CO1	Describe the architecture, modes and interrupt structure of 16 bit microprocessors
	CO2	Discuss various mechanisms of computer architectures that include virtual memory address translation, protection with multitasking and task switching.
	CO3	Comprehend the principles of memory systems with cache memory and its design
	CO4	Explain the architecture and utilize the Instruction set of 16 bit Microcontrollers
	CO5	Illustrate and utilize the integrated peripherals of 16 bit microcontrollers

Module No.	Unit No.	Topics	Ref.	Hrs.
1		<b>Introduction to Microprocessors</b>		08
	1.1	Architecture of 16 bit microprocessor with Pin Diagram, Concept of Segmentation	1,2	
	1.2	Design of Minimum and Maximum Mode Module with relevant ICs.	1,2	
	1.3	Detailed Interrupt Structure	1,2	
	1.4	Instruction Set, Assembler Directives and various addressing modes	1,2	
	1.5	System Design with Memory and I/O interfacing	1,2	
2		<b>Computer Architecture Concepts</b>		10
	2.1	Software architecture of microprocessor in Real mode	3	
	2.2	Software architecture of microprocessor in Protected mode	3	
	2.3	Virtual Memory Concept with Memory Management Unit with Segmentation and Paging (Address Translation Mechanism)	3	
	2.4	Protection Mechanism for program and data.	3	
	2.5	Various Task Switching Mechanisms with their comparison.	3	
2.6	Characteristic comparison among various modern processors from Intel family.	1,2,3,4		
3		<b>Memory Organization</b>		08
	3.1	Computer Memory System Overview with its hierarchy	4	
	3.2	Cache Memory Principles	4	



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	<b>3.3</b>	Elements of Cache Design	4	
	<b>3.4</b>	Cache Organizations and Architectures	4	
	<b>3.5</b>	MESI Cache Protocol Concept	4	
<b>4</b>		<b>16 bit Microcontroller (PIC)</b>		<b>08</b>
	<b>4.1</b>	Microcontroller architecture and Programming model	5,6	
	<b>4.2</b>	Instruction set with addressing modes	5	
<b>5</b>		<b>Integrated Peripherals for 16 bit microcontroller</b>		<b>08</b>
	<b>5.1</b>	Interrupt structure	5	
	<b>5.2</b>	Timers	5,6	
	<b>5.3</b>	Data Converters (ADC and DAC)	5,6	
	<b>5.4</b>	Serial I/O (SPI, I <sup>2</sup> C Protocol)	5,6	
			<b>Total</b>	<b>42</b>

## Recommended Books:

- [1] Douglas Hall, "Microprocessor and Interfacing", TMH Publication
- [2] John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", Pearson Education.
- [3] Walter Triebel, "The 80386DX Microprocessor Hardware, Software and Interfacing", Prentice Hall
- [4] William Stallings, "Computer Organization & Architecture", Pearson Education, Sixth Edition
- [5] Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems (with PIC18 microcontroller family)", Penram International Publishing Pvt. Ltd
- [6] Han- Way Huang, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Cengage Learning





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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET53	Fundamentals of Antenna	3	1		3	1		4
		<b>Examination Scheme</b>						
		<b>Theory Marks</b>						
		<b>ISE</b>		<b>MSE</b>		<b>ESE</b>		<b>Total</b>
		<b>20</b>		<b>20</b>		<b>60</b>		<b>100</b>

Pre-requisite Course Codes		ET42
Course Outcomes	The student will have:	
	CO1	Ability to calculate the fundamental parameters of Antenna
	CO2	Ability to describe fundamental theory of antennas
	CO3	Ability to evaluate and select antenna on the basis of applications
	CO4	Ability to design Antenna Arrays

Module No.	Unit No.	Topics	Ref	Hrs
1		<b>Fundamental Concepts:</b>	1-6	08
	1.1	Introduction, types of Antennas, Radiation mechanism, Poynting vector, Steradian concept, Power intensity.		
	1.2	Antenna Parameter: Radiation pattern, Radiation power density, Radiation Intensity, Gain, Directivity, HPBW, FNBW, Beam efficiency, Bandwidth, Polarization, Input Impedance, Reflection coefficient, Return loss, VSWR, Antenna Efficiency, Effective Aperture, Communication link and Friis transmission equation.		
2		<b>Radiation from wires and loops</b>	1-6	10
	2.1	Introduction, Infinitesimal dipole: Radiation zones, Total radiated power, Radiation resistance, Directivity, Effective area, Short dipole,		
	2.2	Finite-length dipole: Radiated power, Radiation resistance, Directivity, Effective area, Half-wave dipole and its properties, Loop antenna.		
3		<b>Aperture Antennas</b>	1-6	06
	3.1	Introduction, Field equivalence principle, Love's equivalence principle, Electrical and magnetic conductor equivalence principle,		
	3.2	Computation of field quantities of aperture antenna, Relation between wire and aperture antennas, Horn antenna design principle.		
4		<b>Antenna Arrays</b>	1-6	10



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	<b>4.1</b>	Introduction, Two-element array, Example problems, Pattern multiplication concept, N-element array, Uniform array, Array factor, Broad-side and end-fire arrays, Phased array, Directivity and pattern characteristic of linear uniform array.		
	<b>4.2</b>	Non-uniform array, Binomial array, Dolph-Chebyshev array concept, Design principle of Chebyshev array and examples, Planar arrays		
<b>5</b>		<b>Basic Concept of Smart Antennas</b>	1,7	08
	<b>5.1</b>	Introduction, Need of smart antenna system, Overview of smart antenna system, Types of smart antennas, Switched beam system, Adaptive system, Beam forming, Fixed weight beam forming: Maximum signal-to-interference ratio beam-former, Minimum mean square error.		
	<b>5.2</b>	Adaptive beam forming: LMS algorithm, Sample matrix inversion method.		
<b>Total</b>				<b>42</b>

## Recommended Books:

- [1] Antenna Theory- C. A. Balanis- Wiley and sons
- [2] Antennas – John. D. Krauss- TMH ed.
- [3] R. James and P.S. Hall, Handbook of Microstrip Antennas, Peter Peregrinus, 198
- [4] W.L. Stutzman and G.A. Thiele, Antenna Theory and Design, John Wiley, 2012
- [5] R.C. Johnson, Antenna Engineering Handbook, McGraw Hill, 1993
- [6] R. E. Collin, Antennas and Radio Wave Propagation, McGraw-Hill., 1985.
- [7] F. B. Gross, Smart Antennas for Wireless Communications, McGraw-Hill., 2005.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET54	Random Signal Analysis	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

<b>Pre-requisite Course Codes</b>	ET34: Signals and Systems BS41: Applied Mathematics II	
<b>Course Outcomes</b>	CO1	Apply theory of probability in identifying and solving relevant problems.
	CO2	Analyze statistical behavior of single and multiple random variables and manipulate them.
	CO3	Apply transformations of random variables; random sequences & Central limit theorem to solve engineering problems and interpret the significance.
	CO4	Evaluate random variables, random process, Markov chains and Queuing theory using probabilistic approach.

Module No.	Unit No.	Topics	Ref	Hrs
<b>1</b>		<b>Overview of Probability Theory and Basics of Random Variables</b>	<b>1, 2, 4</b>	<b>08</b>
	<b>1.1</b>	Notion of random variable		
	<b>1.2</b>	Continuous random variables, probability density function, probability distribution function, Uniform, Exponential and Gaussian continuous random variables and distributions.		
	<b>1.3</b>	Discrete random variables, probability mass function, probability distribution function, binomial, Poisson and geometric discrete random variables and distributions		
<b>2</b>		<b>Operations on One Random Variable</b>	<b>1,3, 4</b>	<b>07</b>
		Functions of a random variable and their distribution and density functions.		
		Expectation, Variance and Moments of random variable		
		Transformation of a random variable, Markov, Chebyshev and Chernoff bounds, characteristic functions, moment theorem		
<b>3</b>		<b>Multiple of Random Variables and Convergence</b>	<b>1,2, 4</b>	<b>08</b>
		Pairs of random variables, Joint CDF,		



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		Joint PDF Independence , Conditional CDF and PDF, Conditional Expectation.		
		One function of two random variable, two functions of two random variables; joint moments, joint characteristic function, covariance and correlation-independent, uncorrelated and orthogonal random variables.		
		Sequence of Random Variables and Convergence: Random sequences, Central limit theorem and its significance		
<b>4</b>		<b>Random Process</b>	<b>1,3, 4</b>	<b>09</b>
		Random process: Definition, realizations, discrete and continuous time processes.		
		Mean, correlation and covariance functions, stationarity of random process.		
		Ergodicity, Transmission of WSS random process through LTI system, power density spectrum		
		Gaussian and Poisson random process		
<b>5</b>		<b>Markov Chains and Introduction to Queuing Theory</b>	<b>1,2</b>	<b>10</b>
		Markov process, Discrete Markov chains, The n–step transition probabilities, steady state probabilities, Introduction to Continuous time Markov chains, Classifications of states		
		Markovian models, Birth and death queuing models, Steady state results		
		Single and Multiple server Queuing models, Finite source models, Little's formula		
		<b>Total</b>		<b>42</b>

## Reference Books:

1. Alberto Leon Garcia, "Probability And Random Processes For Electrical Engineering", second edition Low price edition Pearson education.
2. Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education.
4. Veerarajan, "Probability, Statistics and Random Processes", Third Edition, McGraw Hill.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL51	Digital Communication Lab	--	--	2	--	--	2	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	Digital Communication (ET51)	
Course Outcomes	CO1	Ability to implement various concepts of digital communication.
	CO2	Ability to trouble shoot hardware circuits
	CO3	Ability to take measurements
	CO4	Ability to write and debug software programs

Exp. No.	Experiment Details	Ref.	Marks
1	Binary phase shift keying.		5
2	Frequency shift keying		5
3	Duo binary Encoder		5
4	Hamming Encoder		5
5	Syndrome Decoder		5
6	Modulation/demodulation software Experiment using MATLAB/SCILAB		5
7	Error correction codes Software Experiment using MATLAB/SCILAB		5
8	ISI/ICI/SNR/BER/Pulse shaping software Experiment using MATLAB/SCILAB		5
<b>Total Marks</b>			<b>40</b>

## References

1. H. Taub, D. Schilling, and G. Saha, "Principles of Communication Systems," Tata Mc-Graw Hill, New Delhi, Third Edition, 2012.
2. Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL52	Microprocessors & Microcontrollers Laboratory	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

<b>Pre-requisite Course Codes</b>		(1) Digital Circuits Laboratory (ETL32) (2) Microprocessors & Microcontrollers ( )
<b>Course Outcomes</b>	CO1	Use hardware and software tools for microprocessors and microcontrollers like 8086, 80386 and PIC
	CO2	Analyze the problem statement and write and execute an assembly language program for 8086/80386/PIC
	CO3	Debug an assembly language program for 8086/80386/PIC
	CO4	Document the procedure and analyze the result of an experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	Arithmetic Operations for microprocessors like 8086	1,2	5
2	Sorting of an array with either byte or word elements with microprocessors	1,2	5
3	Detecting the given string for palindrome with microprocessors	1,2	5
4	Password creation and detection application on microprocessors	1,2	5
5	PIC assembly language programming and simulation	3,4	5
6	PIC LED/LCD interfacing and programming	3,4	5
7	PIC Timers and interrupts programming	3,4	5
8	PIC Peripheral Programming of PLL/GPIO	3,4	5
9	PIC ADC Programming	3,4	5
10	PIC DAC Programming	3,4	5
11	PIC UART Programming	3,4	5
<b>Any 08 Experiments to be performed</b>			<b>Total Marks 40</b>

### Recommended Books:

- [1] Douglas Hall, "Microprocessor and Interfacing", TMH Publication
- [2] John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", Pearson Education.
- [3] Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems (with PIC18 microcontroller family)", Penram International Publishing Pvt. Ltd
- [4] Han- Way Huang, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Cengage Learning



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL53	Antenna Lab	--	--	2	--	--	2	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	ET34		
Course Outcomes	CO1	Install and use modern tool available for antenna design.	
	CO2	Ability to analyze the antenna fundamental parameters.	
	CO3	Ability to analyze and design given antenna.	
	CO4	Debate the results of modern tool and test it.	

Exp. No.	Experiment Details	Ref.	Marks
1	Explore the understanding of IE3D tool used to design antenna and its optimization.	1	5
2	To calculate Fundamental parameters of Antenna (Radiation Intensity, Gain, Directivity, HPBW, BWFN)	3,4	5
3	Simulation of Dipole antenna using IE3D and its optimization.	3,4	10
4	Simulation of Rectangular patch antenna using IE3D and its optimization.	3,4	10
5	To design array of 5 elements to achieve optimum pattern.	3,4	5
6	To test the performance of various antennas using Antenna trainer kit.	2,3	5
<b>Total Marks</b>			<b>40</b>

## References

- 1) IE3D Manual
- 2) Antenna Trainer Kit Manual
- 3) Antenna Theory- C. A. Balanis, Wiley and Sons
- 4) Antennas- John D. Krauss, TMH ed.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL54	Statistical and Computational Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		20		60

Pre-requisite Course Codes	ET54 Random Signal Analysis	
Course Outcomes	CO1	To handle the different data types.
	CO2	To compute the statistical parameters
	CO3	To compute cdf and pdf
	CO4	To plot and interpret from data visualization
	CO5	To Analyse the data

Exp. No.	Experiment Details	Ref.	Marks
1	Computation of Statistical Parameters		5
2	Probability distributions computation (cdf and pdf)		5
3	Regression Analysis		5
4	Data Visualization		5
5	Analysis of Covariance and Time Series Analysis		5
6	Matrix Computation		5
7	Application in Signal Processing		5
8	Application in Communication Engineering		5
<b>Total Marks</b>			<b>40</b>

Note: Statistical Computational Platform: R and Python Numpy, Scipy and matplotlib





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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL55	Photovoltaic Laboratory	-	-	2	-	--	2	2
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

<b>Pre-requisite Course Codes</b>	BS12 : Applied Physics 1 ES21 : Basics Electrical Technology	
	At the end of course students will be able to	
<b>Course Outcomes for Laboratory</b>	CO1	Design DC - AC Conversion.
	CO2	Test and analyze PV cell characteristics and connections.
	CO3	Investigate PV cell based on environmental conditions.
	CO4	Measure different parameters of PV Cells.

Exp. No.	List of Experiments	COs	Marks
1	<b>ASSIGNMENT</b> 1. How is current produced in a Photo-voltaic cell? 2. Equivalent circuit of PV Cell. 3. Sun rise and sun set angle? 4. In the Solar spectrum, which spectrum is contributing to generate current? 5. Factors affecting efficiency of PV modules. 6. What is the efficiency of silicon wafer? 7. Factors which are influencing the Efficiency of the PV Modules? 8. Cost Analysis.	CO3	5
2	<b>To observe the effect of the series resistance on the performance of a solar cell, with a fixed photo current.</b> <b>To observe the effect of the shunt resistance on the performance of a solar cell, with a fixed photo current.</b> A) Run the simulation in SEQUEL. Plot I versus V, and observe how Rseries affects the solar cell performance. Plot P (output power of the cell) versus V. For each value of Rseries, note down the maximum power Pmax. Also plot manually Pmax on linear scale versus Rseries on log scale. Run the simulation. Plot I versus V, and observe how Rshunt affects the solar cell performance. Plot P (output power of the cell) versus V. For each value of Rshunt, note down the maximum power Pmax. Also plot manually Pmax on linear scale versus Rshunt on log scale.	CO2	



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3	<p><b>Experiment:</b> To observe and plot the I-V characteristics of 20W solar cell 1) with load 2) without load. 3) Change in Sun angel 4) Time</p>	CO4	5
4	<p><b>To compare the I-V curve of a solar cells connected in series.</b> <b>To compare the I-V curve of a solar cell connected in parallel.</b> Run the simulation SEQUEL, plot I versus V for the single solar cell and for the series connection of two cells. Comment on the plots. Repeat for P (power) versus V relationship in the two cases. Run the simulation. Plot I versus V for the single solar cell and for the parallel connection of two cells. Comment on the plots. Repeat for P (power) versus V relationship in the two cases.</p>	CO2	5
5	<p><b>To observe the effect of shading of a solar cell on the characteristics of the cell:</b>  Run the simulation SEQUEL,  A) Plot the I-V relationship for the array in two cases: (a) The above condition where <math>I_{p4} = 0.5</math> A and all other photocurrents are 4 A, (b) All photocurrents are equal (4 A).  B) Plot the bypass diode currents (<math>ID1, \dots, ID6</math>) versus the total voltage drop with C4 under shade.  C) Plot the cell voltages (<math>VC1, \dots, VC6</math>) versus the total voltage drop with C4 under shade.</p>	CO3	5
6	<p><b>DC-DC Converters:</b>  Run the simulation SEQUEL for Buck, Boost and Buck-Boost converter implementation and observe the plots, infer the results. Simulate for at least three cases of DC values (3.3V, 5V and 12V) also change the parameters like Switching frequency, Inductor, Capacitor values.</p>	CO1	5
7	<p><b>Real-Time PWM Generation:</b>  To implement Sine-Triangular modulation and low pass filter for DC-AC conversion. Simulate using SEQUEL for DC-AC single leg, Full bridge Inverter and Experiment using NODEMCU microcontroller.</p>	CO1	5
8	<p><b>Mini Project Choice:</b>  To Implement PID controller {or}</p>	CO1	10



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	To Experiment Buck /Boost/DC-AC Converter {or} Any Hardware Experiment of Power Electronics {or} Simulate Solar Power Station for 1KW of power		
<b>9</b>	On-line Quiz	2	<b>10</b>
<b>10</b>	To Demonstrate/Perform the given experiment in lab at the end semester	8,9	<b>10</b>
<b>Total Marks</b>			<b>40</b>

**\* Minimum 8 experiments to be conducted.**

Note: For all the experiments the documentation has to be in LaTeX, the performance parameters are a) Analysis b) Comparison & Discussion c) Technical documentation

## Recommended Books:

### Solar Photovoltaic Energy Conversion

- 1) Fundamentals of Solar Cells: PV Solar Energy Conversion, Alan L Fahrenbruch and Richard H Bube , Academic Press, New York , 1983
- 2) SEQUEL User's manual, Dr. M. B. Patil, IIT Bombay.
- 3) Elements of Power Electronics, Krein and Phillip T. , Oxford University, New York, 2004..



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETP56	Product Design-I	--	--	2	--	--	1	1
		Examination Scheme						
		ISE					Total	
		Phase-I: 10 Phase-II:10 Phase-III:20			MSE	ESE		
			--	20	60			

Pre-requisite Course Codes		ET52
Course Outcomes	CO1	Understand the basic knowledge of functions of an electronic product development processes
	CO2	Finding out Electrical and Physical specifications from datasheets
	CO3	To learn schematic design.
	CO4	To learn Layout design.
	CO5	To learn Technical documentation such as Schematic and layout sheets, PCB and schematic foot prints, bills of material, gerber files etc.

Course Objectives
<p>The purpose of this lab course is to understand various aspects of an electronic product. Specifically about development processes, identifying customer needs, establishing product specifications, concept generation, concept selection, and product architecture. Also about Printed Circuit Board – Anatomy, CAD tools for PCB design, Standard fabrication. Board Assembly – Surface Mount Technology, Through-Hole Technology, Process Control and Design challenges.</p> <p>A group of two or three students shall conceptualize electronic product development as part of lab work. The scope includes usage of CAD tools, PCB making, soldering, troubleshooting, panel design and documentation</p> <p>In the exam you have to design a system mentioned in the problem statement and at the spot soldering and layout design.</p>

### Recommended Books:

1. Electronic Product Design, R.G.Kaduskar, V.B.Baru, Wiley India
2. Printed Circuit Board design and technology - Walter C Bosshart Tata McGraw - Hill-CEDT
3. Handbook of Printed Circuit manufacturing - Raymond H. Clark (Van Nostrand Reinhold Company, New York)
4. Electronic testing and fault diagnosis - G.C. Loveday (Ah wheelerPublication, India)
5. Electronics Engineers reference book 5th Edition ñ Edited by F.F. Mazda Butterworths Publication Co., UK)
6. Principles of Reliable Soldering Techniques, Sengupta R., New Age International



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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		<b>Theories of Employee Motivation</b>	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		<b>Feelings about Work: Job Attitudes and Emotions</b>	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.		<b>Productive and Counterproductive Work Behavior</b>	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.		<b>Leadership and Power in Organizations</b>	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.		<b>Organizational Development and Theory</b>	1,2	05
	5.1	Organizational Development		
	5.2	Organizational Theories		
<b>Total</b>				<b>28</b>



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## **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.( 10<sup>th</sup> 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	<b>Introduction to Human Rights.</b> Enforcement of Human Rights in India including Supreme Court, High Courts, Statutory Commissions– NHRC, NCW, NCM, NC-SC/ST etc.	1	
2	2.1	<b>Right to Information Act, 2005:</b> Evolution and concept; Practice and procedures; Official Secret Act, 1923; Indian Evidence Act, 1872.	1	4
	2.2	<b>Information Technology</b> – legislation and procedures, Cyber	1	



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		crimes – issues and investigations.		
3	3.1	<b>Labor Laws:</b> 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, 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.	2,3	
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





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5	5.1	<b>Corporate Law:</b> 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
			<b>Total</b>	<b>28</b>

### 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.



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## **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
ET61	Digital Time Signal Processing	3	1	--	3	1	--	4
		Examination Scheme						
		Theory Marks						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes		Applied Mathematics III, Network Theory, Signals and Systems	
Course Outcomes	The student will be able to:		
	CO1	Ability to compute various Transform analysis of LTI systems	
	CO2	Ability to apply DFT Properties and Illustrate FFT algorithms	
	CO3	Ability to Design and Realize Digital Filters	
	CO4	Ability to apply engineering problem solving strategies to DSP problems	
	CO5	Ability to design and test signal processing algorithms for various applications	

Module No.	Unit No.	Topics	Ref.	Hrs.
1		<b>Transform Analysis of Linear Time Invariant System</b>		04
	1.1	LTI systems as frequency-selective filters like; low pass, high pass, band pass, notch, comb, all-Pass filters, and digital resonators.		
	1.2	Invertibility of LTI systems, minimum-phase, maximum-phase, mixed-phase systems		
2		<b>The Discrete Fourier Transform and Efficient Computation.</b>	1,3	12
	2.1	Frequency domain sampling and reconstruction of discrete time signals, discrete Fourier transform (DFT), DFT as a linear transformation, properties of the DFT, relationship of the DFT to other transforms		
	2.1	Fast Fourier Transform: Radix-2 and split-radix fast Fourier transform (FFT) algorithms and their applications		
	2.1	Quantization effects in the computation of the DFT		
3		<b>Design of Digital filters and Implementation</b>	1,2	12
	3.1	Design of Infinite Impulse Response (IIR) filters using impulse invariant method and bilinear transformation method, Butterworth and Chebyshev filter approximation.		



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	<b>3.2</b>	Concepts of Finite Impulse Response (FIR) filter, symmetric and anti symmetric FIR filter, FIR filter design using window method and frequency sampling method.		
	<b>3.3</b>	Realization structures for IIR and FIR filters using direct form structures, cascade, parallel structures, and lattice, ladder structure (only conceptual understanding)		
<b>4</b>		<b>Spectral Estimation</b>	1	08
	<b>4.1</b>	Energy Density Spectrum, Estimation of the Autocorrelation and Power Spectrum of Random Signals.		
	<b>4.2</b>	DFT in Spectral Estimation, Power Spectral Estimation: Non Parametric and Parametric methods.		
<b>5</b>		<b>Multi rate Signal Processing and Applications</b>	1	06
	<b>5.1</b>	Sampling Rate Conversion, Polyphase Decomposition, Digital Filter Design, Digital Filter Banks.		
	<b>5.2</b>	Application of Multirate signal Processing for Voice Processing and Radar.		
			<b>Total</b>	<b>42</b>

## Text Books:

1. Alan V. Oppenheim and Ronald Schaffer, "Discrete Time Signal Processing", Pearson Education
2. J. Proakis, D. G. Manolakis, and D. Sharma, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education.
3. Babu R., "Digital Signal Processing", Scitech Publications, Fourth Edition
4. S.Salivahanan, A Vallavaraj, C Gnanapriya, "Digital Signal Processing", Tata McGraw Hill Edition Private Limited, New Delhi, Edition 2010
5. L. R. Rabiner and B. Gold, "Theory and Applications of Digital Signal Processing", Prentice- Hall of India, Edition 2006.

## Reference Books:

1. P.P. Vaidyanathan, "Multirate Systems and Filter Banks", Pearson.
2. Robert Schilling and Sandra Harris, "Fundamentals of Digital Signal Processing using MATLAB", Cengage Learning.
3. Sanjit K.Mitra, "Digital Signal Processing", McGrawHill education.
4. B. Kumar, "Digital Signal Processing", New Age International Publishers, Edition 2014.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET62	Computer Communication Networks	3	1	--	3	1	--	4
		<b>Examination Scheme</b>						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	ETC 502 Analog Communication	
Course Outcomes	CO1	Conceptual understanding and functional aspects of computer communication and telecom networks.
	CO2	Design and configure small/medium sized computer network that meets a specific needs for communications.
	CO3	Simulate computer networks and analyze the simulation results including troubleshoot connectivity problem occurring at layers of TCP/IP model.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		<b>Introduction and Overview of the Internet</b>	4,5	08
		Basic communications model. Protocol layers and service models. Basic definitions. The OSI model. The Internet protocols. The role of standards organizations. What is the Internet? Delay in the Internet (traceroute and ping). History of the Internet. Security in the Internet. Concept of Quality of Service (QoS).		
2		<b>Application Layer</b>	4,5	06
		Application layer protocols. Client-server as a key model. Web, HTTP, FTP, SMTP, POP3, and DNS. Peer-to-peer file sharing networks.		
3		<b>Transport Layer</b>	2,3,4	12
		Transport Protocols introduction. Reliable data transfer - Stop-and-wait and Go-back-N design and evaluation. TCP and UDP semantics and syntax. TCP RTT estimation. Principles of congestion control - efficiency and fairness, reactive and proactive. Sockets programming in basics in Python. A simple client-server implementation.		
4		<b>Network layer and routing</b>	3,4,5	12
		IPv4 and IPv6 Protocol Introduction, Principles of routing. Inside an IP router. IP semantics and syntax. Unicast and Multicast routing Concepts . Routing Algorithm:Link-state		



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		and distance vector. Routing Protocols: RIP, OSPF, BGP, DVMP, PIM. Network Management: SNMP, Other tools and trouble-shooting. Traffic analysis. Configuration management.		
<b>5</b>		<b>Security and Hot Topics</b>		<b>4</b>
		Threats and attacks. Symmetric and public key cryptography. Authentication. Firewalls. VPNs. Overview of hot topics -- IoT, NFV, and SDN		
			<b>Total</b>	<b>42</b>

## References

1. J. F. Kurose and K. W. Ross, “*Computer Networking: A Top-Down Approach*”, Pearson Publication , 5th Edition, March 2009
2. B. Forouzan, “*Data Communication and Networking*”, McGraw Hill Publication, 5<sup>th</sup> edition.
3. L. Garcia “*Communication Networks*” , Mcgraw Hill Pub 2nd Edition





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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		3	--	--	3	--	--	3
ET63	Embedded Systems & RTOS	Examination Scheme						
		ISE		MSE	ESE	Total		
		20		20	60	100		

Pre-requisite Course Codes		(1) Microprocessors & Microcontrollers Laboratory ( ETL52 ) (2) Microprocessors & Microcontrollers (ET52 )
Course Outcomes	CO1	Understand the embedded concepts and architecture models
	CO2	Describe ARM architecture
	CO3	Comprehend the open source RTOS and its usage
	CO4	Design programming models for embedded systems applications

Module No and Title	Detailed Contents	Ref.	Hours
1: Embedded architectures	Architecture of embedded systems, Programming models for Single-Core and Multi-Core structures.	1,2	04
2: ARM Architecture	Introduction to ARM instruction set, addressing modes, operating modes with ARM core, ARMTDMI modes, ADC, Timers, Interrupt structure. Byte ordering (LE, BE), Thumb mode normal mode instructions changes, Pipeline utilization with all register allocations. Compare with ARM7, ARM9, and ARM11 with new features additions. System design with ARM processor.	1,2	14
3: Real-time	Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS,	3,6	12



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Operating Systems	basic architecture of an RTOS, scheduling systems, inter-process communication, performance metric in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparative study.		
4: Open source RTOS	Free RTOS Scheduling and Task Management – Real-time scheduling, Task Creation, Inter task Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts.	3	6
5: Applications	Database applications; Image processing, Process-control, Robotics, Automation, Security and communication.	4,5	6

## Text Books:

1. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley publication
2. ARM System Developer’s Guide Designing and Optimizing System Software – Andrew N. Sloss, Dominic Symes and Chris Wright – Elsevier Inc.
3. Richard Barry, Using the FreeRTOS Real Time Kernel - a Practical Guide - Cortex-M3 Edition.
4. Communicating Embedded Systems: Networks Applications, Francine Krief (Editor) February 2010, Wiley-ISTE
5. P Marwedel, “Embedded System Design”, Springer publication Christopher Hallinan
6. “Embedded Linux Primer: A Practical Real-World Approach”, Second Edition, Pearson Education Publication



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL61	Discrete Time Signal Processing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		20		60

Pre-requisite Course Codes		Electromagnetic Wave Theory
Course Outcomes	CO1	Explores the ability to develop programs for various DSP concepts.
	CO2	Explores the ability to debug programs for various DSP concepts
	CO3	Ability to design and analyze the frequency response of digital IIR and FIR filters.
	CO4	Ability to analyse the result and document the experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	Impulse Response of a given system., Frequency Selective Filter, Convolution and Correlation		5
2	Discrete Fourier Transform, Fast Fourier Transform		5
3	Overlap Add Method/ Overlap Save Method		5
4	Design of IIR filter design		5
5	Design of FIR Filter Design		5
6	Sampling rate conversion of given signal,		5
7	Spectral Estimation		5
8	Real Time Signal Processing		5
<b>Total Marks</b>			<b>40</b>

References:

As recommended by faculty.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL62	Computer Communication Networks Laboratory	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes		
Course Outcomes	CO1	Assemble the components of a PC and install one or more network operating systems resulting in a functioning
	CO2	Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
	CO3	Perform basic configurations on routers and Ethernet switches.
	CO4	Demonstrate knowledge of programming for network communications
	CO5	Learn to simulate computer networks and analyze the simulation results
	CO6	Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model
	CO7	Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Exp. No.	Experiment Details	Ref.	Marks
1	Study of Networking Hardware and Software Components		5
2	Install and Configure Network Operating System (OSS/Linux)		5
3	IP Networking & Network Commands: ifconfig , ping, traceroute , netstat, arp , nslookup dig & route etc.		5
4	Network Protocol Analyzers : TCPDUMP & Wireshark		5
5	Installation & Configuration of TELNET, FTP and Web Server		5
6	Study of Network Simulator-ns-2		5
7	Firewall Implementation (IPTABLES)		5
8	Network Socket Programming		5
<b>Total Marks</b>			<b>40</b>



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL63	Embedded Systems & Operating System Laboratory	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes		(1) Microprocessors & Microcontrollers Laboratory( ) (2) Microprocessors & Microcontrollers ( )
Course Outcomes	CO1	Use hardware and software tools for processors like ARM series.
	CO2	Analyze the problem statement and write and execute an assembly language program for ARM series processors and Real Time OS
	CO3	Debug an assembly language program for ARM series and Real Time OS
	CO4	Document the procedure and analyze the result of an experiment.

Exp. No.	Experiment Details	Marks
1	LEDs and Keyboard Interface	5
2	16*2 LCD Interface	5
3	Counting external events using On Chip counters	5
4	DC/Stepper Motor Control	5
5	On Chip ADC and DAC Programming	5
6	UART and Data transfer	5
7	SPI/I2C/CAN transfer	5
8	Bluetooth/Zigbee/WiFi interface	5
9	SDCARD and File creation	5
10	Free RTOS implementation	5
11	Kernel Object and Interprocess communication	5
12	GSM interface	5
Any 07 Experiments to be performed with one Mini Project		Total Marks 40



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL64	RF systems and Design Laboratory	--	1	2	--	1	1	2
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		60

Pre-requisite Course Codes		ET42
Course Outcomes	The student will have:	
	CO1	Ability to analyse and compute RF system requirement.
	CO2	Ability to use modern tools for designing RF system components.
	CO3	Ability to test RF system components.

Exp. No.	Experiment Details	Ref.	Marks
1	Introduction to RF System Lab	-	-
2	Probe feed Patch Antenna Designing in CAD	1,2	5
3	Probe feed patch Antenna Designing in HFSS using constant values	1,2	5
4	Probe feed patch Antenna Designing in HFSS using variable values	1,2	5
5	Low Pass Filter design	1,3	5
6	High Pass Filter design	1,3	5
7	Bandpass Pass Filter design	1,3	5
8	Bandstop Filter design	1,3	5
9	VNA Calibaration and Component testing	4	5
<b>Total Marks</b>			<b>40</b>

References: 1)IE3D Manual

2) HFSS Manual

3)Balanis

4) Pozar 5)VNA Manual



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned				
		L	T	P	L	T	P	Total	
ETP65	Product Design-II	--	--	2	--	--	1	1	
		<b>Examination Scheme</b>							
		<b>ISE</b>							<b>Total</b>
		<b>Phase-I: 10 Phase-II:10 Phase-III:20</b>			<b>MSE</b>		<b>ESE</b>		
					--	<b>20</b>	<b>60</b>		

Pre-requisite Course Codes		ETP56
<b>Course Outcomes</b>	CO1	Understand the concepts of reliability
	CO2	Learn control panel layout design for various industrial products
	CO3	Thermal design consideration for component level, board level, system level Design
	CO4	Conduct a study on testing of a electronic product
	CO5	Document the product in the form of IPR and Copyright format

Course Objectives
<p>The purpose of this lab course is to understand concepts of reliability, nature of reliability problems in electronic equipment, methods of solving complex systems, Mean Time to Failure (MTTF) and Mean Time between Failure (MTBF) of systems. Maintainability, system downtime, Mean time to Repair (MTTR).</p> <p>The second part of this course is to study types of controls, design and organization of control panel, engineering considerations, layout of components, and selection of materials. Thermal management of electronic equipment, Also about thermal design considerations, component level, board level, system level, fans and system operating characteristics, heat sink design.</p> <p>A group of two or three students shall study environmental testing for product. Environmental test chambers &amp; rooms. Tests carried out on the enclosures Electromagnetic compatibility (EMC) with respect to compliance, Electromagnetic compatibility (EMC) testing, conducted emission test (time domain methods), and radiated emission test basics of standard used.</p> <p>The students are expected to visit Industry to observe product testing lab such as SUNREN, Sameer Mumbai etc. Students should learn the safety and security standards of the product with ISO2001, telecomm interface testing, Quality Management ISO/IEC17025/2005 and safety IS132S2/IEC60950.</p>

### Recommended Books:

1. Electronic Product Design, R.G.Kaduskar, V.B.Baru, Wiley India
2. Electronic testing and fault diagnosis - G.C. Loveday (Ah wheelerPublication, India)



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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
<b>TOTAL</b>				<b>26</b>





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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
<b>TOTAL MARKS</b>			<b>100</b>

## 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 speak Greet 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 Être” (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 around the city / Metro Maps / Reaching Hotel or Youth Hostel		60 mins
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		120 mins



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		and Service Industries 9. Tourism and Monuments 10. Ecological concerns	
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 have Used to express age	120 mins
13.	13.1	Verb Conjugation of "FAIRE – to make / to do / to describe weather conditions Comment fait-il aujourd'hui? 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-il aujourd'hui? 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
<b>Total</b>			<b>28 hours</b>

## 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 – Niveau Débutant- Maïa Grégoire – 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		---
<b>Course Outcomes</b>	CO1	Student will be 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



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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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		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	<b>Introduction to consumer Electronic.</b>	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	<b>Device Interconnects and Peripherals.</b>	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	<b>Interactive and Immersive TV.</b>	1	02





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

## 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



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## 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
<b>Assessment Marks</b>			<b>40</b>

**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, 1<sup>st</sup> 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, 16<sup>th</sup> Edition, 2016.
- [5] N. Jilovec, "*E-Business: Thriving in Electronics Marketplace*", 29<sup>th</sup> 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	

<b>Pre-requisite Course Codes</b>	EL 42: Principle of Control Systems	
At the end of the course students will be able to		
<b>Course Outcomes</b>	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	<b>Fundamentals of Robotics</b>		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	<b>Introduction to Robot Vision</b>		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



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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 application.	1,2,3	5
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
	<b>Eight Experiments Total Marks</b>		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 India Fourth 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



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2	2.1	<b>Cyber offenses &amp; Cybercrimes:</b>  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	<b>Tools and Methods Used in Cybercrime:</b>  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	<b>Security Risk Assessment and Risk Analysis:</b>  Risk Terminology, Laws, Mandates, and Regulations, Risk Assessment Best Practices, The Goals and Objectives of a Risk Assessment, Best Practices for Quantitative and Qualitative Risk Assessment.	7,8, 10	1
	3.2	<b>Vulnerability Assessment and Penetration Testing (VAPT):</b>  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	<b>Cyber Security Laws and Legal Perspectives</b>	1,2, 4,6	1
	4.2	<b>Cyber Crime and Criminal Justice: Penalties, Adjudication and</b>	1,2, 4,6	1



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		Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments		
	<b>4.3</b>	Information Security Standard compliances: SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI-DSS	1,2, 4,6	1
<b>5</b>	<b>5.1</b>	<b>Digital Forensics:</b> Need for forensics, Cyberforensics and Digital Evidence	1,2	1
	<b>5.2</b>	Digital Forensics Life cycle, Computer forensics investigation, setting-up forensics laboratory, Special Tools and Techniques, Forensics Auditing and Compliance Requirements, Antiforensics	1,2	1
	<b>5.3</b>	Forensics of Hand-held devices, Tool-kits for Hand-held device forensics, Techno-Legal Challenges with Evidence from Hand-held Devices	1,2	1
			<b>Total</b>	<b>14</b>

## 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



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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
<b>Assessment Marks</b>			<b>40</b>

**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] Kenneth 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





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[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	<b>Overview and Introduction of Internet of Things:</b> Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device.	1,2,3	1
	1.2	<b>Overview and Introduction of Seven Generations of IoT sensors to Appear:</b> 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	<b>Overview and Introduction of Technological Analysis:</b> 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	<b>Overview and Introduction of IoT Architecture and Protocols:</b> 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 Management.	5,6,8	2
	2.2	<b>Overview and Introduction of IoT Data Link Layer &amp;</b>	7,8	1



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		<b>Network layer Protocols:</b> 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.		
	2.3	<b>Overview and Introduction of Transport &amp; Session Layer Protocols:</b> Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	7,8	2
	2.4	<b>Overview and Introduction of Service Layer protocols &amp; Security:</b> 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	<b>Overview and Introduction of Data Analytics for IoT Introduction</b>	8,9	1
	3.2	<b>Overview and Introduction of Apache Hadoop</b> MapReduce Programming Model Hadoop MapReduce Job Execution MapReduce Job Execution Workflow Hadoop Cluster Setup <b>Using Hadoop MapReduce for Batch Data Analysis</b> Hadoop YARN  <b>Apache Spark</b> <b>Using Apache Storm for Real-time Data Analysis</b> REST-based approach WebSocket-based approach <b>Structural Health Monitoring Case Study</b>	8,9	3
<b>Total</b>				<b>14</b>

## 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



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[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	<b>Implementation of any one of the Technology/ System</b> 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	<b>Implementation of any one of the Technology/ System</b> Outdoor Temperature & Humidity Monitoring using DHT11.	1,2, 3,4	5



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	<p>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 &amp; Bluetooth.</p>		
3	<p><b>Implementation of any one of the Technology/ System</b> 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.</p>	1,2, 3,4	5
4	<p><b>Implementation of any one of the Technology/ System</b> 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.</p>	1,2, 3,4	5
5	<p><b>Implementation of any one of the Technology/ System</b> 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 &amp; Export Sending and Receiving Data from IOT Cloud using ESP8266 Introduction to MIT App Inventor.</p>	1,2, 3,4	5
6	<p><b>Implementation of any one of the Technology/ System</b> Sending and Receiving Data from IOT Cloud using ESP8266 Uploading Temperature &amp; Humidity data to ThingSpeak Cloud &amp; Ubidots cloud using wifi.Building Mobile Application using MIT App Inventor.</p>	1,2, 3,4	5
7	<p><b>Implementation of any one of the Technology/ System</b> Prototyping and Building. Use cases: Smart City Smart Water</p>	1,2, 3,4	5



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	Smart Environment Smart Health (Remote) Smart Waste Management Smart Agriculture Smart Safety Smart Supply Chain & Logistics Smart Manufacturing / Industrial Iot		
8	<b>Implementation of any one of the Technology/ System</b> 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
<b>Assessment Marks</b>			<b>40</b>

**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.



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Pre-requisite Course Codes	Mathematics, Probability ,Programming languages - Java/C++	
<b>Course Outcomes</b>	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.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1	<b>Introduction to Computational Intelligence</b> : Concepts	1,6	0.5
2	2	<b>Basics of Artificial Neural Networks and Convolutional Neural Networks</b>	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	<b>Fuzzy Controllers</b>	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	<b>Basics of Natural Language Processing</b>	4	
	4.1	Basic terminologies and steps involved in NLP		
	4.2	Applications of NLP		
5	5	<b>Statistics in Computational Intelligence</b>	5	03
	5.1	Calculation of standard deviation, root mean square, mean absolute error etc for measuring the fitness of a model		
<b>Total</b>			<b>14</b>	

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
<b>Assessment Marks</b>			<b>40</b>

**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





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## 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

<b>Pre-requisite Course Codes</b>	ES4- Programming Methodology and Data Structures	
After successful completion of the course student will be able to		
<b>Course Outcomes</b>	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	<b>Introduction to Data Structures</b> Introduction, Review of Stack, Queue and Linked List.	1,2	01
2	2.1	<b>Searching And sorting:</b> Searching : Linear Search, Binary Search. Sorting: Insertion sort, Merge sort.	1,2	03
3	3.1	<b>Introduction to Algorithms</b> Algorithm development, Performance analysis, space and time complexity.	3,4	02
4	4.1	<b>Growth of function</b> Big -Oh ,Omega , Theta notation Analysis of insertion sort.	3,4	03
5	5.1	<b>Divide and Conquer Approach</b> Analysis of Merge sort	3,4	01
6	6.1	<b>Binary Trees</b> Representation, Binary Search Tree and its operations, Binary Tree Traversal, AVL Tree, B-tree	1,2	04
<b>Total</b>			<b>14</b>	



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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
<b>Total Marks</b>			<b>40</b>

**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	<b>Introduction to Software Testing</b>		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.	<b>Black-Box Testing</b>		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.	<b>White Box Testing</b>		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		



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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		
			<b>Total</b>	<b>14</b>

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	
			<b>Total</b>	<b>40</b>

**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 Gopaldaswamy 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

<b>Pre-requisite Course Codes</b>	---	
At the end of the course students will be able to		
<b>Course Outcomes</b>	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	<b>Introduction Database Concepts and ER Modeling</b> 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	<b>SQL</b> 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	<b>Normalization</b> Design guidelines for relational schema, Function dependencies, Normal Forms- 1NF, 2 NF, 3NF.	1,2,3	3
4	4.1	<b>Transactions Management:</b> Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability.	1,2,4	2
<b>Total</b>				<b>14</b>



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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
<b>Total</b>			<b>40</b>

**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, Silberchatz, Sudarshan, "Database System Concepts", 7<sup>th</sup> Edition, McGraw – Hill, 2010.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 5<sup>th</sup> 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", 8<sup>th</sup> Edition, Thomson Learning, 2007.
5. Sharaman Shah, "Oracle for Professional", SPD, 2008.
6. Dr. P.S. Deshpande, "SQL & PLSQL for oracle" Black Book, 2007.