Course Title	**Optical Fiber Communication**						
Course Code	22ETU701						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS: 50	**SEE Marks: 50**		**Total Max. Marks = 100**			**Duration of SEE: 03 Hours**	

Course objectives: This course will enable students to:

1. Understand the working and classification of optical fibers in terms of propagation modes
2. Solve problems of transmission characteristics and losses in optical fiber
3. Explain the constructional features and the characteristics of optical sources and detectors
4. Describe the operations of optical amplifiers
5. Understand the concept of Multiplexing, WDM and optical networks

UNIT	Syllabus Content	No. of Teaching Hours
1	**Optical fiber Communications:** The general Optical Fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in Planar Guide, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. **Fibers:** Types and refractive index profiles, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index.	8
2	**Transmission characteristics of optical fiber:** Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. **Optical Fiber Connectors:** Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers.	8

3	**Optical sources:** LEDs and LDs, structures, characteristics**,** modulators using LEDs and LDs. coupling with fibers, noise in Laser diodes, Amplified Spontaneous Emission noise, effects of Laser diode noise in fiber communications. **Optical detectors:** Types and characteristics, structure and working of PIN and AP, noise in detectors, comparison of performance. Optical receivers, Ideal photo receiver and quantum limit of detection.	8
4	**Optical Amplifiers:** basic concept, applications, types, doped fiber amplifiers, EDFA, basic theory, structure and working, Semiconductor laser amplifier, Raman amplifiers, TDFA, amplifier configurations, performance comparison.	8
5.	**Optical System Design:** Considerations, Component choice, Multiplexing, Point-to- point links, System considerations, Link power budget with examples. Rise the time budget with examples. WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH.	8

PRACTICAL COMPONENT OF IPCC	
Sl No.	**I. Experiments using Optical devices**
1	Study of characteristics of LED's, Photo diodes.
2	Study of characteristics Photo Transistors
3	Design of Opto- Couplers circuits
4	Realization of scheme for Optical isolation and applications
5	Study of WDM
II. Experiments using Optical Fiber Communications Trainer (OFT)	
6	Setting up a Fiber Optic Analog Link
7	Setting up a Fiber Optic digital Link
8	Losses in Optical Fiber
9	Measurement of Numerical Aperture
10	Study experiment: Realtime voice signal transmission and receiver using optical fiber communication
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos	

Course Outcomes :

CO1: Know the classification and working of optical fiber with different modes of signal Propagation.
CO2: Understand the transmission characteristics and losses in optical fiber.
CO3: Describe the constructional features and the characteristics of optical sources and Detectors.
CO4: Describe the performance of optical amplifiers.
CO5: Acquire knowledge of optical components and networks

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	1		-		-	-	-	2	-	1	1	2	3
CO2	3	3	2			-	-	-	2	2	2	1	3	2	1
CO3	3	3	2			-	-	-	3	3	1	1	3	3	2
CO4	3	3	1			-	-	-	2	2	2	1	3	2	1
CO5	3	3	2		-		-	-	-	2	-	1	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. **Optical Fiber Communications,** McGraw Hill**,** Gerd Keiser, 2nd Edition, 2013
2. **Optical Fiber Communications,** John M Senior, Pearson Education, 3rd Edition,2010.

REFERENCE BOOKS / WEBLINKS:

1. **Optical Fibre Communication**, Chakrabarti, McGraw Hill, 2015
2. **Optical fibre communication,** Hebbar**,** Elsevier, 2014
3. **Fibre Optic Communications,** Joseph C. Palais**,** 5th Edition Pearson, 2013
4. **Optical Communication Essentials (SIE),** Keiser, 1st Edition, McGraw Hill Education New Delhi, 2008.
3. **Fibre optic Communication**, Mishra and Ugale, Wiley, 2013
5. https://archive.nptel.ac.in/courses/108/106/108106167/

Sub Title: WIRELESS AND MOBILE NETWORKS		
Sub Code: 22ETU702	**No. of Credits: 4=4:0:0(L:T:P)**	**No of lecture hours per week: 4**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives :

1. To study fundamentals of Wireless communication networks, their issues and standards.
2. To study WBAN technology, its architecture, design issues, protocols and applications
3. To study WPAN technology, its architecture, design issues, protocols, components and applications.
4. To study WLAN components, design requirements, WMAN architecture, protocols and applications.

UNIT No.	Syllabus Content	No. of Hours Teaching
1	Review of fundamentals of wireless communication and Networks: Wireless communication channel specifications, Wireless communication systems, Wireless networks, Switching technology, Communication problems, Wireless network issues and standards.	10
2	Wireless body area networks: Properties, Network architectures, Components, Design issues, Network Protocols, WBAN technologies and WBAN applications.	10
3	Wireless personal area networks: Network Architectures, WPAN Components, Requirements of WPAN devices, WPAN Technologies and protocols, WPAN applications, Bluetooth and Zigbee.	8
4	Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications. WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications.	12
5	WWANs, cellular networks, Satellite Network, Applications. Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.	12

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2	3	3	2	2	3	2	3	3	2	2	3	1
CO2	3	3	2	2	2	1	3	3	1	2	3	2	2	3	1
CO3	2	3	3	2	2	1	3	2	2	2	3	2	2	3	1
CO4	1	2	1	3	3	3	2	1	3	1	2	2	1	3	2

TEXT BOOK:

1. S S Manvi, and M. S. Kakkasageri, "Wireless and Mobile network concepts and Protocols", Wiley India Pvt Ltd, 2010.

REFERENCE BOOKS:

1. P Kaveh, Krishnamurthy, "Principles of Wireless network: A unified approach", PHI, 2006.
2. Iti Saha Mitra, "Wireless communication and network: 3G and Beyond", McGraw Hill, 2009.
3. Ivan Stojmenovic, "Handbook of Wireless networks and Mobile Computing", Wiley, 2009.
4. P Nicopolitidis, M. S. Obaidat, et al, "Wireless Networks", Wiley, 2009.
5. Yi-Bing Lin, Imrich Chlamtac, "Wireless and Mobile Network Architectures", Wiley, 2009.
6. Mullet, "Introduction to Wireless Telecommunication Systems and Networks", Cengage, 2009.

Wireless & Mobile Communication Networks Lab

1. Write a MATLAB program to calculate the path loss for Okumura outdoor propagation model in an urban area for 925.7 MHz, 926.4 MHz, 927.8 MHz, 927.1MHz Parameters given
   - d= 1to 20Km (in range of 2Km)
   - h_{te}= 100m to 300m (in range of 50m)
   - h_{re}= 2m to 10m (in range of 2m)
   - EIRP= 1kW
   - Assume unity gain receiving antenna

2. Using Okumura outdoor propagation model, obtain graphical plot for variation of path loss with distance varying assuming that h_{te}, h_{re}, EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.

3. Write a MATLAB program to calculate the path loss for Hata outdoor propagationmodel in an urban area for 925.7 MHz, 926.4 MHz, 927.8 MHz, 927.1 MHz Parameters given-
   - d= 1to 20Km (in range of 2Km)
   - h_{te}= 100m to 300m (in range of 50m)
   - h_{re}= 2m to 10m (in range of 2m)
   - EIRP= 1kW
   - Assume unity gain receiving antenna

4. Using Hata outdoor propagation model, obtain graphical plot for variation of pathloss with distance varying assuming that h_{te}, h_{re}, EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.

5. Using Hata outdoor propagation model, obtain graphical plot for variation of path loss with heights of receiving/transmitting antenna varying assuming that d, EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.

6. Find and plot the variation in power received for Okumura outdoor propagation model in a suburban area assuming all the necessary variables for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.

7. Considering a band of frequencies between 920 MHz to 950 MHz, plot the variation in path loss for Hata outdoor propagation model in a suburban area using MATLAB

8. Obtain the plot for the median path loss using Indoor propagation model, for the frequencies 925 MHz, 925.7 MHz, 926.4 MHz, 927.8 MHZ and 927.1 MHz in an urban area Parameters given-
   - d= 1to 20Km (in range of 2Km)
   - h_{te}= 100m to 300m (in range of 50m)
   - h_{re}= 2m to 10m (in range of 2m)
   - EIRP= 1kW

- Assume unity gain receiving antenna.

9. Assuming all the necessary variables, plot the median path loss for Indoor propagation model for a band of frequencies ranging from 930 MHz to 950 MHz inMATLAB.

10. Write a MATLAB code for CDMA realization.

11. Configure a GSM uplink system using MATLAB.

12. Configure a GSM downlink system using MATLAB.

13. Write a MATLAB code to configure a VOIP network.

14. Write a MATLAB code to configure a Wi-MAX network for three propagation paths.

Course Outcomes :

CO1: Have complete knowledge fundamentals of wireless communication and Networks and their applications.
CO2: Identify the different wireless networks like WBAN, WMAN, WLAN, WMAN,WMAN and understand their architecture and their components.
CO3: Understand and interpret the protocols and standards in different Wireless Communication and Networks.
CO4: Analyze the various design issues in WMAN, WLAN, WMAN, WMAN.

Course Title	**Adaptive Signal Processing**						
Course Code	22ETT703						
Category	Professional Core Course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	2	0	0	5	65	4
CIE MARKS: 50	**SEE Marks: 50**		**Total Max. Marks = 100**			**Duration of SEE: 03 Hours**	

Course Objectives: The objectives are to

1. Know the analysis of discrete time signals.
2. Study modern digital signal processing algorithms and applications.
3. Have an in-depth knowledge of the use of digital systems in real time applications.
4. Apply the algorithms for a wide area of recent applications.
5. Acquire knowledge of adaptive signal processing, prediction, model estimation (learning), and array processing.

UNIT No	Syllabus Content	No. of Teaching Hours	Tutorials
1	**INTRODUCTION:** The filtering problem, Adaptive filters, linear filter structures, approaches the development of linear adaptive filter algorithms. **ADAPTIVE SYSTEMS:** Definitions and characteristics - applications – properties examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error.	8	5
2	**SEARCHING PERFORMANCE SURFACE-STABILITY AND RATE OF CONVERGENCE:** Learning curve gradient search - Newton's method - method of steepest descent - comparison - Gradient estimation - performance penalty - variance - excess MSE and time constants – mis-adjustments.	8	5

3	**LINEAR FILTER:** Linear optimum filtering problem statement, principle of orthogonality, minimum mean squared error, wiener-hopf equations, error performance surface. Channel equalization. Linearly constrained minimum variance filter, generalized side lobe cancellers.	**8**	**5**
4	**METHOD OF STEEPEST DESCENT:** Steepest descent algorithm, stability of the Steepest descent algorithm. **LMS ALGORITHM CONVERGENCE OF WEIGHT VECTOR:** Least Mean square adaptation Algorithm, stability and performance analysis of the LMS algorithm. Concept of least squares.	**8**	**5**
5.	**RECURSIVE LEAST SQUARES (RLS) ALGORITHM:** The matrix inversion lemma, the exponentially weighted RLS algorithm, Convergence analysis of the RLS algorithm. **KALMAN FILTERS:** Recursive minimum mean square estimation for scalar random variables, statement of the Kalman filtering problem.	**8**	**5**

Course Outcomes: After the completion of the course, the student will be able to

1. Learn how to use iterative techniques.
2. Solve parameter estimation problems.
3. Theoretical guarantees of iterative and recursive methods.
4. Enable them to choose the appropriate method for signal processing systems.
5. Techniques like Kalman Filtering and Recursive Least Squares techniques.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE: Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS

1. B. Widrow, S. Stearns, "Adaptive Signal Processing", Prentice-Hall, 1985.
2. S. Haykin, "Adaptive Filter Theory", Prentice-Hall, 2013.

REFERENCE BOOKS / WEBLINKS:

1. Ali H. Sayed, "Fundamentals of Adaptive Filtering", John Wiley, 2003.
2. B. Farhang-Boroujen, "Adaptive Filters: Theory and Applications", John Wiley and Sons, 2013.
3. John G. Proakis, Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson Education / PHI, 2007
4. Bruce P. Gibbs, "Advanced Kalman Filtering, Least-Squares and Modeling", ohn Wiley & Sons, Inc., Hoboken, New Jersey, 2011.

https://onlinecourses.nptel.ac.in/noc25_ee120/preview

https://web.mit.edu/kirtley/kirtley/binlustuff/literature/control/Kalman%20filter.pdf

Course Title	**DSP Algorithms & Architecture**						
Course Code	**22ETT704A**						
Category	Professional Elective						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	40	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. Understand the concepts of digital signal processing techniques.
2. Understand the computational building blocks of DSP processors and its speed issues.
3. Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
4. Learn how to interface the external devices to the TMS320C54xx processor in various modes.
5. Understand DSP algorithms and applications with their implementation using TMS320C54xx processor.

UNIT No	Syllabus Content	No. of Lecture Hours
1	Introduction to Digital Signal Processing: Introduction, A Digital Signal – Processing system, Major features of programmable Digital signal processors, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.	9
2	Architectures for Programmable Digital Signal Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.	8
3	Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54XX, Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.	8

4	Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). Implementation of FFT Algorithms: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index. Generation & Implementation on the TMS32OC54xx	7
5.	Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA). Interfacing and Applications of DSP Processors: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.	7
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

At the end of the course the student will be able to:

CO1: *Explain* the fundamentals of digital signal processing systems and the mathematical tools such as DFT, FFT, and digital filters.

CO2: *Analyze* various architectures and memory organizations of programmable DSP devices for efficient data processing.

CO3: *Demonstrate* programming skills using TMS320C54xx DSP processors, including addressing modes, instruction sets, and pipeline operations.

CO4: *Implement* basic DSP algorithms such as FIR, IIR, interpolation, decimation, and FFT using fixed-point representation and evaluate their performance on real-time DSP hardware.

CO5: *Design* and interface memory and I/O peripherals with DSP processors for applications in speech, biomedical, and image processing systems.

CO-PO-PSO Mapping :

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2					1			1	1			1	2
CO2	3	3				1		2				2			
CO3	3	2			3		1				1				3
CO4	3	3	2	2	3				1				3		
CO5	3	3	3		3										

TEXT BOOKS:

1. "Digital Signal Processing", Avatar Singh and S Srinivasan, Thomson Learning, 2004

REFERENCE BOOKS/WEBLINKS :

1. "Digital Signal Processing: A practical approach", Ifeachor E C, Jervis B. W Pearson-Education, PHI, 2002.
2. "Digital Signal Processors", B Venkataramani and M Bhaskar, TMH, 2nd Ed., 2010
3. "Architectures for Digital Signal Processing", Peter Pirsch, John Wiley.

Course Title	**Digital Image Processing and its applications**						
Course Code	22ETT704B						
Category	Professional elective (PE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives : The objectives are to

6. Understand the basic principles and methods of digital image processing.
7. Be able to formulate solutions to general image processing problems.
8. To learn various image enhancement techniques.
9. To study segmentation techniques used in different applications.
10. To acquire knowledge of concepts of color image processing.

UNIT No	Syllabus Content	No. of Teaching Hours
1	**DIGITAL IMAGE FUNDAMENTALS** Background, fundamental steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image sensing and acquisition, Image Sampling and Quantization, Some basic relationships between pixels.	9
2	**IMAGE ENHANCEMENT IN SPATIAL DOMAIN** Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/ Logic Operations, Use of Python for implementation of image processing algorithms, medical applications.	8

3	**IMAGE ENHANCEMENT IN FREQUENCY DOMAIN** Introduction to Fourier Transform and the Frequency domain for an im Smoothing Frequency Domain Filters, Sharpening Frequency domain filters, homomorphic filtering.	**7**
4	**IMAGE SEGMENTATION:** Detection of discontinuities, edge linking and boundary detection, Thresholding, region oriented segmentation, segmentation of morphological watersheds, the use of motion in segmentation,face detection applications.	**8**
5.	**COLOR IMAGE PROCESSING** : Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing	**7**

Course Outcomes : After the completion of the course, the student will be able to

6. Explain the representation of a digital image.
7. Understand the effect of applying various enhancement techniques in spatial domain.
8. Analyze the impact of frequency domain techniques on images.
9. Analyze computer-vision applications with various segmentation techniques.
10. Know the applicability of various color-models.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS

1. Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing", PHI 4th Edition, 2017.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar," Digital Image Processing, TMH
3. Publication, 2nd edition, 2017

REFERENCE BOOKS / WEBLINKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI Learning , 3rd Edition,
2. Madhuri A Joshi "Digital Image Processing –an alogorithm approach", PHI Learning, 2006
3. http://eeweb.poly.edu/~onur/lectures/lecture8.pdf

Course Title	**Machine Learning with Python**						
Course Code	**22ETT704C**						
Category	**Professional Elective Course**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. Define machine learning and problems relevant to machine learning.
2. Differentiate supervised, unsupervised and reinforcement learning
3. Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning.
4. Perform statistical analysis of machine learning techniques.

7.

UNIT No	Syllabus Content	No. of Teaching Hours
1	**Introduction:** Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias. Python libraries suitable for Machine Learning: Numerical Analysis and Data Exploration with NumPy Arrays, and Data Visualization with Matplotlib Text Bookl, Sections: 1.1 — 1.3, 2.1-2.5, 2.7 L1 - L5	08
2	**Decision Tree Learning:** Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Example program in Python Text Bookl, Sections: 3.1-3.7 L1 - L3	08
3	**Artificial Neural Networks :** Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm. Example program in Python Text book 1, Sections: 4.1 —4.6 L1 - L3	07
4	**Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL	08

	principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm, Example program in Python.Text book 1, Sections: 6.1 — 6.6, 6.9, 6.11, 6.12 L1 - L4	
5.	E**valuating Hypothesis:** Motivation, Estimating hypothesis accuracy, Basics of the sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms. Instance-Based Learning: Introduction, k—nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning Example program in Python. Textbook 1, Sections: 5.1-5.6, 8.1-8.5, 13.1-13.3 L1 - L3	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

1.Identify the problems in machine learning.
2. Select supervised, unsupervised or reinforcement learning for problem-solving.
3. Apply theory of probability and statistics in machine learning
4. Apply concept learning, ANN, Bayes classifier, k nearest neighbor.
5. Perform statistical analysis of machine learning techniques.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraW Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Ethem Alpaydyn, Introduction to machine learning, second edition, MIT press.
3. https://Www.analyticsvidhya.com/blog/2015/04/comprehensive-guide- data-exploration-sas-using-python-numpy—scipy—matplotlib-pandas/
4. https://www.oreilly. com/library/vieW/python-for-data/978 149 1 95765 3/ ch01 .html

Course Title	**Wireless Sensor Networks and its Applications**						
Course Code	22ETT704D						
Category	Professional elective (PE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

1. To learn the technologies and challenges of Wireless Sensor Networks.
2. To study the architecture of node and networks.
3. To understand various protocols of Wireless Sensor Networks.
4. To learn the topology control and positioning of nodes.
   To get familiarized with different platforms and tools needed for Wireless Sensor Networks.

Unit No.	Syllabus	No. of Teaching hours
1	**OVERVIEW OF WIRELESS SENSOR NETWORKS** Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Mobile Ad-Hoc Networks, 4G LTE and applications.	08
2	**ARCHITECTURES** Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures	08

	of Merit, Gateway Concepts.	
3	**NETWORKING SENSORS** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, B- MAC, IEEE 802.15.4 standard and Zigbee, Dissemination protocol for large sensor network. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	09
4	**INFRASTRUCTURE ESTABLISHMENT** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. **SENSOR NETWORK PLATFORMS AND TOOLS** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	08
5	**APPLICATION** Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions,Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ Telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol(CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols	06

Course Outcomes :

CO1. Learnt the technologies and challenges of Wireless Sensor Networks.
CO2. Understood the architecture of sensor node and networks.
CO3. Understood various protocols of Wireless Sensor Networks.
CO4. Learnt the topology control and positioning of nodes, different platforms and tools.
CO5. To Study the Application for Wireless Sensor Networks.

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
O1	3	2			2	2	2					1	3	2	2
O2	3	2			3							2	3	3	1
O3	3	2			3							2	3	3	1
O4	3	2	2	2	3				2	2		1	3	3	2
O5	3	3	2	2	3	2	2	1	2	2	2	1	3	3	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. “Wireless Sensor Networks”, Spinger 1st Edition 2004.

4. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017.

REFERENCE BOOKS:

1. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks Technology, Protocols and applications", Wiley Publications, 2013.
3. K Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
4. N P Mahalik, "Sensor Networks and Configuration- Fundamentals , standards , platforms and applications", Springer verlag, 2007.

Course Title	**Wireless Sensor Networks**						
Course Code	22ETT705A						
Category	Open elective (OE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

5. To learn the technologies and challenges of Wireless Sensor Networks.
6. To study the architecture of node and networks.
7. To understand various protocols of Wireless Sensor Networks.
8. To learn the topology control and positioning of nodes.
   To get familiarized with different platforms and tools needed for Wireless Sensor Networks.

Unit No.	Syllabus	No. of Teaching hours
1	**OVERVIEW OF WIRELESS SENSOR NETWORKS** Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Mobile Ad-Hoc Networks, 4G LTE and applications.	09
2	**ARCHITECTURES** Single-Node Architecture - Hardware Components, Energy Consumption of	09

	Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	
3	**NETWORKING SENSORS** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, B- MAC, IEEE 802.15.4 standard and Zigbee, Dissemination protocol for large sensor network. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	09
4	**INFRASTRUCTURE ESTABLISHMENT** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	06
5	**SENSOR NETWORK PLATFORMS AND TOOLS** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	06

Course Outcomes :

CO1. Learnt the technologies and challenges of Wireless Sensor Networks.
CO2. Understood the architecture of sensor node and networks.
CO3. Understood various protocols of Wireless Sensor Networks.
CO4. Learnt the topology control and positioning of nodes.
CO5. Studied the different platforms and tools for Wireless Sensor Networks.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	2	2					1	3	2	2
CO2	3	2			3							2	3	3	1
CO3	3	2			3							2	3	3	1
CO4	3	2	2	2	3				2	2		1	3	3	2
CO5	3	3	2	2	3	2	2	1	2	2	2	1	3	3	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

5. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley, 2005.
6. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

7. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. “Wireless Sensor Networks”, Spinger 1st Edition 2004.

REFERENCE BOOKS:

5. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
6. Kazem Sohraby, Daniel Minoli, and Taieb Znati, “Wireless Sensor Networks Technology, Protocols and applications”, Wiley Publications, 2013.
7. K Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
8. N P Mahalik, “Sensor Networks and Configuration- Fundamentals , standards , platforms and applications”, Springer verlag, 2007.

Course Title	**Multimedia Communication**						
Course Code	22ETT705B						
Category	Open Elective Course(OEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To understand the different compression techniques for Text and Image with examples.
3. To study the different compression techniques for Audio.
4. To study the different compression techniques for Video.
5. To identify Multimedia Communication across Networks.

Unit No	Syllabus Content	No. of Teaching Hours
1	**MULTIMEDIA COMMUNICATIONS:** Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, Network QoS, Application QoS.	07
2	**TEXT AND IMAGE COMPRESSION**: Introduction, compression principles, Text compression – Static Huffman coding, Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG Encoder and Decoder.	08

3	**AUDIO COMPRESSION:** Introduction, Audio compression – DPCM, ADPCM, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders.	08
4	**VIDEO COMPRESSION** : Video compression principles, H.261, H.263, H.264, H.265, MPEG, MPEG-1, MPEG-2, and MPEG-4, animation.	08
5	**MULTIMEDIA INFORMATION NETWORKS:** Introduction, LANS, Ethernet, Token Ring, Bridges, FDDI High- Speed LANS	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

CO1: Acquire the knowledge of types of Multimedia networks and applications.
CO2: Illustrate the representation of information of Text, Images, Audio and Video.
CO3: Analyze the Text and Image compression using different techniques and Standards.
CO4: Analyze the Audio and Video compression using different techniques and Standards.
CO5:. Describe Multimedia Communication across Networks.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
O1	3		1	1						2		2	2	1	
O2	2	2	3	1	2				2	1		2	3	2	1
O3	2	3	2	1	3				2	1		2	3	2	1
O2	2	2	2	1	2				2	1		2	3	2	1
O3	3		1	1						2		2	2	1	

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Fifth Indian reprint 2011.

REFERENCE BOOKS:

1. **Multimedia: Computing, Communications and Applications**- Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758

2. **Fundamentals of Multimedia** – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Course Title	**Fundamentals of Digital Image Processing**						
Course Code	22ETT705C						
Category	Open elective (OE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

<u>Course Objectives</u> : The objectives are to

11. Understand the basic principles and methods of digital image processing.
12. Be able to formulate solutions to general image processing problems.
13. To learn various image enhancement techniques.
14. To study segmentation techniques used in different applications.
15. To acquire knowledge of concepts of color image processing.

UNIT No	Syllabus Content	No. of Teaching Hours
1	**DIGITAL IMAGE FUNDAMENTALS** Background, fundamental steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image sensing and acquisition, Image Sampling and Quantization, Some basic relationships between pixels.	**9**
2	**IMAGE ENHANCEMENT IN SPATIAL DOMAIN** Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/ Logic Operations, Use of Python for implementation of image processing algorithms.	**8**
3	**IMAGE ENHANCEMENT IN FREQUENCY DOMAIN** Introduction to Fourier Transform and the Frequency domain for an im Smoothing Frequency Domain Filters, Sharpening Frequency dor filters, homomorphic filtering.	**7**

4	**IMAGE SEGMENTATION:** Detection of discontinuities, edge linking and boundary detection, Thresholding, region oriented segmentation, segmentation of morphological watersheds, the use of motion in segmentation.	**8**
5.	**COLOR IMAGE PROCESSING** : Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing	**7**

Course Outcomes : After the completion of the course, the student will be able to

11. Explain the representation of a digital image.
12. Understand the effect of applying various enhancement techniques in spatial domain.
13. Analyze the impact of frequency domain techniques on images.
14. Analyze computer-vision applications with various segmentation techniques.
15. Know the applicability of various color-models.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS

1. Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing", PHI 4th Edition, 2017.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar," Digital Image Processing, TMH Publication, 2nd edition, 2017

REFERENCE BOOKS / WEBLINKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI Learning , 3rd Edition,
2. Madhuri A Joshi "Digital Image Processing –an alogorithm approach", PHI Learning, 2006
3. http://eeweb.poly.edu/~onur/lectures/lecture8.pdf

Course Title	**Computer Communication Networks**						
Course Code	22ETU601						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. To define and understand the Layer functions of OSI model and TCP/IP Suite.
2. To study framing, flow control and error control and different Multiple accesses techniques.
3. To study the standards and protocols of Wired and Wireless LANs.
4. To understand IPv4, IPv6 formats and to implement the different Routing algorithms.
5. To study UDP and TCP protocols in Transport Layer.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Layered tasks & Models**: OSI Model, Layers in OSI model, TCP/IP Suite, Addressing. **Switching:** Circuit switched Networks, Datagram Networks, Virtual-Circuit Networks.	8
2	**Data Link Control** : Framing, Flow & Error Control, Cyclic Redundancy Check, Sliding Window Protocols, HDLC. **Multiple Access**: Random access –CSMA, CSMA/CD, CSMA/CA, Controlled access – Reservation, Polling and Token Passing, Channelization – FDMA, TDMA, CDMA.	8
3	**Wired LANs**: Ethernet: IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet. **Wireless LANS**: IEEE 802.11, Bluetooth. Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Loop problem & Spanning Tree, Routers, Gateways.	8
4	**Network Layer:** Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6, Delivery, Forwarding techniques and Process, Unicast Routing Protocols: Distance Vector Routing, Link State Routing, Dijktras Algorithm.	8

5.	**Transport layer:**: User Datagram protocol: User Datagram, UDP operation, UDP Applications. Transmission Control Protocol: TCP Services, TCP Features, Segment. **Congestion Control & QOS:** Congestion Control, Scheduling & Traffic Shaping- Leaky Bucket & Token Bucket.	8

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PRACTICAL COMPONENT OF IPCC	
Sl No.	**I. Implementation of Algorithms using C/C++ Language**
1	HDLC frame to perform Bit stuffing and destuffing.
2	HDLC frame to perform Byte stuffing and destuffing.
3	Encryption and decryption using Substitution method.
4	Encryption and decryption using Transposition method.
5	Sliding Window Protocol of Data Link Layer
6	CRC-CCIT polynomial to obtain CRC code and verify the same for with and without Error
7	Dijkstra's algorithm to compute the shortest routing path.
8	To find minimum spanning tree of a subset.
9	Congestion control using Leaky Bucket algorithm.
II. CCN Experiments using Hardware	
10	Establishing connection between external devices using RS 232 communication
11	Establishing connection between external devices using MODEM communication
12	Establishing connection between external devices using Fiber Optic communication.
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos	

Course Outcomes :

CO1: Identify and differentiate the architecture of OSI model and TCP/IP model and different Switching Techniques.

CO2: Implement DLL protocols in HDLC formats. and Analyze performance of channel Access using Random, Controlled and Channelization protocols.

CO3: Discuss the different Ethernet standards of Wired and Wireless LANs.

CO4: Implement different Routing algorithms and analyze IPV4 and IPV6 formats and transitions.

CO5: Acquire the knowledge of UDP and TCP Protocols in Transport Layer, Congestion and

QOS

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. **Data Communication and Networking,** Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25- 906475-3.

REFERENCE BOOKS / WEBLINKS :

1. **Computer Networks**, Andrew Tanenbaum, Pearson Education 2008
2. **Computer Networks, James F. Kurose, Keith W. Ross**: Pearson education, 2nd Edition, 2003
3. **Introduction to Data communication and Networking, Wayne Tomasi: Pearson education 2007**
4. **www.tutorialspoint.com/...communication_computer_network/data_communication**

Course Title	**ARM & Embedded System Design**						
Course Code	**22ETT602**						
Category	PCC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. Understand the basic concepts of Embedded Systems.
2. Explain the Characteristics and quality attributes and Program of Embedded Systems.
3. Get exposure to an advanced microcontroller Cortex M3.
4. Understand the definition, structure and Working of Real Time Operating system.
5. Analyze different Embedded Systems in various Domain applications.

UNIT	Syllabus Content	No. of Teaching Hours	Tutorial
1	**Typical Embedded System:** Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware and Embedded Firmware approaches.	08	05
2	**Characteristics and Quality Attributes of Embedded Systems:** Characteristics of an Embedded system, Quality attributes of Embedded Systems. **Hardware Software Co-Design and Program Modelling**: Fundamental issues in Hardware Software Co-Design, Computational Models in Embedded Design.	08	05
3	**ARM-32bit Microcontroller:** ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Cortex-M3 Basics, Instruction Sets.	08	05

4	**RTOS for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Multiprocessing and Multitasking, Task scheduling, Task Communication.	08	05
5.	**Embedded Systems-Application and Domain Specific**: Washing Machine-application specific Embedded System, Automotive-Domain Specific Example of Embedded Systems, Key Players of Automotive Embedded Market. **Design Case Studies:** Digital camera, Embedded Systems inAutomobile, Smart Card Reader, Automated Meter Reading System.	07	06

Course Outcomes :

CO1. Understand different blocks of a Typical Embedded System.
CO2. Analyze different characteristics, quality attributes and modelling Techniques of embedded system design
CO3. Apply the knowledge of Instruction Set to program ARM 32bit Microcontroller.
CO4. Analyze the concepts of Real time kernel & Operating System services.
CO5. Evaluate the current trends in embedded industry and analyze different application and domain specific examples of embedded systems through case studies.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2										2	2	2
CO2	3	2	2	2	2								2	2	2
CO3	3	2	2	2	2								2	2	2
CO4	3		2										2	2	2
CO5	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Text book

1. Shibu K V, "Introduction to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2009
2. Joseph Yiu,"The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, (Elsevier), 2008

Reference Books:

1. "Raj Kamal, "Embedded Systems – Architecture, Programming and Design", edition, Mc Graw Hill, 2012
3. James K Peckol "Embedded Systems – A contemporary Design Tool", edition, John Weily, 2008

Sub Title : CRYPTOGRAPHY & NETWORK SECURITY		
Sub Code: 22ETT603A	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Category	Professional Elective	
Exam Duration : 3 hours		**Total No. of Contact Hours : 39**

Course Objectives:

1. To provide an introduction to the fundamental principles of cryptography and its applications on the network security domain.
2. To study various approaches to Encryption techniques, Design Principles and Modesof operation.
3. To study a given system with respect to security of the system.
4. To analyze the given system with respect to digital signature and intruders.
5. To analyze the given system with respect to malicious software and firewalls.

UNIT No	Syllabus Content	No of Teaching Hours
1	**Introduction:** Services, mechanisms and attacks, The OSI security architecture, A model for network security. **Symmetric Ciphers**: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of Operation.	08
2	**Principles of Public-Key Cryptosystems**: Public-key cryptosystems, Applications for public-key cryptosystems, requirements for public-key cryptography, The RSA algorithm, Key Management, Diffie – Hellman KeyExchange.	07
3	**Web Security Consideration**: Security socket layer (SSL), SSL architecture, Transport layer security, Secure Electronic Transaction.	07

4	**Digital signatures**: Requirements, direct digital signature, arbitrated digital signature, Digital Signature Standard , DSS approach, Digital Signature Algorithm. **Intruders**: Intruders, Intrusion techniques, Intrusion Detection, distributed intrusion detection, honeypots, Intrusion detection exchange format.	09
5	**Malicious software**: Viruses and Related Threats, malicious programs, nature of viruses, virus structure, types, Virus Countermeasures, antivirus approaches, advanced antivirus techniques, . **Firewalls**: Firewalls Design Principles, firewall characteristics, types of firewalls, firewall configurations, Trusted Systems, data access control, concept of trusted systems.	08

Course Outcomes:

CO1: Apply the concepts of cryptographic techniques that provides information and network security.
CO2: Demonstrate the importance of SSL layer and Transport layer security.
CO3:Explain the concepts of public-key Cryptosystems.
CO4:Illustrate the importance of Digital signature and Intruders.
CO5 : Understanding of Firewalls

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2										2	2	2
CO2	3	2	2	2	2								2	2	2
CO3	3	2	2	2	2								2	2	2
CO4	3		2										2	2	2
CO5	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOK:

1. **Cryptography and Network Security– William Stalling, Pearson Education, 2003.**

REFERENCE BOOKS:

1. **Cryptography and Network Security – Behrouz A. Forouzan, TMH, 2007.**
2. **Cryptography and network security– Atul Kahate, , TMH, 2003.**
3. **williamstallings.com/Extras/Security-Notes/**

Sub Title : Fundamentals of AI & ML		
Sub Code: 22ETT603C	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Course Category : Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

After completing the course, the students should:

1. Analyse the various Machine Learning challenges.
2. Understand various classification techniques.
3. Understand various dimensionality reduction and SVM methods.
4. Understand decision trees.
5. Become familiar with random forest concept.

Unit No.	Syllabus	No. of Teaching hours
1	**The Machine Learning Landscape:** About Machine Learning(ML), Uses and applications with examples, Types of Machine learning, Main challenges of Machine learning, Testing and Validating. **End to End Machine Learning:** Working with Real Data, Frame the Problem, Select the performance measure, Prepare the Data for ML Algorithms, Training and evaluating the Data set. **Bayesian Decision Theory:** Introduction, Classification, Losses and Risks, Discriminant Functions, Association Rules.	08
2	**Classification:** MNIST, Training binary Classifiers, Performance measures, MultiClass classification, Error Analysis, Multilevel and Multi-output Classification.	08

	Training Models: Linear Regression, Gradient descent, Regularised Linear models- Ridge and Lasso Regression, Logistic Regression.	
3	**Dimensionality Reduction:** The Curse of Dimensionality, Main Approaches of Dimensionality, PCA, Kernel PCA, LLE, Linear Discriminant Analysis(LDA). **Support Vector Machines:** Linear SVM classification, Non-Linear SVM, SVM Regressions, Kernelized SVMs.	08
4	**Decision Trees:** Univariate Trees: Classification and Regression Trees, Training and Visualising a Regression Tree, Pruning, Rule Extraction from Trees, Learning Rules from data, Making prediction, Learning Estimating Class probabilities, CART Training Algorithm, Computational Complexity, G1n1 Impurity or Entropy? Regularisation Hyperparameters, Multivariate Trees.	08
5	**Ensemble Learning and Random Forests:** Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting. **Unsupervised Learning Techniques:** Clustering – K Means, Spectral, Hierarchical.	07

Course Outcomes:

CO1 : Ability to analyze the Machine Learning challenges.
CO2 : Understanding of various classification techniques.
CO3 : Understand ing of various dimensionality reduction and SVM methods.
CO4 : Understanding of various dimensionality reduction and SVM methods.
CO5 : Familiarity with random forest concept.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Text Books:

1. Introduction to Machine Learning, Ethem Alpaydin, PHI learning Pvt. Ltd, 3rd Edition, 2018.
2. Hands on Machine learning with Scikit-Learn and TensorFlow: concepts, tools, and Techniques to build intelligent systems, Aurelien Geron, O'Reilly Media 2019.

Reference Books :

1. Pattern Recogniti.on and Machine Learning, Bishop, Christopher M, Springer Publication.
2. The Elements of Statistical Learning, Trevor Hastle, Robert Tibshirani, Jerome H, Friedman, Springer Publication.

Sub Title : RADAR Engineering		
Sub Code:22ETT603B	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Course Category : Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

After completing the course, the students should:

1. To understand radar principles, waveforms, and operational basics.
2. To predict radar range, detection capabilities, and signal-to-noise ratio (SNR).
3. To Explore MTI, Pulse Doppler radar, and digital signal processing in radar systems.
4. To learn about radar applications, tracking systems, and radar antenna designs.
5. To develop skills in solving radar-related problems and analyzing system components.

Unit No.	Syllabus	No. of Teaching hours
1	**Basics of Radar:** Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect topulse wave form-PRF,PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems.	08
2	**The Radar Equation:** Prediction of Range 'Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation,	08

	Envelope Detector - False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets - sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.	
3	**MTI and Pulse Doppler Radar:** Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweepto Sweep subtraction and DelayLine Canceler, MI1 Radar with- Power Amplifier Transmitter, Delay Line Cancelers- Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MI1 Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing-Blind phases, I and QChannels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD.	08
4	**Tracking Radar:** Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse (one-and two- coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range,Comparison ofTrackers.	08
5	**The Radar Antenna :** Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phase darrayAntennas. **Radar Receiver:** The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver,Duplexers and Receivers Protectors, Radar Displays.	07

Course Outcomes:

After successful completion of the course, the students are able to

CO1 : Describe the radar fundamentals.
CO2 : Analyze the radar signals.
CO3 : Explain the working principle of pulse Doppler radars, their applications and limitations.
CO4 : Describe the working of various radar transmitters and receivers.
CO5 : Analyze the range parameters of pulse radar system, which affect the sys- tem performance.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2

CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Introduction to Radar Systems- Merrill Skolink, 3e,TMH, 2001

REFERENCE BOOKS/WEBLINKS:

1. Radar Principles, Technology, Applications-Byron Edde, Pearson Education, 2004.

Subject Title : **Principles of VLSI Design**		
Sub Code : 22ETT603D	**No of credits : 3=3:0:0** **(L-T-P)**	**No of hrs/week : 3**
Course Category : Professional Elective		
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course objectives :

1. To teach the Basic MOS technology.
2. To design the Basic circuit and Layout diagram.
3. To teach CMOS subsystem design and basic circuit concepts.
4. To analyze scaling of MOS circuits and process illustration.
5. To teach the basics of memory, registers clocks in MOS technology.

Unit No	Syllabus	No of hours
1	**BASIC MOS TECHNOLOGY:** Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. BiCMOS technology.	8
2	**CIRCUIT DESIGN PROCESSES:** The Complementary CMOS Inverter –DC Characteristics. MOS layers. Stick diagrams. Design rules and layout – lambda-based designand other rules. Examples. Layout diagrams. Symbolic diagrams.	8

3	**CMOS SUBSYSTEM DESIGN:** Architectural issues. Switch logic. Gate logic, Design examples – combinational logic, CMOS Complementary, Pseudo NMOS, Dynamic CMOS, Clocked CMOS, Pass Transistor logic, Clocked circuits. **BASIC CIRCUIT CONCEPTS:** Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.	8
4	**SCALING OF MOS CIRCUITS:** Scaling models and factors. **CMOS SUBSYSTEM DESIGN PROCESSES:** General considerations. Process illustration. ALU subsystem. Adders. Multipliers, Serial Parallel, Braun Array, Baugh -Wooley.	8
5	**MEMORY, REGISTERS AND CLOCK:** Timing considerations. 4Transistor Dynamic Memory, One Transistor Dynamic Memory, 4 Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cellarrays.	7

Course Outcomes:

CO1 : An ability to apply to apply knowledge about basic MOS technology.
CO2 : An ability to design and implement MOS transistor, layout and symbolic diagrams.
CO3 : An ability to design architectural issues and basic circuit concepts.
CO4 : An ability to identify scaling models and their limitations with subsystem processillustration.
CO5 : The broad education necessary to understand the impact of CMOS in storage devices andclocks

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Basic VLSI Design - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste and K. Eshragian, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2000.

REFERENCE BOOKS:

1. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K. N. Bhat, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

2.http://www.scrbd.com/doc/121356137/CMOS-VLSI-VTU-full-notes

Course Title	**Mobile Communication**						
Course Code	22ETT604A						
Category	Open elective (OEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

After completing the course, the students should:

1. Analyse the environment in which the wireless industry operates.
2. Understand the different propagation mechanisms of wireless signals.
3. Understand different modulation schemes used in wireless communications.
4. Understand GSM concepts for wireless communication.
5. Become familiar with 3G technologies.

Unit No.	Syllabus	No. of Teaching hours
1	**Introduction to wireless communication system & Networks:** History & Evolution of mobile radio communication, Different generation of Wireless Cellular Networks 1G,2G, 3G ,4G & 5G. Examples of Wireless Communication System. **Cellular Concept:** Frequency reuse. Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Capacity in Cellular Systems.	08
2	**Mobile radio propagation(large scale path loss):**Free space propagation model, relating power to electric field, three basic propagation mechanisms, reflection, Two-ray model, diffraction, outdoor and indoor propagation models	07
3	**Mobile radio propagation(Small scale fading and multipath):**Small scale multipath propagation, impulse response model, small scale multipath measurement, parameters of mobile multipath channels, types of small scale fading.	08
4	**Global System for Mobile (GSM):**GSM services and features, system architecture, Radio subsystem, channel types. Example of GSM call, frame structure for GSM, signal processing in GSM.	08

5	**3G Digital cellular technology**:2.5G TDMA,GPRS ,EDGE Technologies, Need for 3G cellular network,IMT-2000 global standard, UMTS technology, W-CDMA air interface, TD-SCDMA technology, CDMA 2000 cellular technology. (**Text 2**)	08

Course Outcomes:

1. Demonstrate cellular radio concepts in the design of wireless communication systems
2. Analyse different propagation mechanisms.
3. Study small scale propagation models and modulation scheme of wireless communication systems .
4. Understand GSM concepts for wireless communication.
5. Learn about 3G wireless technology

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3	3							2	2	2
CO2	3	3			3			3					2	2	2
CO3	3			3	3	3							2	2	2
CO4	3	3				2		2					2	2	2
CO5	3	3				2			2				2	2	2

TEXT BOOKS:

1. **Wireless communications –Theodore. S. Rappaport**, PHI, second edition,2010.
2. **Wireless Communications** – **T.L. Singal**, Mcgraw Hill,2015.

REFERENCE BOOKS/WEBLINKS:

1.	**Mobile Cellular Telecommunication** – Lee W.C.Y, MGH, 2002.
2.	**Wireless communication** – D P Agrawal: 2nd Edition Thomson learning, 2007.
3.	**Fundamentals of Wireless Communication** – David Tse, Pramod Viswanath, Cambridge.
4.	**Fundamentals of 5G Mobile networks** – Jonathan Rodriguez, WILEY, 2015.
5.	https://youtu.be/hQvHNVRv_ms (5G cellular networks: 6 new technologies)

Subject Title : **Fundamentals of VLSI Design**		
Sub Code : 22ETT604C	**No of credits : 3=3:0:0** **(L-T-P)**	**No of hrs/week : 3**
Category	**Open elective (OEC)**	
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course objectives :

1. To teach the Basic MOS technology.
2. To design the Basic circuit and Layout diagram.
3. To teach CMOS subsystem design and basic circuit concepts.
4. To analyze scaling of MOS circuits and process illustration.
5. To teach the basics of memory, registers clocks in MOS technology.

Unit No	Syllabus	No of hours
1	**BASIC MOS TECHNOLOGY:** Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. BiCMOS technology.	8
2	**CIRCUIT DESIGN PROCESSES:** The Complementary CMOS Inverter –DC Characteristics. MOS layers. Stick diagrams. Design rules and layout – lambda-based designand other rules. Examples. Layout diagrams. Symbolic diagrams.	8
3	**CMOS SUBSYSTEM DESIGN:** Architectural issues. Switch logic. Gate logic, Design examples – combinational logic, CMOS Complementary, Pseudo NMOS, Dynamic CMOS, Clocked CMOS, Pass Transistor logic, Clocked circuits. **BASIC CIRCUIT CONCEPTS:** Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.	8
4	**SCALING OF MOS CIRCUITS:** Scaling models and factors. **CMOS SUBSYSTEM DESIGN PROCESSES:** General considerations. Process illustration. ALU subsystem. Adders. Multipliers, Serial Parallel, Braun Array, Baugh -Wooley.	8

5	**MEMORY, REGISTERS AND CLOCK:** Timing considerations. 4Transistor Dynamic Memory, One Transistor Dynamic Memory, 4 Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cellarrays.	7

Course Outcomes:

CO1 : An ability to apply to apply knowledge about basic MOS technology.
CO2 : An ability to design and implement MOS transistor, layout and symbolic diagrams.
CO3 : An ability to design architectural issues and basic circuit concepts.
CO4 : An ability to identify scaling models and their limitations with subsystem processillustration.
CO5 : The broad education necessary to understand the impact of CMOS in storage devices andclocks

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3	3							2	2	2
CO2	3	3			3			3					2	2	2
CO3	3			3	3	3							2	2	2
CO4	3	3				2		2					2	2	2
CO5	3	3				2			2				2	2	2

TEXT BOOKS:

1. Basic VLSI Design - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (originalEdition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste and K.Eshragian, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2000.

REFERENCE BOOKS:

1. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K. N. Bhat, TataMcGraw-Hill Publishing Company Limited, New Delhi, 2007.

http://www.scrbd.com/doc/121356137/CMOS-VLSI-VTU-full-notes

Course Title	**Embedded System Design & ARM Processor**						
Course Code	**22ETT604B**						
Category	Open Elective						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	0	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. Understand the basic concepts of Embedded Systems.
2. Explain the Characteristics and quality attributes and Program of Embedded Systems.
3. Get exposure to an advanced microcontroller Cortex M3.
4. Understand the definition, structure and Working of Real Time Operating system.
5. Analyze different Embedded Systems in various Domain applications.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Typical Embedded System:** Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators	7
2	**Characteristics and Quality Attributes of Embedded Systems:** Characteristics of an Embedded system, Quality attributes of Embedded Systems. **Hardware Software Co-Design and Program Modelling**: Fundamental issues in Hardware Software Co-Design, Computational Models in Embedded Design.	8
3	**ARM-32bit Microcontroller:** ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Instruction Sets.	8
4	**RTOS for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Multiprocessing and Multitasking, Task scheduling, Task Communication.	8
5.	**Embedded Systems-Application and Domain Specific**: Washing Machine-application specific Embedded System, Automotive-Domain Specific Example of Embedded Systems, Key Players of Automotive Embedded Market.	8

Course Outcomes :

CO1. Understand different blocks of a Typical Embedded System.
CO2. Analyze different characteristics, quality attributes and modelling Techniques of embedded system design
CO3. Apply the knowledge of Instruction Set to program ARM 32bit Microcontroller.
CO4. Analyze the concepts of Real time kernel & Operating System services.
CO5. Evaluate the current trends in embedded industry and analyze different application and domain specific examples of embedded systems through case studies.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2										2	2	2
CO2	3	2	2	2	2								2	2	2
CO3	3	2	2	2	2								2	2	2
CO4	3		2										2	2	2
CO5	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Text book 1: Shibu K V, "Introduction to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2009
Text Book 2: Joseph Yiu,"The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, (Elsevier), 2008
Reference Books:
1. "Raj Kamal, "Embedded Systems – Architecture, Programming and Design", edition, Mc Graw Hill, 2012
2. James K Peckol "Embedded Systems – A contemporary Design Tool", edition, John Weily, 2008

Sub Title : Principles of Satellite Communication		
Sub Code: 22ETT604D	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

After completing the course, the students should:

1. Analyse the different orbits and orbital parameters.
2. Understand antenna look angles and eclipse.
3. Understand different link budget analysis.
4. Understand various subsystems and controls.
5. Become familiar with earth segments

Unit No.	Syllabus	No. of Teaching hours
1	**Orbits :** Introduction, Kepler's Laws, Definitions, Orbital Elements, Apogee and Perigee Heights, Orbital perturbations, Sidereal Time, The Orbital Plane, Sun-synchronous Orbit. - relevant problems	08
2	**Geostationary Orbit :** Antenna Look Angles, Polar Mount Antenna, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	08
3	**Space Link :** EIRP, Transmission Losses, Link Power budget equation, System noise, CNR , Uplink, Downlink, Combined CNR. - relevant problems	08
4	**Space Segments :** Power supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders **Specialized services:** Satellite Mobile service, VSATs , Radarsat, GPS **(Text2)**	08
5	**Earth Segment :** Receive only home TV system, out door unit, indoor unit, MATV, CATV,Tx-Rx earth station	07

Course Outcomes:

1. Analyze different types of orbits and orbital parameters.
2. To calculate look angle for a satellite .
3. Compute different types of losses in satellite communication.
4. Able to analyze different subsystems
5. Have knowledge of earth segment.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Satellite Communications –Dennis Roddy,4th Edition,McGraw Hill International edition,2008.
2. Fundamentals of Satellite Communication-SK Raman,PearsonEducation,2011

REFERENCE BOOKS/WEBLINKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2006.
2. Satellite Communication Concepts and Applications – K.N.RajaRao, 2nd Edition., PHI ,Publication year 2013.
3. www.nrsc.gov.in

Course Title	**ARM Processor & Embedded System Design Lab**						
Course Code	**22ETL606**						
Category	PCCL						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives:

This laboratory course enables students to

1. Develop the embedded C level programming of ARM Cortex M3 Processor using Kiel µ vision 5.
2. Understand Interfacing of different modules to LPC1768 MCU

Sl. No.	Experiment Content
1	Write a Assembly Language Program to Calculate 10+9+8+7+……..+1.
2	Write a Assembly Language Program to store data in RAM.
3	Write a Assembly Language Program to find squares of first 5 natural numbers and store data in RAM.
4	Write a Assembly Language Program to find 2's compliment of a number and store data in RAM.
5	Write a Assembly Language Program to solve the given polynomial function.
6	Write a C program to Output the message using UART of LPC1768.
7	Write a C Program to interface LED using LPC 1768.
8	Write a C Program to interface Relay using LPC 1768.
9	.Write a C programs to interface a DAC of LPC 1768.
10	Write a C program to interface Keypad using LPC 1768.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

CO1: Create assembly ,Embedded C level programs of ARM Cortex M3

CO2: Interface different modules to LPC1768 MCU.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	2			3			1	3	2	1
CO2	3	3	2		2	2			3			1	3	2	1
CO3	3	3	2		2	2			3			1	3	2	1
CO4	3	3	2		2	2			3			1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Joseph YIu," The Definite Guide to the ARM Cortex M3" ,Second Edition,Newnes,2008

Course Title	**ANTENNA DESIGN AND TESTING Lab**						
Course Code	**22ETT607A**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	-	2
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. To understand the various antenna parameters.
2. Conduct experiments to study the Radiation pattern of Antennas.
3. Design different types of antenna arrays and study the pattern characteristics (MATLAB)
4. Design of MMIC antennas like Patch Antenna and study the characteristics.

Sl.No	Experiments
1	Matlab/C implementation of to obtain the radiation pattern of an antenna.
2	To obtain the radiation pattern of a Dipole Antenna and calculate its directivity.
3	To calculate the aperture of a Dipole Antenna.
4	Determine the directivity and Gain of Horn antenna.
5	To obtain the Radiation pattern of a microstrip antenna.
6	Experimental study of radiation pattern of Parabolic antenna..
7	Analysis of E & H plane horns.
8	Plot 2-D and 3-D radiation pattern of omnidirectional antenna using MATLAB.
9	Design and implementation of any broadside array antenna using MATLAB.
10	Design and implementation of any endfire array antenna using MATLAB.
Demonstration Experiments	
11	Design of dipole antenna using FEKO/ HFSS Software
12	Design of a Patch Antenna using FEKO /HFSS Software.

Course outcomes :

At the end of the course the student will be able to:

1. Analyze the radiation pattern and characteristics of antenna
2. Ability to design various antenna
3. Ability to use different software tools to study antenna characteristics
4. Analyze radiation pattern of linear array antennas

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	2	3	-	-	-	2	1	2	1	3	2	2
CO2	3	3	2	2	3	-	-	-	2	1	2	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	2	1	3	3	3
CO4	3	3	3	2	3	-	-	-	2	1	2	1	3	2	1
CO5	3	3	3	2	3	-	-	-	2	1	2	1	3	3	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Course Title	**Communication Simulink Toolbox**						
Course Code	**22ETT607C**						
Category	Ability Enhancement Course(AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives:

- To impart knowledge of simulation software in communication systems.
- To develop skills required to build and analyze the performance of various communication systems under different conditions.

Sl. No.	Experiment Content
1	Amplitude Modulation & demodulation using Simulink.
2	Frequency Modulation & demodulation using Simulink.
3	Phase Modulation & demodulation using Simulink.
4	DSB-SC & SSB Modulation & demodulation using Simulink.
5	ASK Modulation & demodulation using Simulink.
6	FSK Modulation & demodulation using Simulink.
7	PSK Modulation & demodulation using Simulink.
8	QPSK Transmitter and Receiver in Simulink.
9	DPSK Modulation & demodulation using Simulink.
10	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behavior in presence of AWGN.
Study Experiment:	
11	Modulation & demodulation of a random binary data stream using 16 – QAM.
12	Multiplexing – TDM, FDM using Simulink.
13	PCM using Simulink.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Perform modulation and demodulation of various through simulation.
2. Analyze different keying techniques.
3. Plot eye diagram and scatter plot of digital modulation techniques.
4. Demonstrate different modulation and multiplexing schemes using matlab/simulink.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO2	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO3	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO4	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Communication Toolbox – Examples (https://in.mathworks.com/)
2. "Digital Communication Laboratory" Courseware by Professor Lee C Potter, Dr. Yang Yang, Electrical and Computer Engineering, The Ohio State University.

Course Title	IoT LAB						
Course Code	**22ETT607B**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives:

1. Assess the vision and introduction of IoT and understand how M2M is connected to IOT.
2. Identify the appropriate hardware and software components of IoT for communication.
3. Gain knowledge on Cloud Storage models, web servers and how to integrate device, data and cloud management framework for IoT.
4. Learn the concepts of various data analytics and operational technology security with IoT.

Sl. No.	Experiment Content
1	Getting Started with IoT Arduino/Raspberry Pi
2	To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth
7	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0′ is received from smartphone using Bluetooth.
8	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.

9	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
10	To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Interpret the vision of IoT from a global context, compare and contrast M2M and IoT Technology

CO2: Relate the appropriate Hardware and software components of IoT for providing the communication among the devices

CO3: Implement device, data and cloud management services for IoT applications.

CO4: Explore various data analytical techniques and operational security for IoT applications.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3							2	2		2	3	2	2
CO2	3	3							2	2		2	3	2	2
CO3	3	3							2	2		2	3	2	2
CO4	3	3							2	2		2	3	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Course Title	**Virtual instrumentation using LabVIEW**						
Course Code	22ETT607D						
Category	Ability Enhancement course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

1. .Aware of various front panel controls and indicators.
2. Connect and manipulate nodes and wires in the block diagram.
3. Locate various tool bars and pull-down menus for the purpose of implementing specific functions.
4. Locate and utilize the context help window.
5. Familiar with LabVIEW and different applications using it.

Sl. No.	**Experiment Content** Programs(using LabVIEW software)to realize the following:
1	1. Basic arithmetic operations: addition, subtraction, multiplication and division
2	2. Boolean operations: AND, OR, XOR, NOT and NAND
3	3. Sum of ‘n’ numbers using ‘for’ loop
4	4. Factorial of a given number using ‘for’ loop
5	5. Determine square of a given number
6	6. Factorial of a given number using ‘while‘ loop
7	7. Sorting even numbers using ‘while’ loop in an array
8	8. Finding the array maximum and array minimum
9.	Demonstration Experiments (For CIE)
9	10. Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	11. Build a Virtual Instrument that simulates a Basic Calculator (using formula node).

Course Outcomes:

At the end of the course the student will be able to:

CO1 : Use LabVIEW to create data acquisition, analysis and display operations
CO2 : Create user interfaces with charts, graph and buttons
CO3 : Use the programming structures and data types that exist in LabVIEW
CO4 : Use various editing and debugging techniques.
CO5 : Analyse various electronic circuits

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO2	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**2**
CO3	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO4	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO5	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**2**

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome,PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

Course Title	VLSI Design Lab						
Course Code	22ETT607E						
Category	Ability Enhancement course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

6. .Aware of various front panel controls and indicators.
7. Connect and manipulate nodes and wires in the block diagram.
8. Locate various tool bars and pull-down menus for the purpose of implementing specific functions.
9. Locate and utilize the context help window.
10. Familiar with LabVIEW and different applications using it.

Sl. No.	**Experiment Content** Programs(using LabVIEW software)to realize the following:
1	12. Basic arithmetic operations: addition, subtraction, multiplication and division
2	13. Boolean operations: AND, OR, XOR, NOT and NAND
3	14. Sum of ‘n’ numbers using ‘for’ loop
4	15. Factorial of a given number using ‘for’ loop
5	16. Determine square of a given number
6	17. Factorial of a given number using ‘while‘ loop
7	18. Sorting even numbers using ‘while’ loop in an array
8	19. Finding the array maximum and array minimum
20. Demonstration Experiments (For CIE)	
9	21. Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	22. Build a Virtual Instrument that simulates a Basic Calculator (using formula node).

Course Outcomes:

At the end of the course the student will be able to:

CO1 : Use LabVIEW to create data acquisition, analysis and display operations
CO2 : Create user interfaces with charts, graph and buttons
CO3 : Use the programming structures and data types that exist in LabVIEW
CO4 : Use various editing and debugging techniques.
CO5 : Analyse various electronic circuits

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO2	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**2**
CO3	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO4	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**1**
CO5	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**1**	**3**	**1**	**2**

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome,PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

V Semester

MANAGEMENT AND ENTREPRENEURSHIP FOR TELECOMMUNICATION ENGINEERS			
Course Code: 22ETT501	21ET	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours :	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand basic skills of Management.
2. Understand the need for Entrepreneurs and their skills.
3. Identify the Management functions and Social responsibilities.

Module-1	**08 hrs**

Management: Nature and Functions of Management- Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Professionons, Introduction to Project Management in Telecommunications.

Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making-Meaning, Types and Steps in Decision Making, Project Planning and Integration in Telecommunications.

(Selected topics from Chapters 4 & 5, Text 1 and Introduction chapter in Text 2).

Module-2	**07 hrs**

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees-Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staff"mg-Need and Importance, Recruitment and Selection Process

(Selected topics from Chapters 7, 8 & 11, Text 1).

Module-3	**08 hrs**

Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication - Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership.

(Selected topics from Chapters 15to 18and 9, Text 1).

Module-4	08 hrs

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance
(Selected topics from Chapter 3, Text 1).

Module-5	08 hrs

Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship
(Selected topics from Chapter 2, Text 3).

Course outcomes:

At the end of the course the student will be able to:

CO 1. Understand the fundamental concepts of Management and Entrepre- neurship and opportunities in order to setup a business

CO 2. Identify the various organizations' architecture

CO 3. Describe the functions of Managers, Entrepreneurs and their social responsibilities

CO 4. Understand the components in developing a business plan

CO 5. Recognize the various sources of funding and institutions supporting entrepreneurs.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

Text Books:

1. Principles of Management - P.C Tripathi, P.N Reddy, McGraw Hill Education, fYhEdition, 2017. ISBN- 13:978-93-5260-5354.

2. Project Management for Telecommunication Managers, Cella L. Desmond, Kluwer Academic Publishers.

3. Entrepreneurship Development Small Business Enterprises- Poomima MCharantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.

4. Robert D. Hisrich, Mathew J. Manimala, Michael PPeters and DeanA. Shepherd, "Entrepreneurship", S1h Edition, Tata Mc-Graw HillPublishing Co.Ltd.- New Delhi, 2012

Reference Books:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, I01h Edition 2016. ISBN- 978-93-392-2286-4

Course Title	**MICROWAVE ENGINEERING & ANTENNA THEORY**						
Course Code	**22ETU502**						
Category Scheme and Credits	Integrated Professional Core Course (IPCC)					Category Scheme and Credits	Professional Core Course (IPCC) No. of Hours/Week
	No. of Hours/Week	Scheme and Credits	No. of Hours/Week	Scheme and Credits	No. of Hours/Week		
	L	0	L	0	L	65	L
CIE Marks : 50	4		**Total Max. Marks = 100**			4	

UNIT No.	**Syllabus Content**	**No. of Teaching Hours**
1	**Introduction:** Microwave communication system, advantages and applications, frequency bands. Working principle of Klystrons, Travelling Wave Tube Amplifiers, Magnetron Oscillator, Working principle of GUNN diode, PIN diode, relevant problems. (Text-1)	7
2	**Microwave Devices : Passive Devices**-Introduction, Working principle and S-Matrix representation of Microwave Tee Junctions, Directional couplers, Isolators and Circulators. (Text-2)	7
3	**Antenna Basics:** Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones (Text 3).	8
4	**Point sources and arrays:** Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and Spacing, relevant problems. (Text 3)	8
5.	**Antenna Types:** Introduction: Horn Antennas, Rectangular antennas, The Helix geometry, Helix modes, yagi-uda antenna, Helical Antenna, Parabolic Reflector, The paraboloidal Reflector, relevant problems. (Text 3)	9

PRACTICAL COMPONENT OF IPCC Using suitable simulation software, demonstrate the operation of the following circuits:	
Sl no.	**Experiments**
1	Experiment to study Gunn Diode source and its characteristics
2	Determination of the Modes Transit Time, Electronic Timing Range and Sensitivity of klystron source.
3	Calibration of Crystal Detector.

4	Calibration of Variable Waveguide Attenuator
5	Finding Isolation and Insertion loss of Circulator/Isolator.
6	Finding the parameters of Directional coupler. Extraction of S-parameter.
7	Finding the parameters of Magic tee. Extraction of S- parameter.
8	Field intensity measurement of a Horn antenna.
9	Field intensity measurement of a Parabolic dish
10	Matlab/C implementation of to obtain the radiation pattern of an antenna.
11	Experimental study of radiation pattern of two modes in Helical antenna

Course Outcomes :

CO1: Realize the applications of microwave communication system
CO2: Apply S-Matrix representation for various microwave devices
CO3: Identify the basic parameters for antenna systems
CO4: Analyze various antenna parameters and their significance.
CO5: Identify various antenna configurations for suitable applications.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	2	3	-	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1
CO5	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1.Microwave Engineering: Annapurna Das, Sisir K Das TMH Publication, 2nd,2010
2.Microwave&RADAREngineering – M.Kulkarni, Umesh Publications,2001,reprint
3. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.

REFERENCE BOOKS / WEBLINKS :

1. . Microwave Devices and circuits- Liao / Pearson Education.
2. Antennas and Wave Propagation- Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures (e-Resources)

- **Nptel Videos and Lectures**

- **https://www.tutorialspoint.com/antenna_theory/antenna_theory_horn.html**
- **http://www.antenna-theory.com/antennas/smallLoop.php**

Course Title	**Digital Communication**						
Course Code	**22ETU503**						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	2	0	0	5	65	4
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
2. Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
3. Understand the principles of spread spectrum communications.
4. Understand the basic principles of information theory and various source coding techniques.
5. Build a comprehensive knowledge about various Source and Channel Coding techniques.
6.

UNIT No	Syllabus Content	No. of Teaching Hours	Tutorials
1	**Waveform Coding Techniques:** Introduction, Quantization noise and SNR, types of quantization, Adaptive Delta modulation, applications & Problems	08	05
2	**Base-Band Shaping for Data Transmission:** Discrete PAM signals, power spectra of discrete PAM signals. ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission.	08	05
3	**Digital Modulation Techniques:** Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation	08	05

	techniques. **Spread Spectrum Modulation:** Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications.		
4	**Information Theory:** Introduction, Measure of Information, Information Content of a Message, Average Information Content(Entropy) of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences, Markoff Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources.	08	06
5.	**Source Coding :** Encoding the source output, Shannon's Encoding Algorithm, Shannon-Fano encoding algorithm, Huffman Coding, Source Coding theorem, prefix coding,	07	05

Course Outcomes :

After the completion of the Course, the student will be able to

CO1 : Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.

CO2 : Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.

CO3 : Differentiate various spread spectrum schemes and compute the performance parameters of communication system.

CO4 : Apply the fundamentals of information theory and perform source coding for given message.

CO5: Apply the fundamentals of information theory and perform channel coding for given message.

CO-PO-PSO Mapping :

NOTE : Correlation levels 1, 2 or 3 are as defined below:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978- 0-471-64735-5.

2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.

3. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

4. Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.

5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Reference Books:

1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/108102096

Course Title	**Digital Communication Lab**						
Course Code	**22ETL504**						
Category	Professional Core Course Lab (PCCL)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives:

This laboratory course enables students to

1. Design and demonstrate communication circuits for different digital modulation techniques.
2. To simulate Source coding Algorithms using C/C++/ MATLAB code.

Sl. No.	Experiment Content
1	To conduct the experiment of Amplitude shift keying SK generation and detection.
2	To conduct the experiment of Frequency shift keying generation and detection.
3	To conduct the experiment of Binary phase shift keying generation and detection.
4	To conduct the experiment of Quadrature phase shift keying generation and detection using kit
5	To conduct the experiment of Differential phase shift keying generation and detection using kit
6	To conduct the experiment of Pulse Code modulation using kit.
7	Write a Matlab program to find the entropy of information source generating independent message sequences.
8	Write a Matlab program to encode binary data using Shannon's theorem.
9	Write a Matlab program program to encode binary data using Huffman code.

10	Write a Matlab program to encode binary data using Shannon-Fano encoding.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

CO1: Design and test the digital modulation circuits and display the waveforms.

CO2: To Implement the source coding algorithm using C/C++/ MATLAB code.

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1			3			1	3	2	1
CO2	3	3	2		2	1			3			1	3	2	1
CO3	3	3	2		2	1			3			1	3	2	1
CO4	3	3	2		2	1			3			1	3	2	1

CO-PO-PSO Mapping:

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978- 0-471-64735-5.

2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Sub Title : Fundamentals of Satellite Communication		
Sub Code: 22ETT505A	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Course Category : Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives: This course will enable students to:

1. Analyse the different orbits and orbital parameters.
2. Understand antenna look angles and eclipse.
3. Understand different link budget analysis.
4. Understand various subsystems and controls.
5. Become familiar with earth segments

Unit No.	Syllabus	No. of Teaching hours
1	**Orbits :** Introduction, Kepler's Laws, Definitions, Orbital Elements, Apogee and Perigee Heights, Orbital perturbations, Sidereal Time, The Orbital Plane, Sun-synchronous Orbit. - relevant problems	08
2	**Geostationary Orbit :** Antenna Look Angles, Polar Mount Antenna, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	08
3	**Space Link :** EIRP, Transmission Losses, Link Power budget equation, System noise, CNR , Uplink, Downlink, Combined CNR. - relevant problems	08
4	**Space Segments :** Power supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders **Specialized services:** Satellite Mobile service, VSATs , Radarsat, GPS **(Text2)**	08
5	**Earth Segment :** Receive only home TV system, out door unit, indoor unit, MATV, CATV,Tx-Rx earth station	07

Course Outcomes:

CO1 : Analyze different types of orbits and orbital parameters.
CO2 : To calculate look angle for a satellite .
CO3 Compute different types of losses in satellite communication.
CO4 : Able to analyze different subsystems
CO5 : Have knowledge of earth segment.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Satellite Communications –Dennis Roddy,4th Edition,McGraw Hill International edition,2008.
2. Fundamentals of Satellite Communication-SK Raman,PearsonEducation,2011

REFERENCE BOOKS/WEBLINKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2006.
2. Satellite Communication Concepts and Applications – K.N.RajaRao, 2nd Edition., PHI ,Publication year 2013.
3. www.nrsc.gov.in

Sub Title : TRANSMISSION LINES AND WAVE GUIDES		
Sub Code: 22ETT505C	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Course Category : Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives :

1. To introduce the types of Transmission Lines and analyze of their circuit equivalent.
2. To understand the concept of Standing waves.
3. To learn use of Smith chart.
4. To understand different types of propagation in Guided waves.
5. To Study waves in rectangular guide, Attenuation in co-axial line, excitation, and resonant cavities

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Transmission – Line Theory** :The transmission Line general solution, Physical significance of the equations; the infinite line, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0, Open and short circuited Lines, Reflection loss, problems . **(Text 1)**	08
2	**Impedance matching :** standing waves; nodes ; standing wave ratio. input impedance of dissipation less line, input impedance of open- and short-circuited lines, single-stub impedance matching, The quarter wave Line and its applications, relevant equations and problems. **(Text 1)**	08
3	**Smith Chart and its applications :** Smith Circle diagram, Applications of Smith chart, Single-stub impedance matching with Smith Chart. **(Text 1)**	08
4	**Guided waves :** Applications of restrictions to Maxwell's equation, types of propagation; TM, TE and TEM, Transmission of TM,**TE and TEM waves in parallel planes. (Text 1 & 2)**	08
5.	**Wave guides :** Application of Maxwell's equations to the rectangular wave guides, The $TM_{m,n}$ wave in the rectangular guide, The $TE_{m,n}$ wave in the rectangular guide, Excitation of wave guides, Guide terminations, Resonant cavities (Text 1 & 2)	07

Course Outcomes : At the end of the course, students will be able to:

CO1 : Explain various types of transmission lines, types of losses and distortions in them.
CO2 : Computation of parameters related to standing wave and learning design strategies for impedance matching.
CO3 : Use Smith chart to solve problems associated with transmission lines and impedance matching.
CO4 : Analyse types of guided wave between two parallel planes.
CO5: Analyse presence of modes in various types of waveguides.

CO-PO-PSO Mapping :

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1."**Network Lines and Fields**" , John D Ryder, 2 edition, PHI, 2005.

REFERENCE BOOKS/WEBLINKS:

1. "**Transmission Lines and Networks**", Umesh Sinha, 8th edition, Satya Prakashana (Tech India Publication), 2003.
2. "**Networks and systems**", Roy Choudhury,2nd edition,2009, New Academic Science Ltd.

Course Title	**Multimedia Communication**						
Course Code	22ETT505B						
Category	Professional Elective Course(PEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To understand the different compression techniques for Text and Image with examples.
3. To study the different compression techniques for Audio.
4. To study the different compression techniques for Video.
5. To identify Multimedia Communication across Networks.

Unit No	Syllabus Content	No. of Teaching Hours
1	**MULTIMEDIA COMMUNICATIONS:** Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, Network QoS, Application QoS.	07
2	**TEXT AND IMAGE COMPRESSION**: Introduction, compression principles, Text compression – Static Huffman coding, Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG Encoder and Decoder.	08
3	**AUDIO COMPRESSION:** Introduction, Audio compression – DPCM, ADPCM, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders.	08
4	**VIDEO COMPRESSION** : Video compression principles, H.261, H.263, H.264, H.265, MPEG, MPEG-1, MPEG-2, and MPEG-4, animation.	08
5	**ENTERPRISE NETWORKS:** Introduction, LANS, Ethernet, Token Ring, Bridges, FDDI High- Speed LANS	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

CO1: Acquire the knowledge of types of Multimedia networks and applications.
CO2: Illustrate the representation of information of Text, Images, Audio and Video.
CO3: Analyze the Text and Image compression using different techniques and Standards.
CO4: Analyze the Audio and Video compression using different techniques and Standards.
CO5:. Describe Multimedia Communication across Networks.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	1						2		2	2	1	
CO2	2	2	3	1	2				2	1		2	3	2	1
CO3	2	3	2	1	3				2	1		2	3	2	1
CO2	2	2	2	1	2				2	1		2	3	2	1
CO3	3		1	1						2		2	2	1	

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Fifth Indian reprint 2011.

REFERENCE BOOKS:

1. **Multimedia: Computing, Communications and Applications**- Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758
2. **Fundamentals of Multimedia** – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Sub Title : OOPs using C++		
Sub Code: 22ETT505D	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Professional Elective		
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

1. To learn the concepts of object oriented programming.
2. To learn the basic concepts and functions in C++.
3. To learn programming in C++ using classes and objects.
4. To study constructors, destructors and operator overloading concepts.
5. To study inheritance and virtual functions in C++.

UNIT No	Syllabus	No. of Teaching hours
1	**Beginning with C++:** Object Oriented Programming Paradigm**,** Basic concepts of OOP**,** Benefits of OOP, Applications of C++,Structure of C++ program, Tokens, Keywords, Identifiers, Data types, User Defined Data types, Derived Data types, Symbolic constants, Dynamic Initialization of variables.	08
2	Reference Variables**,** Operators in C++, Scope Resolution Operators, Memory Management Operators, Manipulators, Type-cast operators, Operator precedence, Control Structures, Functions prototyping, Call by reference, Return by reference, Inline function, Default arguments, Function Overloading.	08
3	**Classes and objects** : Specifying the class, Defining member functions, Nesting of member functions, Private Member functions, Arrays within a class, Memory allocation for objects, Static Data members, Static member functions, Arrays of objects, Objects as function arguments, Friendly functions.	08
4	**Constructors, Destructors and operator overloading:** Parameterized Constructors, Constructors with default arguments, Copy constructor, Const Objects, Destructors Operator Overloading Unary and binary operators, Overloading binary operators using friends.	08
5	Inheritance, Defining Derived classes, Single, Multilevel, Multiple hierarchical and hybrid inheritance, Virtual base classes, Abstract classes, Constructors and derived classes, Pointers, Pointers to objects, Pointers to derived classes. (Blended Learning)	07

Course Outcomes :

CO1: Apply the basic concepts and structure of OOPs for programming in C++.
CO2 : Describe the object-oriented programming approach in connection with C++.
CO3 : Illustrate the usage of objects and classes.
CO4 : Make use of constructors, destructors and operator overloading in C++ programs.
CO5 : Apply inheritance, virtual and pure functions in C++ programming.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

TEXT BOOK:

1. Object Oriented Programming with C++, E. Balaguruswamy, Galgotia Publications, 2004.

REFERENCE BOOKS/WEBLINKS :

1. Object Oriented Programming using C++, Robert Lafore, Galgotia publications.
2. C++ Primer , Lippman and Lajoie, 3rd edition, Addison Wesley.
3. www.atilim.edu.tr/~mcs215/Lecture%20Notes/book.pdf

Course Title	**Digital System Design Using Verilog**						
Course Code	**ETU302**						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. To impart the concepts of designing and analyzing combinational logic circuits.
3. To impart design methods and analysis of sequential logic circuits.
4. To impart the concepts of VERILOG-data flow and behavioral models for the design of Digital systems.

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Principles of combinational logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3 and 4 variables, incompletely specified functions (Don't Care terms), Quine-McCluskey using don't care terms. **Introduction to Verilog:** Structure of Verilog module, Operators, Data Types, Styles of Description.	8
2	**Logic Design with MSI Components:** Adders and subtractors – Half, Full and Parallel, Binary comparators Decoders-BCD decoders, Encoders. **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description, Signal Declaration and Assignment Statement, Data Type: Vector.	9
3	**Logic Design with Programmable Logic Devices:** Digital multiplexers - Using multiplexers as Boolean function generators, Programmable Logic Devices (PLDs).	6
4	**Flip-Flops:** The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, D flip flop, T Flip-flop Characteristic equations, Registers. **Verilog Behavioral description:** Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of combinational and sequential circuits.	9

5	**Applications of Flip-Flops:** Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers –Ring and Johnson counters, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. **Verilog Structural description:** Highlights of Structural description, Organization of structural description, Binding, Structural description of combinational and sequential circuits.	8

PRACTICAL COMPONENT OF IPCC Using suitable simulation software, demonstrate the operation of the following circuits:	
Sl no.	**Experiments**
1	To simplify the given Boolean expressions and realize using Verilog program.
2	To realize Adder/Subtractor (Full/half) circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, Priority encoder
6	To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2-bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type
8	To realize Counters - up/down (BCD and binary) using Verilog Behavioral description.
Demonstration Experiments (For CIE only – not to be included for SEE) Use FPGA kit for downloading VERILOG codes and check the output for interfacing experiments.	
9	Verilog code to display messages on the given seven segment display.
10	Verilog code to control speed, direction of Stepper motor.
11	Verilog code to generate different waveforms (Square, Triangle, Ramp, Sine) using DAC change the frequency and amplitude.
12	Verilog code to control external lights using relays.
13	Verilog code to simulate Elevator operation.
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos	

Course Outcomes

At the end of the course the student will be able to:

CO1: Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.

CO2: Analyze and design for combinational logic circuits.

CO3: Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential Circuits using Flip Flops.

CO4: Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using VERILOG descriptions.

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	1	3	1	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001.
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.
3. HDL Programming VERILOG and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Logic Design, by Sudhakar Samuel, Pearson/ Sanguine, 2007
3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010

Course Title	**SIGNALS AND SYSTEMS**						
Course Code	**ETT303**						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. learn the basics of signals, systems and their properties.
2. apply impulse response representation of Linear Time Invariant systems to compute system output.
3. represent systems in time, frequency and complex domain.
4. understand properties of impulse response representation, difference and differential equation and block diagram representation.
5. compute Z – transform, its inverse and RoC. To learn unilateral Z-Transforms for solving difference equation.
6. To study Fourier series and transform of signals. To compute frequency domain representation of signals.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Basics of Signals and Systems:** Definitions of signal and system, Classification of signals, Sampling of Signals, Basic operations on signals, elementary signals: basic continuous-time signals and discrete-time signals, Properties of systems. Problems. (L1, L2, L3)	8
2	**Linear Time Invariant system – 1 :** Introduction, Convolution: Impulse response representation for LTI Systems, Convolution sum and Convolution Integral. Problems. Auto correlation and cross correlation. (L1, L2, L3)	8
3	**Linear Time Invariant system – 2 :** Properties of impulse response representation for LTI systems, Differential and Difference equation representations. (L1, L2, L3)	8
4	**Z-Transforms:** Introduction, Z – transform, Properties of ROC, Properties of Z – transforms, Problems Inversion of Z – transforms, Transform analysis of LTI Systems, Unilateral Z- Transform and its application to solve difference equations, Problems. (L1, L2, L3)	8

5.	**Fourier Analysis of Continuous Time Signals and systems** : Introduction, Fourier Series representation of periodic signals, Fourier Transform, Properties of Fourier Transforms, Problems. **Fourier Analysis of Discrete Time signals and systems :** Introduction, Discrete Fourier series, Fourier Transform, Properties of Fourier Transforms, Problems. (L1, L2, L3)	8

PRACTICAL COMPONENT OF IPCC		
Sl No.	**Experiments**	
1	a.	Program to create and modify a vector (array).
	b.	Program to create and modify a matrix.
2	Programs on basic operations on matrix.	
3	Program to solve system of linear equations.	
4	Program to generate discrete waveforms.	
5	Program to perform basic operation on signals.	
6	Program to perform convolution of two given sequences.	
7	a.	Program to perform verification of commutative property of convolution.
	b.	Program to perform verification of distributive property of convolution.
	c.	Program to perform verification of associative property of convolution.
8	Program to compute Impulse response from the given system.	
9	Program to compute step response from the given system.	
10	Program to solve difference equation.	
11	Programs to find Z-transform and inverse Z-transform of a sequence.	
12	Program to verify sampling theorem in time domain.	
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

CO1: Explain signals, systems and their representation in time and frequency domains.
CO2: Evaluate the response of the system in time and frequency domains.
CO3: Analyze frequency domain representation of continuous time and discrete time systems.
CO4: Apply transformation to analyze signal characteristics in time and frequency domain and . properties of transforms to solve problems on LTI systems.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	1	3	1	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Simon Haykin and Barry Van Veen "Signals and Systems", Wiley India Pvt Ltd, 2nd Edition, 2007.

REFERENCE BOOKS / WEBLINKS :

1. M J Roberts, "Signals and Systems", Mc Graw Hill, 2nd Edition, 2011.
2. I J Nagrath, S N Sharan, R Ranjan and S Kumar. "Signals and Systems" TMH, 2002.
3. H P Hsu "Signals and Systems", Scham's outlines, TMH, 2008.
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems", Pearson Education Asia / PHI, 2nd Edition, 2015.
5. https://engineering.purdue.edu/ChanGroup/ECE302Notes/Book_v1.pdf

Course Title	**Analog Electronic Circuits**						
Course Code	**ETT304**						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. To design various Diode and BJT biasing configurations.
2. To explain and design various types of MOSFET configurations.
3. To analyze different Power amplifier circuit
4. To analyze and construct different Op-amp feedback circuits.
5. To understand and design different filter circuits using Op-amp.

UNIT No	Syllabus Content	No. of Teaching Hours
1	Diode Circuits and Transistor biasing: Clippers and clampers, Voltage Multipliers. Operating point of transistor, Fixed bias circuits, Emitter bias , Voltage divider bias, DC bias with voltage feedback configuration, Design operations, Transistor switching networks, PNP transistors, Bias stabilization - relevant problems. (Text 1: 2.9,2.10,2.12,4.2,4.3,4.4,4.5,4.6,4.8,4.9,4.11,4.12)	09
2	Field Effect Transistor : VMOS,CMOS, Introduction to MOSFET, Enhancement & Depletion MOSFETs, EMOSFET Drain feed back configuration, Voltage divider configuration, Design of FET amplifier networks. (Text 1: 5.10, 5.11, 9.8, 9.9, 9.10, 9.11, 9.12)	07
3	Power Amplifiers: Introduction, series fed and transformer coupled Class A amplifiers, Class B amplifier operations and circuits, amplifier distortions, heat sinking, Class C and ClassD amplifiers-relevant problems. (Text 1: 16.1,16.2,16.3,16.4,16.5,16.6,16.7,16.8)	07
4	Operational Amplifiers: Introduction, Ideal Op-amp ,Equivalent circuit, Ideal voltage transfer curve, Open loop configurations, Op-amp with negative feedback, Block diagram representation of feedback configurations, Voltage series and shunt feedback amplifiers, Difference Amplifier. [Text 2: 2.3,2.4,2.5,2.6,3.1,3.2,3.3,3.4,3.5]	07

5.	Op-Amp Circuits and Applications: Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. ADC and DAC converters. Sample and Hold circuit 555 Timer and its Applications: Monostable and Astable Multivibrators. [Text 2: 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9,8.11,8.15,9.4.1, 9.4.2, 9.4.3]	09
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

CO1 : Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
CO2 : Design and analyse different MOSFET circuit configurations.
CO3 : Understand the topologies in the design of power amplifiers.
CO4: Analyze different feed back amplifier configurations using op-amp, applications such as ADC, DAC, filters and timers.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2			1			1	1			1	2
CO2	3	2		2		1		2				2			
CO3			3		2		1				1				3
CO4			3	2					1				3		

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3

REFERENCE BOOKS/WEBLINKS :

1. Electronic Principles, Albert Malvino, David J Bates, 7th Edition, McGraw Hill Education (India) Private Limited, 2017, ISBN:978-0-07-063424-4 1.

2. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford, 2015. ISBN:978-0-19-808913-1

Web links and Video Lectures (e-Resources)

1. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
2. https://nptel.ac.in/courses/117101106

Course Title	**Analog and Digital Electronic Lab**						
Course Code	**ETL305**						
Category	Professional Core Course (PCCL)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives:

1. To provide practical exposure to design, setting up, execute and analyze various analog and digital circuits.
2. To give the knowledge and practical exposure on simple applications of analog and digital circuits.

Sl. No.	Experiment Content
	Introduction to Analog and Digital lab experiments
1	Design and set up a full wave rectifier with and without filters and to determine ripple factor and rectifier efficiency.
2	Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
3	Design and set up an RC coupled amplifier using voltage divider bias and determine the gain bandwidth product from its frequency response.
4	Design and set-up the crystal oscillator and determine the frequency of oscillation.
5	Plot the drain and transfer characteristics of an n-channel FET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
6	Design and set up the circuits using Op Amp: i)Adder, ii) Integrator, iii) Differentiator.
7	Design and implement (a) Half Adder & Full Adder using basic gates and NAND gates, (b) Half subtractor & Full subtractor using NAND gates.

8	Realize (i) Binary to Gray code conversion & vice-versa (IC74139), (ii) BCD to Excess-3 code conversion and vice versa
9	Realization of two-bit comparator using IC7485.
10	Truth Table Verification of: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop
11	Realize the shift registers using IC7474/7495: (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring counter and (vi) Johnson counter.
12	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop. b) Mod-N Counter using IC7490.

Study Experiments using Virtual Lab [vlab.co.in] :

(1) V-I Characteristics of Diode
(2) Rectifiers
(3) Various Basic Gates
(4) Multiplexors and Demultiplexors

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1 : Design and test simple Analog and Digital electronic circuits as per the specifications using discrete electronic components.

CO2: Design and applications of Diodes, Transistors and Op amps in electronic circuits.

CO3: Understand the Operational amplifier and FET circuits.

CO4: Design and test the combinational logic circuits for real time applications, sequential logic circuits for real time applications.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	1	3	2	1	2	3	2	2
CO2	3	2	3	2	1	1	1	1	3	2	1	2	3	2	2
CO3	3	2	3	2	1	1	1	1	3	2	1	2	3	2	2
CO4	3	2	3	2	1	1	1	1	3	2	1	2	3	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.
2. Fundamentals of Logic Design, Charles H. Roth Jr., Larry L. Kinney, Cengage Learning, 7th Edition.

Course Title	**FUNDAMENTALS OF TELECOMMUNICATIONS**						
Course Code	**ETT306A**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives:

1. Understanding basic terms and principles of signal processing in telecommunication transmission.
2. Describing basic principles of the modern digital telecommunications.
3. Implementing acquired knowledge in professional specialist courses (theoretical and practical).
4. Understanding basic operation settings for telecommunication systems and equipment.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Introductory Concepts:** Introduction to Telecommunication, End-Users, Nodes, and Connectivity, Telephone Numbering and Routing, The Use of Tandem Switches in a Local Area, Introduction to the Busy Hour and Grade of Service, Simplex, Half-Duplex, and Full Duplex, One-Way and Two-Way Circuits, Network Topologies, Variations in Traffic Flow, Quality of Service, Standardization in Telecommunications.	8
2	**Signals Convey Intelligence :** Basic Concepts of Electricity for Communications, Early Sources of Electrical Current, The Electrical Telegraph: An Early Form of Long-Distance Communications Electrical Signals, Introduction to Transmission, Modulation, Binary Digital Signals, Introduction to Transporting Electrical Signals, Wire Pair, Coaxial Cable	7

	Transmission, Fiber-Optic Cable, Radio Transmission	
3	**Quality of Service and Telecommunication Impairments** Quality of Service: Voice, Data, and Image, Signal-to-Noise Ratio, Voice Transmission, Data Circuits, Video (Television), The Three Basic Impairments and How They Affect the End-User, Amplitude Distortion, Phase Distortion, Noise, Typical Levels, Echo and Singing.	**8**
4	**Transmission and Switching: Cornerstones of a Network:** Traffic Intensity Defines the Size of Switches and the Capacity of Transmission Links, Traffic Studies, Discussion of the Erlang and Poisson Traffic, Formulas, Waiting Systems (Queueing), Dimensioning and Efficiency, Quantifying Data Traffic, Introduction to Switching, Basic Switching, Concentration and Expansion, Local Switch, Early Automatic Switching Systems, Common Control (Hard-Wired), Stored Program Control, Concentrators and Remote Switching,	**8**
5.	**Voice Telephony & Television Transmission :** Definition of the Voice Channel, The Human Voice, Operation of the Telephone Subset, The Subset Mouthpiece or Transmitter, The Subset Earpiece or Receiver, Video Transmission, Composite Signal, Critical Video Parameters, Transmission Standard—Level, Video Transmission Standards (Criteria for Broadcasters), Color Transmission.	**8**

Course Outcomes:_

1. Explain basic physical and technical principles of modern digital telecommunications,
2. Describe basic principles of operation in modern digital telecommunication equipment and systems,
3. Demonstrate measurements and experiments in laboratory on actual components, devices, equipment and systems in telecommunications,
4. Describe development and implementation methods of telecommunication systems,
5. Examine communication equipment for the technical functionality.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

NOTE : Correlation levels 1, 2 or 3 are as defined below:

Text book
"Fundamentals of Telecommunications" by Roger L. Freeman, Second Edition A JOHN WILEY & SONS, INC., PUBLICATION.
2. H. Taub, D.L. Schilling«Principles of Telecommunication Systems", 3rd edition 2006.
3. Tziolas , M. Salehi, "Communications Systems», 1st edition 2003, University of Athens Eds.

Course Title	**8051 Microcontroller**						
Course Code	**ETT306C**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. Understand the difference between a microprocessor and a microcontroller
2. Familiarize the basic architecture of 8051 micro controller.
3. Program 8051microprocessor using Assembly Level Language and C.
4. Understand the interrupt system of 8051 and the use of interrupts.
5. Understand the operation and use of inbuilt Timers/Counters and the Serial port of 8051.
6. Interface 8051 to external memory and I/O devices using its I/O ports.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Introduction to Microcontroller:** Microprocessor Vs Microcontroller, RISC & CISC CPU architecture, Harvard & Von-Neumann CPU architecture. 8051 Microcontroller: 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM)	7

	interfacing.(L1,L2)	
2	**8051 Instructions and Programming**: Addressing Modes, 8051 instructions, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. 8051 programming: Assembler directives, Assembly language programs. Stack operations. (L1,L2,L3)	8
3	**8051 Programming in C:** Data Types and Time delay in 8051C, I/O programming in 8051 C, Logical Operations in C. **Timers/counters:** 8051 timers/counters, programming 8051 timers/counters in assembly and C. (L1,L2,L3)	8
4	**8051 Serial Communication**- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, 8051 Serial Communication, Programming in assembly and C. 8051 interrupts :Interrupts and Basics of Interrupts. (L1,L2,L3)	8
5.	**8051 Interfacing and Applications** Interfacing 8051 to ADC-0804, DAC, LCD, Keyboard and Stepper motor and their 8051 Assembly and C language interfacing programming. (L1,L2,L3)	8

Course Outcomes :

CO1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory .

CO2. Develop 8051 Assembly level programs using the 8051 instruction set.

CO3. Develop 8051 Assembly / C language program to generate timings and waveform using 8051 timers.

CO4. Develop 8051 Assembly / C language programs to send & receive serial data using 8051 serial port.

CO5. Interface various peripheral devices to 8051 using I/O ports.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2	2	2
CO2	3	3											2	2	2
CO3	3	3											2	2	2
CO4	3	3											2	2	2
CO5	3	3											2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

Text book 1:Kenneth J. Ayala, "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.
Text Book 2:Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006 / Pearson, 2006.
Reference Books:
1. "The 8051 Micro controller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN:978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Course Title	**Principles of Sensors and Signal Conditioning**						
Course Code	**ETT306B**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	S S	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hr**	

Course objectives: This course will enable students:

7. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized and analyzed.

8. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration.

9. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.

10.To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Sensor fundamentals and characteristics** Sensor Classification, Performance and Types, Error Analysis characteristics	8
2	**Optical Sources and Detectors** Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.	7
3	**Intensity Polarization and Interferometric Sensors** Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, Fabry- Perot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers. **Strain, Force, Torque and Pressure sensors** Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors.	8
4	**Position, Direction, Displacement and Level Sensors** Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magnetostrictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self-generating sensors. **Velocity and Acceleration sensors** Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.	8
5.	**Flow, Temperature and Acoustic sensors** **Flow sensors:** pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. Micro flow sensor, Coriolis mass flow and drag flow sensor. **Temperature sensors:** Thermoresistive, thermoelectric, semiconductor and optical, Piezoelectric temperature sensor. **Acoustic sensors:** microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.	8

Course Outcomes :

CO1-Use concepts in common methods for converting a physical parameter into an electrical quantity.

CO2-Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.

CO3-Design and develop sensors using optical methods with desired properties, evaluate performance characteristics of different types of sensors, Create analytical design and development solutions for sensors.

CO4-Locate different types of sensors used in real life applications and paraphrase their importance.

CO5-Compete in the design, construction, and execution of systems for measuring physical quantities.

CO-PO-PSO Mapping:

	O1	*O2*	*O3*	*O4*	*O5*	*O6*	*O7*	*O8*	*O9*	*O10*	*O11*	*O12*	*SO1*	*SO2*	*SO3*
CO1			2					-		-	2	-	3	2	-
CO2			2					-		-	2	-	3	2	2
CO3		3				-			-	-	1	-	3	3	1
CO4		3				-	-			1	1	-	3	2	-
CO5			2					-		1	1	1	2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.

2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS / WEBLINKS:

1. Gerd Keiser, "Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.

2. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press,

Florida.

3. Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.

4. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Course Title	**Control Systems**						
Course Code	**ETT306D**						
Category	ESC/ETC/PLC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0		0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1.Formulate the mathematical modeling of systems and understand the concepts of transfer function, obtain transfer function using block diagram reduction and signal flow graph techniques.

2. Analyze the response of second order systems using standard test signals and analyze steady state error.

3. Analyze stability of systems using RH criteria, Root Locus, Nyquist and Bode plot and obtain state variable model for electrical systems.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Mathematical Modeling and Transfer Function of Electrical system:** Introduction to control system, open loop and closed loop systems, advantages and disadvantages, types of feedback, transfer function, Transfer function of Electrical networks, Block diagram Reduction, Signal Flow Graph and Mason's gain formula.	9

2	**Time Response of feedback control systems:** Standard test signals, Unit step response of second order system, time domain specifications, Steady state error analysis.	8
3	**Stability analysis using RH Criteria:** Concepts of stability, Necessary conditions for stability using Routh's array, Routh - Hurwitz stability criterion, Relative stability analysis.	8
4	**Stability analysis using Root Locus:** The root locus concepts, Construction of root loci, Effect of addition of poles and zeros.	8
5.	**Stability analysis using Bode plots**: Bode magnitude and phase plots, Gain and phase margin.	6

Course Outcomes :

CO1 Write the mathematical model for electrical systems and find the transfer function using block diagram reduction technique and signal flow graph.

CO2 Analyze transient and steady state response of second order systems using standard test signals and analyze steady state error.

CO3 Analyze the stability of the systems by applying RH criteria and root locus techniques.

CO4 Analyze the stability of the system using frequency domain technique of Bode plots.

CO5 Analyze the electrical system using state variables.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3		2		2		2					2	2	2
CO2	3	3		2		2		2					2	2	2
CO3	3	3		2		2		2					2	2	2
CO4	3	3		2		2		2					2	2	2
CO5	3	3		2		2		2					2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High

TEXT BOOKS:

2. Richard C.Dorf and Robert H. Bishop ,Modern Control Systems, Pearson Education, Edition

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REFERENCE BOOKS / WEBLINKS :

1. I.J.Nagrath and Gopal M ,Control Systems Engineering, New Age International (P) Limited, Edition V, 2008.

2. Ogata K. Modern Control Engineering, Pearson EducationAsia/PHI. Edition V, 2010.

3. Kuo C. Benjamin Automatic Control Systems, John Wiley & Sons,Edition IX, 2014.

4. Gopal M. Control Systems – Principles and Design. TMH, Edition IV, 2012.

Course Title	**Logic Design Lab using Pspice/MultiSIM**						
Course Code	**ETL308A**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course Objectives :

1. Impart the concepts of De Morgan's Theorem, SOP and POS forms.
2. Impart the concepts of designing and analyzing combinational logic circuits.
3. Impart the concepts of analysis of sequential logic circuits.
4. Analyze and design any given synchronous sequential circuits.

Sl. No.	Experiments
1	Implementation of De Morgan's theorem and SOP/POS expressions using Pspice/Multisim.
2	Implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor using Pspice/Multisim.
3	Design and implementation of 4-bit Parallel Adder/ Subtractor using IC 7483 and BCD to Excess-3 code conversion and vice-versa using Pspice/Multisim.
4	Design and implement of IC 7485 4-bit magnitude comparator using Pspice/Multisim.
5	To Realize Adder & Subtractor using IC 74153 (4:1 MUX) and 4-variable function using IC74151 (8:1MUX) using Pspice/Multisim.
6	To realize Adder and Subtractor using IC 74139 (Demux/Decoder) and Binary to Gray code conversion & vice versa using 74139 using Pspice/Multisim.
7	SR, Master-Slave JK, D & T flip-flops using NAND Gates using Pspice/Multisim.
8	Design and realize the Synchronous counters using JK Flipflops (up/down decade/binary) using Pspice/Multisim.
9	Realize the shift registers and their modes (SISO, PISO, PIPO, SIPO) using 7474/7495 using Pspice/Multisim.
10	Design Pseudo Random Sequence generator using 7495 using Pspice/Multisim.

11	Design Serial Adder with Accumulator and simulate using Pspice/Multisim.
12	Design using Pspice/Multisim Mod-N Ripple Counters using JK Flipflops.

Course Outcomes : (Course Skill Set):

At the end of the course the student will be able to:
CO1: Realize a given expression using minimum number of appropriate logic gates.
CO2: Design and analyze various combinational circuits such as adders, subtractors, comparators, multiplexers and code converters.
CO3: Construct flips-flops, ripple counters and shift registers.
CO4: Design and implement and analyze synchronous counters.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					3	1	2	3		3	3	3	3
CO2	3	3	2	2	3	3	3	1	2	3		3	3	3	3
CO3	3		3	3		3	3	1	2	3		3	3	3	3
CO4	3		3	3	3	3	3	1	2	3		3	3	3	3

NOTE: Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Learning Resources:

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

Course Title	**Analog Electronic Circuits using Lab using PSpice**						
Course Code	**ETL308B**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course objectives:

- 1. To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
- 2. To give the knowledge and practical exposure on simple applications of analog electronic circuits.

Expt. No.	Experiment Content	No. of Hours
	Introduction above PSpice/MultiSIM	2
1	Experiments to realize diode clipping (single, double ended) circuits.	2
2	Experiments to realize diode clamping (positive, negative) circuits.	2
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).	2
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determine line/load regulation characteristics.	2
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).	2
6	Set-up and study the working of complementary symmetry class B push pull power amplifier (other power amplifiers can also be suitably considered) and calculate the efficiency.	2
7	Design and set-up the oscillator circuits (Hartley, Colpitts etc. using BJT/FET) and determine the frequency of oscillation.	2

8	Design and set-up the crystal oscillator and determine the frequency of oscillation.	2
9	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.	2
10	Experiments to realize Transfer and drain characteristics of a FET.	2
11	Experiments to realize UJT triggering circuit for Controlled Full wave Rectifier.	2
12	Experiments to realize Transfer and drain characteristics of a MOSFET.	2

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1 : Understand the circuit schematic and its working.
CO2: Study the characteristics of different electronic devices.
CO3: Design and test simple electronic circuits as per the specifications using discrete electronic components.
CO4 : Compute the parameters from the characteristics of active devices.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO2	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO3	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO4	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. David A Bell, “Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.

2. Muhammed H Rashid, “Introduction to PSpice using OrCAD for circuits and electronics”, 3rd Edition, Prentice Hall, 2003.

Course Title	**Linear Integrated Circuits Lab using Pspice / MultiSIM**						
Course Code	**ETL308C**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course objectives:

- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function ICs.
- To use MultiSim/PSpice software for circuit design and simulation.

Expt. No.	Experiments using PSpice	No. of Hours
1	To construct and study Inverting amplifier using OPAMP.	2
2	To construct and study Non-inverting amplifier using OPAMP	2
3	To construct and study the Differentiator & Integrator using OPAMP.	2
4	Construct & test timer circuit using IC 555 timer	2
5	Design and Verification of Differential amplifier.	2
6	To obtain the output of voltage comparator and zero crossing detector.	2
	Experiments using MultiSim	
7	To realize a Full Wave Rectifier using Op-Amps	2
8	To realize a Half Wave Rectifier using Op-Amps.	2
9	To realize an Inverting Schmitt Trigger using Op-Amps.	2
10	To realize an Astable Multivibrator using Op-Amps	2
11	To design and implement an R C Phase Shift Oscillator using Op-Amps.	2
12	To design and implement R-2R Digital to Analog Converter using Op-Amps.	2

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1.Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.

2. Relate to the manufacturer's data sheets of IC 555 timer and IC μa741 op-amp.

3. Realize and verify the operation of Analog integrated circuits like Amplifiers, Rectifiers, Comparators and Waveform generators.

4. Design and implement Analog integrated circuits like Oscillators, Timer circuits, Data converters and compare the experimental results with theoretical values.

CO-PO-PSO Mapping :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	-	2	1	3	3	3	3	1
CO2	3	3	3	3	1	-	-	2	2	1	-	2	3	1	-
CO3	3	3	2	3	3	-	-	-	2	1	3	3	3	2	1
CO4	3	3	2	3	3	-	-	-	2	1	3	3	3	3	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.

Course Title	**LabVIEW Programming Basics**						
Course Code	**ETL308D**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course objectives:

- 1. Aware of various front panel controls and indicators.
- 2. Connect and manipulate nodes and wires in the block diagram.
- 3.Locate various toolbars and pull-down menus for the purpose of implementing specific functions.
- 4.Locate and utilize the context help window.
- 5.Familiar with LabVIEW and different applications using it.
- 6. Run a Virtual Instrument (VI).

Expt. No.	Experiment Content	No. of Hours
	Introduction to LabVIEW	2
1	Basic arithmetic operations: addition, subtraction, multiplication and division.	2
2	Boolean operations: AND, OR, XOR, NOT and NAND.	2
3	Sum of ‘n’ numbers using ‘for’ loop.	2
4	Factorial of a given number using ‘for’ loop	2
5	Determine square of a given number.	2
6	Factorial of a given number using ‘while ‘loop.	2
7	Sorting even numbers using ‘while’ loop in an array.	2
8	Finding the array maximum and array minimum.	2

9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.	2
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).	2
11	Build a Virtual Instrument that simulates a Water Level Detector.	2
12	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.	2

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1 : Use Lab VIEW to create data acquisition, analysis and display operations

CO2 : Create user interfaces with charts, graph and buttons

CO3 : Use the programming structures and data types that exist in Lab VIEW

CO4 : Use various editing and debugging technique

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO2	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO3	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2
CO4	3	2	3	2	3	-	-	1	3	2	1	2	3	3	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011

2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

Course Title	**Communication Theory**						
Course Code	**ETT401**						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	2	2	0	0	4	52	3
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

This course will enable students to

1. Understand and analyse concepts of Analog Modulation schemes viz: AM, FM., Low pass sampling and Quantization.
2. Understand and analyse concepts digitization of signals viz; sampling, quantizing and encoding.
3. Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
4. Evolve the concept of quantization noise for sampled and encoded signals and study the c concepts of reconstruction from these samples at a receiver.

UNIT No	Syllabus Content	No. of Hours	
		Teaching	Tutorial
1	**AMPLITUDE MODULATION:** Introduction, Amplitude Modulation: Time & Frequency Domaindescription, Switching modulator, Envelop detector. **DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION:** Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.	05	05
2	**SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION:** SSB Modulation and Demodulation ,VSB Modulation, Frequency Translation, Frequency Division Multiplexing, Application of VSB.	05	05
3	**ANGLE MODULATION:** Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL,	06	06

	Nonlinear Effects in FM Systems. The Superheterodyne Receiver.		
4	**NOISE**: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. **NOISE IN ANALOG MODULATION**: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Preemphasis and De-emphasis in FM	05	05
5.	**SAMPLING AND QUANTIZATION:** Introduction, Significance of analog to digital conversion, The Low pass Sampling process, Pulse Amplitude Modulation. Time Division Multiplexing, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation	05	05
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos			

Course Outcomes :

At the end of the course the student will be able to:

CO1 : Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations.

CO2 : Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.

CO3 : Characterize the influence of channel noise on analog modulated signals.

CO4 : Understand the concepts of sampling and quantization and the characteristics of pulse amplitude modulation and pulse code modulation systems.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO2	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO3	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO4	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

REFERENCE BOOKS/WEBLINKS :

1. B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2. Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.

Course Title	**DIGITAL SIGNAL PROCESSING**						
Course Code	**ETU402**						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

3. H Taub & D L Schilling, Principles of Communication Systems, TMH, 2011.

Course objectives:

1. To introduce signals, systems, time and frequency domain concepts, frequency domain sampling, DFT and its properties and linear filtering.
2. To compute DFT using FFT algorithms.
3. To study and design analog and digital IIR filters and analog to digital filter transformation.
4. To study windows and frequency sampling method for FIR filter design.
5. To learn implementation of IIR and FIR filters by direct form – I and II, cascade, lattice and parallel realization.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Discrete Fourier Transforms (DFT) & its Properties:** Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Introduction to Decimation and Interpolation. (L1, L2, L3)	8
2	**Fast-Fourier-Transform (FFT) algorithms:** Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation- in-time and decimation-in-frequency algorithms. Goertzel algorithm and chirp-z transform. (L1, L2, L3)	8
3	**IIR filter:** Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filters (Butterworth and Chebyshev) - Impulse Invariance method and Bilinear Transformation method. (L1, L2, L3)	8
4	**FIR filter:** Introduction to FIR filters, design of FIR filters using -	8

	Rectangular, Hamming, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique. (L1, L2, L3)	
5.	**Implementation of discrete-time systems:** Structures for IIR and FIR systems- direct form I and direct form II systems, cascade, lattice and parallel realization. (L1, L2, L3)	8

PRACTICAL COMPONENT OF IPCC

List of Programs to be implemented & executed using any programming languages like C++/Python/Java/Scilab / MATLAB/CC Studio (but not limited to)

Sl no.	Experiments
1	Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
2	Computation of circular convolution of two given sequences and verification of commutative, distributive and associative property of convolution.
3	Computation of linear convolution of two sequences using DFT and IDFT.
4	Computation of circular convolution of two given sequences using DFT and IDFT
5	Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
6	Verification of Parseval's theorem
7	Design and implementation of IIR (Butterworth) low pass filter to meet given specifications.
8	Design and implementation of IIR (Butterworth) high pass filter to meet given specifications.
9	Design and implementation of low pass FIR filter to meet given specifications.
10	Design and implementation of high pass FIR filter to meet given specifications.
11	To compute N- Point DFT of a given sequence using DSK 6713 simulator.
12	To compute linear convolution of two given sequences using DSK 6713 simulator.
13	To compute circular convolution of two given sequences using DSK 6713 simulator.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

Course outcomes: At the end of the course, the student will be able to:

CO1: Explain the frequency domain representation of finite length sequences and systems.

CO2: Apply the knowledge of Fourier and Z-transform to solve the signal processing problems and realize systems.

CO3: Design filters for the given specifications by applying appropriate transformation.

CO4: Analyse the signal processing concepts for efficient system design.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	1	2	1	3	1	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

Text Books:

1. Proakis & Manolakis, "Digital Signal Processing - Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Li Tan, Jean Jiang, "Digital Signal processing - Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893.

Reference Books:

1. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 2013.
2. Oppenheim & Schaffer, "Discrete Time Signal Processing", PHI, 2003.
3. D Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Course Title	**Network & Field Theory**						
Course Code	**ETU403**						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. Apply mesh and nodal techniques to solve an electrical network.
2. Solve different problems related to Electrical circuits using Network Theorems and Two port network.
3. To facilitate the students in understanding the Concepts of Electric and Magnetic Fields through Mathematical representations.
4. To enable the students in using the concepts of Field theory to arrive at important Mathematical relations associated with Electromagnetic waves.

Potential Gradient.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Basic concepts of Network Analysis :** Types of Sources, Source Transformation, Conversion from Start to Delta and Delta to Star Network, Loop analysis, Nodal analysis with independent DC and AC Excitations.	08
2	**Network Theorems :** Super position theorem, Thevenin's theorem, Norton's Theorem, Maximum Power transfer Theorem, relevant problems.	08
3	**Coulomb's Law and Electric Field Intensity:** The Experimental law of Coulomb, Electric Field Intensity, Field of a line charge. **Electric Flux Density and Gauss-Divergence Theorem:** Electric Flux Density, Gauss' Law, Application of Gauss' Law for a	0 8

	Differential Volume Element, Divergence, Maxwell's First Equation, Divergence Theorem.	
4	**Electric Potential:** Energy Expended in moving a point charge in an Electric field, The Line Integral, Definition of Potential Difference and Potential, Potential field of a point charge. **Boundary conditions :** Boundary conditions on fields at Conductor-dielectric and Dielectric-dielectric interface.	08
5.	**Steady Magnetic field:** Biot-Savart's Law, Ampere's Circuital Law , Current density, Curl, Stokes' Theorem, Magnetic Flux and Flux density. **Time Varying Fields and Maxwell's Equations:** Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form.	08

Expt. No.	**Experiments using Simulation Software : PSpice/MultiSIM/MATLAB**	**No. of Hours**
1	Verification of Mesh analysis for a given circuit.	2
2	Verification of Nodal analysis for a given circuit.	2
3	Verification of Superposition theorem	2
4	Verification of Norton's theorem	2
5	Verification of Thevenin's theorem	2
6	Verification of Maximum power transfer theorem.	2
7	Calculating Force using Coulomb's law.	2
8	Finding Electric field intensity by computing gradient of potential.	2
9	Finding Divergence of Flux density.	2
10	Finding Curl of Magnetic field intensity	2
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the course, the student will be able to

CO1 : Analyse and solve Electric circuit, by applying, loop analysis, Nodal analysis

CO2 : Applying network Theorems.

CO3 : Understanding of Electric field , Magnetic fields and applying of Coulomb law, divergence theorem, Stokes' theorem from the perspective of Electric and Magnetic fields.

CO4 : Apply Electric and Magnetic field concepts to arrive at Maxwell's equations,

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					2			1	2			1	2
CO2	3	3		2				2				2			
CO3			3	2			3				3				3
CO4			3	2					3				3		

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Text Books :

1. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, McGraw Hill Education, Indian Edition 8e.
2. Network Analysis, M E Van Valkenburg, Pearson, 3e.
3. W H Hayt and J A Buck, "Engineering Electromagnetics", Mc Graw Education, 8th Edition, 2014.

Reference Books :

1. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition.
2. Mathew N O Sadiku, "Elements of Electromagnetics", Oxford University Press, 4th edition, 2007.
3. Karl Erik Lonngren,**"Fundamentals of Electromagnetics with MATLAB",** Sava Vasilev Savov, Randy J. Jost, SciTech Publication, 2nd edition,2007.

WEBLINKS :

https://archive.nptel.ac.in/courses/117/105/117105085

1. https://nptel.ac.in/courses/108106073

Course Title	**Communication Laboratory**						
Course Code	**ETL404**						
Category	Professional Core Course laboratory (PCCL)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

This laboratory course enables students to

1. Model an analog communication system signal transmission and reception.
2. Realize the electronic circuits to perform analog and pulse modulations and demodulations.
3. Verify the sampling theorem and relate the signal and its spectrum before and after sampling.
4. Understand the process of PCM and delta modulations.
5. Understand the PLL operation.

Sl No.	Syllabus Content
1	Design of active second order Butterworth low pass and high pass filters.
2	Amplitude Modulation and Demodulation of (a) Standard AM and (b) DSBSC
3	Frequency modulation and demodulation
4	Design and test Time Division Multiplexing and Demultiplexing of two bandlimited signals.
5	Design and test Pulse sampling, flat top sampling and reconstruction.
6	Design and test Mixer for frequency translation.
7.	Design and test Pulse amplitude modulation and demodulation
8.	Illustration of (a) AM modulation and demodulation and display the signal and its spectrum. (b) DSB-SC modulation and demodulation and display the signal and its spectrum.(Use MATLAB/SCILAB)
9.	Illustration of FM modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)

10	Illustrate the process of sampling and reconstruction of low pass signals. Display the signals and its spectrums of both analog and sampled signals. (Use MATLAB/SCILAB).
11	Illustration of Delta Modulation and the effects of step size selection in the design of DM encoder. (Use MATLAB/SCILAB)
12	Demonstration of Amplitude modulation and demodulation using Labview.
13	Demonstration of Frequency modulation and demodulation using Labview.

Course Outcomes :

At the end of the course the student will be able to:

1. Demonstrate the AM and FM modulation and demodulation by representing the signals in time and frequency domain.
2. Design and test the sampling, Multiplexing and PAM with relevant circuits.
3. Demonstrate the basic circuitry and operations used in AM and FM receivers.
4. Illustrate the operation of PCM and delta modulations for different input conditions.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					3	3	3	3					3	3	1
CO2					3	3	3	3					3	3	1
CO3					3	3	3	3					3	3	1
CO4					3	3	3	3					3	3	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Louis E Frenzel, Principles of Electronic Communication Systems, McGraw Hill Education (India)Private Limited, 2016.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press,2015.

Course Title	**PRINCIPLES OF TRANSMISSION LINES AND WAVE GUIDES**						
Course Code	**ETT405A**						
Category	ESC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	**SEE Marks : 50**			**Total Max. Marks = 100**		**Duration of SEE : 03 Hours**	

Course objectives: This course will enable students to:

1. To introduce the types of Transmission Lines and analyze of their circuit equivalent.
2. To understand the concept of Standing waves.
3. To learn use of Smith chart.
4. To understand different types of propagation in Guided waves.
5.To Study waves in rectangular guide, Attenuation in co-axial line, excitation, and resonant cavities

UNIT	Syllabus Content	No. of Teaching Hours
1	**Transmission – Line Theory** :The transmission Line general solution, Physical significance of the equations; the infinite line, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0, Open and short circuited Lines, Reflection loss, Insertion loss **(Text 1)**	8
2	**Impedance matching :** standing waves; nodes ; standing wave ratio, input impedance of dissipation less line, input impedance of open- and short-circuited lines, single-stub impedance matching,. **(Text 1)**	8
3	**Smith Chart and its applications :** Smith Circle diagram, Applications of Smith chart, Single-stub impedance matching with Smith Chart. **(Text 1)**	8
4	**Guided waves :** Applications of restrictions to Maxwell's equation, types of propagation; TM, TE and TEM, Transmission of **TM,TE and TEM waves in parallel planes. (Text 1 & 2)**	7
5.	**Wave guides :** Application of Maxwell's equations to the rectangular wave guides, The $TM_{m,n}$ wave in the rectangular guide, The $TE_{m,n}$ wave in the	8

	rectangular guide, The TEM wave in the coaxial Line, Attenuation in the coaxial Line (Text 1 & 2)	

Course Outcomes : At the end of the course, students will be able to:

CO1 : Explain various types of transmission lines, types of losses and distortions in them.
CO2 : Computation of parameters related to standing wave and learning design strategies for impedance matching.
CO3 : Use Smith chart to solve problems associated with transmission lines and impedance matching.
CO4 : Analyse types of guided wave between two parallel planes.
CO5: Analyse presence of modes in various types of waveguides.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	3	2					1	2		2	3	1	2
CO2	2	3	3	3					1	2		2	3	2	2
CO3	2	3	3	3					1	2		2	3	2	2
CO4	3	2	3	2					1	2		2	3	1	2
CO5	3	2	3	2					1	2		2	3	1	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1."**Network Lines and Fields**" , John D Ryder, 2 edition, PHI, 2005.

REFERENCE BOOKS/WEBLINKS:

1. "**Transmission Lines and Networks**", Umesh Sinha, 8th edition, Satya Prakashana (Tech India Publication), 2003.
2. "**Networks and systems**", Roy Choudhury,2nd edition,2009, New Academic Science Ltd.

Course Title	**TELECOMMUNICATION SWITCHING SYSTEMS**						
Course Code	**ETT405B**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	**0**	**0**	**0**	**3**	**39**	**3**
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

Course Objectives :

1. To understand Basics and features of digital switching systems and traffic model.
2. To understand evolution of switching systems.
3. Ability to design a Grading considering the inlets and outlets of switches and understand Telecommunication Traffic.
4. To understand switching systems and Time division switching.
   Ability to understand Switching system software and system maintenance.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Introduction of Telecommunication Switching:** Developments of telecommunications, Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM,TDM, PDH and SDH, Transmission performance.	8
2	**Evolution of switching Systems:** Introduction, classifications and functions of switching system, Circuit switching and message switching, Distribution systems, Basics of crossbar systems, Electronic switching, Digital Switching Systems	8
3	**Telecommunication Traffic:** Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems.	7
4	**I. Switching Systems:** Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems. **II. Time Division Switching:** Introduction, space and time switching, Time switching networks, Synchronization, Frame alignment.	7
5.	**I. Switching system software:** Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1, level 2 and level 3 control, Digital switching system software classification, Call models, Connect sequence, Software linkages during call, Call features, Feature flow diagram, Feature interaction. **II. Maintenance of Digital Switching System:** Introduction, Scope, Software maintenance, Interface of a typical digital switching system, central office, System	9

	outage and its impact on digital switching system reliability, Impact of software patches on digital switching system maintainability, Embedded patcher concept, Growth of digital switching system central office, Generic program upgrade, A methodology for proper maintenance of digital switching system.	

Course Outcomes :

1. Learners will understand Introduction to Telecommunication switching systems.
2. Learners will be able to understand Evolution, functions, switching technologies of switching systems.
3. To design Traffic model grading.
4. Learners will understand switching systems and Time division switching.
5. Learners will understand Working principles of digital switching systems software and its maintenance.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Telecommunication and Switching, Traffic and Networks - J E Flood: Pearson Education, 2002.
2. Digital Switching Systems, Syed R. Ali, TMH Ed 2002.

REFERENCE BOOKS/WEBLINKS:

1. Telecommunications switching systems and networks – Thyagarajan Vishvanathan, PHI - 2003
2. http://www.btechbunks.com/2011/03/telecommunication-switching-systems.html?m=1

Course Title	**Television Engineering**						
Course Code	**22ETT405C**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	2	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

COURSE OBJECTIVES:

1. To study the analysis and synthesis of TVPictures, Composite Video Signal, Receiver Picture Tubes
and-Television Camera Tubes
2. To study the principles of Monochrome Television Transmitter and Receiver systems.
3. To study the advanced topics in Television systems.
4. To study the various Color Television systems with a greater emphasis on PAL.

UNIT	Syllabus Content	No. of Teaching Hours
1	**FUNDAMENTALS OF TELEVISION :** TV transmitter and receivers, synchronization, Basic factors of TV system: aspect ratio, image continuity, interlaced scanning, flicker, picture resolution, Composite video signal, Horizontal and vertical sync details, no of scanning lines, scanning sequence details. Monochromatic Picture tube, Electrostatic focusing, Beam deflection, picture tube characteristics and specifications, monochrome TV camera.	8
2	**MONOCHROME TV TRANSMITTER :** TV transmitter - picture signal transmission, sound signal transmission, vestigial side band transmission, TV signal propagation â€“ Interference - TV transmission Antennas. **MONOCHROME TV RECEIVER :** RF tuner, IF subsystem, video amplifier, sound section, sync separation and processing, deflection circuits, scanning circuits	8
3	**CAMERA TUBES : Basic Principles,** Types: Image Orthicon, Vidicon, Plumbicon, Block diagram of broad cast TV transmitter, Block diagram of broadcast TV receiver. **Essentials of Colour Television :** Compatibility colour perception- Three colour theory- luminance, hue and saturation-colour television cameras- values of luminance and colour difference signals-formation of chrominance signal.	7
4	**Colour TV display tubes :** delta gun, precision in-line and Trinitron colour	8

	picture tubes, purity and convergence, purity and static and dynamic convergence adjustments, automatic degaussing circuit, grey scale tracking. **Colour television systems :** NTSC colour TV system, limitations of NTSC system, PAL colour TV system, merits and demerits of the PAL system - SECAM colour TV system, merits and demerits of SECAM system.	
5.	**Advanced Colour TV Systems - Cable TV :** cable signal sources, cable signal processing, cable signal distribution - digital television - DTH, threedimensional (3D) TV. **Extended Definition television (EDTV), HDTV, LCD Television :** LCD technology, LCD matrix types & operation, Plasma Television : conduction of charge, signal processingin plasma TV receivers.	8

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Acquire knowledge in Fundamentals of Television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
2. Identify the elements of Television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
3. Interpret the essentials of colour TV and various colour TV systems.
4. Acquire knowledge in fundamentals of television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
5. Compare different display tubes and various colour TV systems.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	1	3	1	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. 1. R.R. Gulati-Modern Television Practice - Principles, Technology and Service - New Age International Publication, 2009.
2. R.R. Gulati-Monochrome and Colour TV - New Age International Publication, 2002.

REFERENCE BOOKS / WEBLINKS :

6. S. P.Bali - Colour Television Theory and Practice - TMH, 1994
7. A.M. Dhake - Television and Video Engineering - 2nd Edition - 16th Reprint-2006.
8. http://nptel.iitm.ac.in/
9. http://jwfiles.net/files/6/f0bsb8og8vy3yq/Tv-Lectures_JWFILES.pdf
10. http://jwfiles.net/fiu1pa6wkw84/Tv-L...FILES.pdf.html.

Course Title	**BIOLOGY FOR ENGINEERS**						
Course Code	**BITT407**						
Category	Basic Science Course (BSC)						
Scheme and Credits	No of Hours/Week					Total Teaching Hours	Credits
	L	T	P	SS	Total		
	02	00	00	00	02	26	2
CIE Marks:50	**SEE Marks:50**		**Total Max.marks=100**		**Duration of SEE:02 Hours**		

COURSE OBJECTIVES:

1. To convey that Biology is as important a scientific discipline as Physics, Chemistry and Mathematics.
2. To know about the classification underlying criteria of biology, such as morphology, biochemical, or ecological.
3. To study Genetics, Bio-molecules, Enzymes and Metabolism.
4. To understanding the macro molecular analysis.
5. To learn microbiology and its industrial applications.

UNIT No	Syllabus Content	No of Hours
1	**Introduction:** Science and Engineering, Biology and its application. Cell: The Basic Unit of Life , Cell theory, Cell shapes, structure of a Cell, prokaryotic and eukaryotic Cells. **Classification:** Brief introduction to five kingdoms of classification.	5
2	**Bio-molecules:** Carbohydrates, Amino acids and Proteins, Lipids- classification , functions. **Enzymes:** Enzymes, properties and classification. Mechanism of enzyme action. Enzymes and their application in Industry.	5

3	**Genetics:** Mendelian Law, Laws of inheritance. gene interaction, genetic disorders. **Information transfer**: Nucleic acid, replication of DNA, types of RNA,transcription, genetic code.	**6**
4	**Metabolism** - Concepts, metabolic basis for living, non-equilibrium and steaty state. Photosynthesis ,glycolysis ,fermentation and Krebs cycle.	**5**
5	**Microbiology** – Microorganism, growth kinetics, culture media, microscopy, applications of microbiology, immunology and immunity.	**5**

COURSE OUTCOMES: On successful completion of this course, the students will be able to:

CO1: **Define** the cells, its structure and functions. And different types of cells , basis for classification

CO2: **Explain** about genetics, bio-molecules, its structure and function. And their role in a living organism

CO3: **Determine** the concept of enzymes and macro molecules for applications.

CO4: **Interpret** about the genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms.

CO5: **Illustrate** about the metabolism and microbiology applications.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		1			1									1
CO2	1		1			1									1
CO3	1		1			1							1	1	1
CO4	1		1			1							2	3	2
CO5	1		1			1							1	2	1

Strength of Correlation: Low-1, Medium-2, High-3

TEXT BOOK:

1. **Biology for Engineers,** Wiley Precise Textbook series, 1st Edition.
2. **Biology for Engineers**, T Johnson, CRC press, 2011 Molecular Biology and Biotechnology 2nd Edition. J.M. Walker and E.B. Gingold. Panima Publications.
3. Biology: A global approach, N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman**,** Pearson Education Ltd, 2018.

REFERENCE BOOKS:

1. **Molecular Biology,** G. Padmanabhan, K. SivaramSastry, C. Subramanyam, 1995, Mac Millan Publications.
2. **Biochemistry of Nucleic acids.**1992. 11th edition R.L.P. Adams, J. T. Knowlers, D. P. Leader, Chapman and Hall Publications.
3. **Genetic Engineering** –SandhyaMitra.
4. **Cell and Molecular biology**. De Robertis EDP & EMF De Robertis. 2001. Lippincott Williams &Wilkins.Bombay.

Course Title	**Embedded C Basics**						
Course Code	**ETL406A**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course Objectives :

Course objectives:

1. Understand the basic programming of Microprocessor and microcontroller.
2. To develop the microcontroller-based programs for various applications.

Sl.No	Experiments
	Conduct the following experiments by writing C Program using Keil microvision simulator (any 8051 microcontroller can be chosen as the target).
1.	Write a 8051 C program to multiply two 16 bit binary numbers.
2.	Write a 8051 C program to find the sum of first 10 integer numbers.
3.	Write a 8051 C program to find factorial of a given number.
4.	Write a 8051 C program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5.	Write a 8051 C program to find the square of a number (1 to 10) using look-up table.
6.	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7.	Write a 8051 C program to arrange a series of 32 bit numbers in ascending/descending order.
8.	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
Demo Programs	
9.	Write a 8051 C program to scan a series of 32 bit numbers to find how many are negative.
10.	Write a 8051 C program to display “Hello World” message (either in simulation mode or interface an LCD display).
11.	Write a 8051 C program to convert the hexadecimal data 0xCFh to decimal and display the digits on ports P0, P1 and P2 (port window in simulator).

Course Outcomes :

After the completion of the course, the student will be able to

1. Write C programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051 C.
2. Develop testing and experimental procedures on 8051 Microcontroller, analyze their operationunder different cases.
3. Develop programs for 8051 Microcontroller to implement real world problems.
4. Design and Develop Mini projects

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					2			1	2			1	2
CO2	3	3		2				2				2			
CO3			3	2			3				3				3
CO4			3	2					3				3		

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. "The 8051 Microcontroller: Hardware, Software and Applications", V Udayashankara and M S Mallikarjuna Swamy, McGraw Hill Education, 1st edition, 2017.

Course Title	**Octave / Scilab for Signals**						
Course Code	**ETL406B**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course Objectives:

1. Preparation: To prepare students with fundamental knowledge/ overview in the field of signal processing.
2. Core Competence: To equip students with a basic foundation in electronic engineering and mathematics fundamentals required for comprehending the operation and application of signal processing.
3. Professionalism & Learning Environment: To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Sl No	Experiments
1	Verify the Sampling theorem.
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm. Verify the result using theoretical computations
4	Determine the correlation using FFT algorithm. Verify the result using theoretical computations
5	Determine the spectrum of the given sequence using FFT. Verify the result using theoretical computations
6	Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency
7	Design and test IIR Butterworth 1st and 2nd order low & high pass filter.
8	Design and test IIR Chebyshev 1st and 2nd order low & high pass filter.
9	Generation of an AM – Suppressed Carrier Wave & visualization of the time domain and frequency domain plots.
10	Generation and visualization of standard test signals (both continuous and discrete time)
11	Generation and visualization of audio signal (pre-recorded) and generation of echo.
12	Generation and visualization of the STFT of a chirp (and other related) signal.

Course Outcomes: After the completion of the course, the student will be able to:

CO1 : Demonstrate the DSP concepts using Scilab/Octave
CO2 : Design and verify the characteristics of digital filters using Scilab/Octave.
CO3 : Apply FFT algorithm to compute the response of the system using Scilab/Octave.
CO4 : Generate and study different signals using Scilab/Octave.
CO5 : Demonstrate and visualize different real world signals using Scilab/Octave programs.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO2	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO4	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO5	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Digital Signal Processing Using MATLAB, John G Proakis and Vinay K Ingle, Cengage Learning, 2011.

<table>
<tr><td>Course Title</td><td colspan="7">C++ Basics</td></tr>
<tr><td>Course Code</td><td colspan="7">ETL406B</td></tr>
<tr><td>Category</td><td colspan="7">Ability Enhancement Course (AEC)</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="2">Total teaching hours</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td><td>26</td><td>1</td></tr>
<tr><td>CIE Marks : 50</td><td colspan="3">SEE Marks : 50</td><td colspan="2">Total Max. Marks = 100</td><td colspan="2">Duration of SEE : 01 Hours</td></tr>
</table>

Course objectives:

1. Understand object-oriented programming concepts, and apply them in solving problems.
2. To create, debug and run simple C++ programs.
3. Introduce the concepts of functions, friend functions, inheritance and polymorphism.
4. Introduce the concepts of exception handling.

Sl. No.	Programs
1	Write a C++ program to find largest & smallest of three numbers using inline functions Max & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1+ m2 and m4 = m1 – m2 else display error.
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.

6	Write a C++ program to exercise static members & static class.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data ofan employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances= 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specifier by means of members variables & members functions.
11	Write a C++ program to create three objects for a class named count object with data members such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using "this" pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Course Outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Develop C++ program to solve simple and complex problems
2. Apply and implement object-oriented concepts like message passing, function overloading, operator overloading and inheritance to solve real-world problems.
3. Implement features such as friend function/class & exception handling to develop C++ Programs.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	2	1		1	3	1	2
CO2	3	3	3	2	1		1		1	1			2	1	1
CO3	3	3	3	1	1		1		1	1			2	1	1
CO4	3	3	3	2	2	2	2	1	2	1	1	1	3	1	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002.
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill.

Course Title	**ELECTRONIC DEVICES & CIRCUITS LABORATORY using LABview**						
Course Code	**22EEL406D**						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 01 Hours**	

Course objectives:

1. Design and demonstrate the diode circuits and transistor amplifiers.
2. Explain various BJT parameters, connections and configurations.
3. Explain various types of FET biasing and demonstrate the use of FET amplifiers.
4. Analyze Power amplifier circuits in different modes of operation.
5. Construct Feedback and Oscillator circuits using FET.

Every experiment has to be designed, circuit to be drawn / constructed and executed in the specified software. Results are also to be noted and inferred.

Experiments using LabVIEW

Study of LabVIEW

1. P-N Junction Diode Characteristics (Forward & Reverse bias)
2. Zener Diode Characteristics (V-I Characteristics)
3. BJT Input & Output characteristics (CE configuration)
4. FET Drain (output) & Transfer Characteristics (CS configuration)
5. Clipper operation: positive, negative biased clippers.
6. Clamper operation: positive, negative biased clampers.
7. SCR Characteristics using Multisim/LabVIEW
8. UJT Characteristics using Multisim/LabVIEW
9. BJT- CE Amplifier using Multisim/LabVIEW
10. BJT-CC Amplifier using Multisim/LabVIEW
11. Half Wave Rectifier using Multisim/LabVIEW
12. Full Wave Rectifier using Multisim/LabVIEW

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO2	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO4	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO5	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Telecommunication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2025-26 (2022 Scheme)

VII SEMESTER(Swappable VII and VIII SEMESTER)

Sl.No	Course andCourseCode		CourseTitle	TeachingDepartment (TD)and QuestionPaper SettingBoard(PSB)	TeachingHours/Week				Examination				Credits
					TheoryLecture	Tutorial	Practical/ Drawing	Self-Study	Durationhours	CIEMarks	SEEMarks	TotalMarks	
					L	T	P	S					
1	IPCC	22ETU701	Optical Fiber Communication		3	0	2		03	50	50	100	4
2	IPCC	22ETU702	Wireless and Mobile Networks		3	0	2		03	50	50	100	4
3	PCC	22ETT703	Adaptive Signal Processing		3	2	0		03	50	50	100	4
4	PEC	22ETT704x	Professional Elective Course		3	0	0		03	50	50	100	3
5	OEC	22ETT705x	Open Elective Course – 2		3	0	0		01	50	50	100	3
6	PROJ	22ETP706	Major Project Phase-II		0	0	12		03	100	100	200	6
										400	300	700	24

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course,**OEC**:OpenElectiveCoursePR:ProjectWork,**L:**Lecture,**T**:Tutorial,**P**:PracticalS= Self-Study,**CIE**:ContinuousInternalEvaluation,**SEE**:SemesterEndEvaluation.**TD-**TeachingDepartment,**PSB**:PaperSettingdepartment,**OEC**:OpenElective Course, **PEC**:Professional Elective Course. **PROJ**: Projectwork

Professional Elective Course 22XXT704x

22ETT704A	DSP algorithms and architecture	22ETT704C	Machine Learning using Python
22ETT704B	Digital image processing and its applications	22ETT704D	Wireless Sensor Networks and its Applications

Open Elective Course 22XXT705x

22ETT705A	Wireless Sensor Networks	22ETT705C	Fundamentals of Digital Image Processing
22ETT705B	Multimedia Communication		

Note: VII and VIII semesters of IV years of the program

(1) InstitutionscanswaptheVIIandVIIISemesterSchemesofTeachingandExaminationstoaccommodateresearchinternships/industryinternshipsaftertheVIsemester**.**

(2)CreditsearnedforthecoursesofVIIandVIIISemesterSchemeofTeachingandExaminationsshallbecountedagainst the correspondingsemesterswhetherthe VII orVIIIsemesters iscompletedduringthe beginningoftheIVyearorthelater partofIVyearsof the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the EngineeringandTechnologycurriculum.Multidisciplinarycoursesthatareaddedsupplementthelatesttrendandadvancedtechnologyintheselectedstreamof Engineering.Eachgroupwillprovideanoptiontoselect onecourse.Theminimumnumberofstudents'strengthsfor offeringprofessionalelectivesis10.However,thisconditionalshall notbeapplicabletocaseswherethe admissiontotheprogram is less than10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they canopt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under theguidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this conditionshallnot beapplicabletoclass whereth eadmissiontotheprogramis lessthan10.

PROJECT WORK(21XXP75): TheobjectiveoftheProjectwork is

(i) Toencourageindependentlearningandthe innovativeattitudeofthestudents.

(ii) Todevelopinteractiveattitude,communicationskills,organization,timemanagement,andpresentationskills.

(iii) Toimpartflexibilityandadaptability.

(iv) Toinspireteamworking.

(v) Toexpandintellectualcapacity,credibility,judgmentandintuition.

(vi) Toadheretopunctuality,settingandmeetingdeadlines. To installresponsibilitiestooneselfandothers.

(vii) Totrainstudentstopresentthetopicofprojectworkinaseminarwithoutanyfear,facetheaudienceconfidently,enhancecommunicationskills,involveingroupdiscussiontopresent andexchangeideas.

CIE procedure for ProjectWork:

(1) Singlediscipline: TheCIEmarksshallbeawardedbyacommitteeconsistingoftheHeadoftheconcernedDepartmentandtwoseniorfacultymembersoftheDepartment,oneofwhomshallbe theGuide.

TheCIEmarksawardedfortheprojectwork,shallbebasedontheevaluationoftheprojectworkReport,projectpresentationskill,andquestionandanswersessionintheratio50:25:25.Themarksawarded fortheprojectreportshallbethe samefor allthebatchmates.

(2) Interdisciplinary: ContinuousInternalEvaluationshallbegroup-wiseatthecollegelevelwiththeparticipationofallguidesofthecollege.Participationofexternal guide/s,ifany,isdesirable.TheCIEmarksawardedfortheprojectwork,shallbebasedontheevaluationofprojectworkReport,projectpresentationskill,andquestionandanswer sessionin theratio50:25:25.Themarksawardedfor theprojectreport shallbe thesameforallthebatch mates.

SEEprocedureforProjectWork:SEEforprojectworkwillbeconductedbythetwoexaminersappointedbytheUniversity.TheSEEmarksawardedfortheprojectworkshallbebasedonthe evaluationofprojectworkReport,projectpresentationskill,andquestionandanswersessionintheratio50:25:25.

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: ----------
Tentative Scheme of Teaching and Examination effective from the Academic Year -------- (2022 Scheme)

VIIISEMESTER(SwappableVIIandVIIISEMESTER)

Sl.No	Course andCourseCode		CourseTitle	TeachingDepartment (TD)and QuestionPaper SettingBoard(PSB)	TeachingHours/Week				Examination				Credits
					TheoryLecture	Tutorial	Practical/ Drawing	Self-Study	Duration inhours	CIEMarks	SEEMarks	TotalMarks	
					L	T	P	S					
1	PEC	22ETT801x	Professional Elective (Online Courses)		3	0	0		-	-	-	-	3
2	OEC	22ETT802x	Open Elective (Online Courses) - 3		3	0	0		-	-	-	-	3
3	INT	22ETI803	Internship(Industry/Research) (14-20Weeks)		0	0	12		03	100	100	200	10
										200	200	400	16

L:Lecture,**T**:Tutorial,**P**:PracticalS= Self-Study,**CIE**:ContinuousInternalEvaluation,**SEE**:SemesterEndEvaluation.**TD-**TeachingDepartment,**PSB**:PaperSettingdepartment,**OEC**:OpenElectiveCourse,**PEC**:ProfessionalElectiveCourse.**PROJ**:Projectwork,**INT**:IndustryInternship/ResearchInternship/Rural Internship.

Professional Elective Course (Onlinecourses) 22ETT801x			
22ETT801A		22ETT801C	
22ETT801B		22ETT801D	
Open Elective Courses (OnlineCourses) 22XXT802x			
22ETT802A		22ETT802C	
22ETT802B		22ETT802D	

Note: VII and VIII semesters of IV years of the programSwapping Facility

- InstitutionscanswapVIIandVIIISemesterSchemeofTeachingandExaminationstoaccommodate**researchinternships/industryinternships/RuralInternship**aftertheVIIsemester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII orVIIIsemester is completedduringthebeginningof IVyearor later part of IVyearofthe program.

Elucidation:

AtthebeginningofIVyearsoftheprogrami.e.,afterVIsemester,VIIsemesterclassworkandVIIIsemester**ResearchInternship/IndustrialInternship/RuralInternship**shallbepermittedtobeoperatedsimultaneouslybytheUniversitysothatstudentshaveampleopportunityforaninternship.Inotherwords,agoodpercentageoftheclassshall attendVIIsemester classworkandasimilarpercentageofothersshallattendto ResearchInternshiporIndustrial InternshiporRural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), StudyCentreestablishedintheparent institute and/or at reputedresearchorganizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall beconsidered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequentUniversityexaminationafter satisfyingtheinternshiprequirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with thefieldandimparts theskill requiredforcarryingout research.

Industry internship: Is an extended periodofworkexperienceundertakenbystudents tosupplementtheirDegreeforprofessional development. It also helpsthemlearntoovercomeunexpectedobstaclesandsuccessfullynavigateorganizations,perspectives,andcultures.Dealingwithcontingencieshelpsstudentsrecognize,appreciate,andadapt toorganizational realitiesby temperingtheirknowledgewith practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in differentacademicyearsforexploringvariousopportunitiesintechno-socialfields,to connectandworkwithRuralIndiafor their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.The students arepermitted tocarryouttheinternshipanywhereinIndiaorabroad.Universityshallnotbearany expensesincurredinrespectoftheinternship.

- With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside thestate or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University/Institute shall not be aranycostinvolvedincarrying out the internship by students.** However, tudentscanreceiveanyfinancialassistanceextendedbytheorganization

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2022 Scheme

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	--	22ETT501	Management & Enterprenuship for Telecommunication Engineers	ETE	3	0	0		03	50	50	100	3
2	IPCC	22ETU502	Microwave Engineering and Antenna Theory	ETE	3	0	2		03	50	50	100	4
3	PCC	22ETT503	Digital Communication	ETE	3	2	0		03	50	50	100	4
4	PCCL	22ETL504	Digital Communication Lab	ETE	0	0	2		03	50	50	100	1
5	PEC	22ETT505x	Professional Elective Course	ETE	3	0	0		03	50	50	100	3
6	PROJ	22ETM506	Mini Project	ETE	0	0	4		03	100		100	2
7	AEC	22RMT507	Research Methodology and IPR	ETE	2	2	0		02	50	50	100	3
8	MC	22CVT508	Environmental Studies	TD: CV PSB: CV	2	0	0		02	50	50	100	2
9	HS	22CDN509	Aptitude and Verbal Ability Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	22NSN510	National Service Scheme (NSS)	Mentors	0	0	2			100	---	100	PP/ NP
		22PEN510	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON510	Yoga	Yoga Teacher									
								Total		500	300	800	22

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study CIE: Continuous Internal Evaluation, SEE:Semester End

Evaluation. K : The letter in the course code indicates common to al the stream of Engineering. PROJ: Project /Mini Project. PEC: Professional Elective Course

Professional Elective Course 22XXT505x

22ETT505A	**Fundamentals of Satellite Communication**	**22ETT505B**	**Multimedia Communication**
22ETT505C	**Transmission Lines and Waveguides**	**22ETT505D**	**OOPS using C++**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governingthe Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

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2022 Scheme

VI SEMESTER

Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
IPCC	22ETU601	Computer Communication Networks	ETE	3	0	2		03	50	50	100	4
PCC	22ETT602	ARM Processor & Embedded System Design	ETE	3	2	0		03	50	50	100	4
PEC	22ETT603x	Professional Elective Course	ETE	3	0	0		03	50	50	100	3
OEC	22ETT604x	Open Elective Course-I	ETE	3	0	0		03	50	50	100	3
PROJ	22ETP605	Major Project Phase I	ETE	0	0	4		03	100	--	100	2
PCCL	22ETL606	ARM Processor & Embedded System Design Lab	ETE	0	0	2		03	50	50	100	1
AEC/SDC	22ETT607x OR 22ETL607x	Ability Enhancement Course/ Skill Development Course V	ETE	If the course is offered as a Theory				01	50	50	100	1
				1	0	0						
				If course is offered as a practical								
				0	0	2						
HS	22CDN608	Analytical and Reasoning Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP

MC	**22NSN609**	**National Service Scheme (NSS)**	**Mentors**	**0**	**0**	**2**			**100**	**---**	**100**	**PP/ NP**
	22PEN609	**Physical Education (PE) (Sports and Athletics)**	**Physical Education Director**									
	22YON609	**Yoga**	**Yoga Teacher**									
								Total	**500**	**300**	**800**	**18**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **S**= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to all the stream of Engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course.

Professional Elective Course: 22XXT603x			
22ETT603A	**Cryptography& Network Security**	**22ETT603B**	**RADAR Engineering**
22ETT603C	**Fundamentals of AI & ML**	**22ETT603D**	**Principles of VLSI Design**
Open Elective Course 22XXT604x			
22ETT604A	**Mobile Communication**	**22ETT604B**	**Embedded System Design & ARM Processor**
22ETT604C	**Fundamentals of VLSI Design**	**22ETT604D**	**Principles of Satellite Communication**

Ability Enhancement Course / Skill Enhancement Course-V 22XXT607x OR 22XXL607x			
22ETT607A	**Antenna Design & Testing Lab**	**22ETT607B**	**IoT Lab**
22ETT607C	**Communication Simulink Toolbox**	**22ETT607D**	**Virtual Instrumentation using LabVIEW**
22ETT607E	**VLSI Design Lab**		

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governingthe Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 **National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they canopt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.
Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	MAT301	Transform Calculus, Fourier Series and Numerical Techniques	ETE	3	2	0		03	50	50	100	4
2	IPCC	ETU302	Digital System Design using Verilog	ETE	3	0	2		03	50	50	100	4
3	IPCC	ETU303	Signals and Systems	ETE	3	0	2		03	50	50	100	4
4	PCC	ETU304	Analog Electronic Circuits	ETE	3	0	0		03	50	50	100	3
5	PCCL	ETL305	Analog and Digital Electronics Lab	ETE	0	0	2		03	50	50	100	1
6	ESC	ETT306x	ESC/ETC/PLC	ETE	3	0	0		03	50	50	100	3
7	UHV	HST307	Social Connect and Responsibility	ETE	0	0	2		01	100	---	100	1
8	AEC/ SEC	ETL308x	Ability Enhancement Course/Skill Enhancement Course – III	ETE	If the course is a Theory: 1	0	0		01	50	50	100	1
					If a course is a laboratory: 0	0	2		02				
9	HS	CDN309	Aptitude and Verbal Ability Skill-I	Placement Cell	2	0	0		--	50	--	50	PP/NP
10	MC	NSN310	National Service Scheme (NSS)	Mentors	0	0	2		--	100	---	100	PP/NP
		PEN310	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		YON310	Yoga	Yoga Teacher									
									Total	550	350	900	21

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, S= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation. K: This letter in the course code indicates common to all the streams of Engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC) 22XXT306x			
ETT306A	Fundamentals of Telecommunications	**ETT306B**	Principles of Sensors and Signal Conditioning
ETT306C	8051 Microcontroller	**ETT306D**	Control Systems
Ability Enhancement Course – III 22XXT308x **OR** 2XXL308x			
ETL308A	Logic Design Lab using Pspice / MultiSIM	**ETL308B**	Linear Integrated Circuits Lab using Pspice / MultiSIM
ETL308C	Analog Electronic Circuits Lab using PSpice/MultiSIM	**ETL308D**	LabVIEW Programming Basics

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

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IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lect	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	ETT401	Communication Theory	ETE	3	0	0		03	50	50	100	3
2	IPCC	ETU402	Digital Signal Processing	ETE	3	0	2		03	50	50	100	4
3	IPCC	ETU403	Network & Field Theory	ETE	3	0	2		03	50	50	100	4
4	PCCL	ETL404	Communication Laboratory	ETE	0	0	2		03	50	50	100	1
5	ESC	ETT405x	ESC/ETC/PLC	ETE	3	0	0		03	50	50	100	3
6	AEC/ SEC	ETL406x	Ability Enhancement Course/Skill Enhancement Course- IV	ETE	If the course is Theory: 1	0	0		01	50	50	100	1
					If the course is a lab: 0	0	2		02				
7	BSC	BIT407	Biology For Engineers	ETE	2	0	0		03	50	50	100	2
8	UHV	HST408	Universal human values	ETE	1	0	0		01	50	50	100	1
9	HS	CDN409	Aptitude and Verbal Ability Skill-II	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	NSN410	National Service Scheme (NSS)	Mentors	0	0	2			100	---	100	PP/ NP
		PEN410	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		YON410	Yoga	Yoga Teacher									
									Total	500	400	900	19

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course (ESC/ETC/PLC) 22XXT405x OR 22XXL405x			
ETT405A	Principles of Transmission Lines & Waveguides	**ETT405B**	Telecommunication Switching Systems
ETT405C	Television Engineering		
Ability Enhancement Course / Skill Enhancement Course – IV 22XXT405x OR 22XXL406x			
ETL406A	Embedded C Basics	**ETL406B**	Octave / Scilab for Signals
ETL406C	C++ Basics	**ETL406D**	Electronic Devices & Circuits using LABVIEW

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall

not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of Degree.