VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Electronics and Telecommunication Engineering

Department of Electronics and Telecommunication Engineering

Third Year (Sem V & Sem VI) Syllabus
(2026 'NEP&Autonomy' Scheme)

Batch [2024-2028]

VIVEKANAND EDUCATION SOCIETY'S
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Department of Electronics and Telecommunication Engineering

Semester V Scheme									
Course Type	**Course Code**	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
			Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Programme Core Course (PCC)	26ETPC51	Antenna and Wave Propagation	3	2	-	3	1	-	4
Programme Core Course (PCC)	26ETPC52	Microprocessor and Microcontrollers	3	2	-	3	1	-	4
Programme Core Course (PCC)	26ETPC53	Digital Signal Processing	3	2	-	3	1	-	4
Programme Elective	26ETPE51X	Program Elective Course -I	3	2	-	3	1	-	4
Multidisciplinary Minor (MDM)	26ETMM51	Information & Web App Management	4	-	-	4	-	-	4
Open Elective(OE)	26OE5XX	Open Elective Course -II (Mooc Course)	-	-	-	4	-	-	4
Total Credits						20	04	--	**24**

* *Tutorial for complete class*

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Program Elective Course -I

Course Code	Name Of The Subject
26ETPE511	Digital and IPTV Engineering
26ETPE512	Control Systems for space crafts
26ETPE513	Microelectronics

Open Elective Course-II(Online Mooc Courses)

Course Code	Name Of The Subject
26ETOE521	Banking and Finance Laws
26ETOE522	Biodiversity for Sustainability
26ETOE523	Health and Disability in Humanities
26ETOE524	Entrepreneurship
26ETOE525	HR Analytics

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Semester V Marks Scheme								
Course Type	**Course Code**	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
Programme Core Course (PCC)	26ETPC51	Antenna and Wave Propagation	60	20	20	25	25	150
Programme Core Course (PCC)	26ETPC52	Microprocessor and Microcontrollers	60	20	20	25	25	150
Programme Core Course (PCC)	26ETPC53	Digital Signal Processing	60	20	20	25	25	150
Programme Core Course (PCC)	26ETPE51X	Program Elective Course -I	60	20	20	25	25	150
Multidisciplinary Minor (MD M)	26ETMM51	Information & Web App Management	60	20	20	-	-	100
Open Elective(OE)	26OE5XX	Open Elective Course -II	-	-	-	-	-	100
Total Marks								**800**

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COURSE NAME: ANTENNAS AND WAVE PROPAGATION

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC51	Antennas and Wave Propagation	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

Antennas and Wave Propagation Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC51	Antennas and Wave Propagation	03	02	---	03	01	---	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPC51	Antennas and Wave Propagation	20	20	60	-	-	100

Course Prerequisite: Electromagnetic Field Two port network Transmission Line	
Course Objectives:	
1	To learn the fundamental parameters of Antenna
2	To learn about linear wire antenna and its types
3	To learn about Antenna arrays and synthesis
4	To learn about various Special types of Antennas
5	To learn about Radio wave propagation
Course Outcomes: After successful completion of the course students will be able to:	
1	To understand the significance of antenna parameters like radiation pattern, directivity, gain

	etc.
2	To understand the field equations of linear wire antennas.
3	To design linear antenna arrays and understand the concept of synthesis.
4	To design and understand the various applications of Special types of Antennas.
5	To understand the different modes of Radio wave propagation.

Module		Content	Hrs
1		**Antenna Fundamentals**	**06**
	1.1	Introduction : Types and Applications of Antennas, Radiation mechanism. Antenna Parameters: Radiation pattern, Radiation power density, Radiation Intensity, Gain, Directivity, HPBW, FNBW, Beam efficiency, Bandwidth, Polarization, Input Impedance, Reflection coefficient, Return loss, VSWR, Antenna Efficiency, Effective Aperture, Friis transmission equation.	
2		**Linear Wire Antennas**	**06**
	2.1	Introduction : Infinitesimal dipole, Small dipole, Finite-length dipole, Half-wave dipole - Radiation zones, Total radiated power, Radiation resistance, Directivity, Effective area. Comparative study of Dipole, Monopole and Folded Dipole antenna.	
3		**Antenna Arrays**	**12**
	3.1	Introduction : Two-element array - Array factor and Pattern multiplication, Case study of two Isotropic point sources, N-element Linear Array (uniform spacing and amplitude), Broad-side and End-fire arrays, Phased array, Directivity of Hansen woodyard endfire array, N-element Linear Array (uniform spacing and non uniform amplitude) Binomial array, Dolph-Chebyshev array, Examples, Planar arrays.	
	3.2	Array Pattern synthesis: Fourier series method, Binomial arrays, The array polynomial, Chebyshev arrays, Super directive arrays.	

4		**Special Antennas I:**	**05**
	4.1	**Broadband Antennas** : Introduction, Principle of Helical Antenna, Introduction and design of Yagi Uda array **Frequency Independent Antenna** : Introduction, Principle and design of Log Periodic Antenna **Narrowband Antenna** : Introduction, Principle and design of Rectangular Microstrip Antenna	
5		**Special Antennas II:**	**05**
	5.1	**Aperture Antennas** : Introduction, Principle of Plane Reflector, Corner Reflector, Parabolic Reflector Antenna. **Advanced Antennas** : Introduction - Dielectric Resonator Antenna, Wearable Antenna, Reconfigurable Antenna.	
6		**Radio Wave Propagation**	**05**
	6.1	Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept, Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading, Multi hop propagation.	
		Total	**39**

Textbooks:	
1	C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, Third Edition, 2016.
2	J.D. Kraus, R.J. Marhefka, and A.S. Khan, "Antennas & Wave Propagation", Fourth Edition, McGraw Hill 2011.
3	R. E. Collin, "Antennas and Radio Wave Propagation", International Student Edition, McGraw Hill, Fourth Edition, 1985.

4	G. Kumar, K. P. Ray, "Broadband Microstrip Antenna", Artech House, First Edition, 2002.
5	K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation," Tech. India Publications, New Delhi, 2001.
Reference Books:	
1	Warren L. Stutzman, Gary A. Thiele, "Antenna Theory and Design", John Wiley & Sons, 1981.
Access to NPTEL course:	
	https://archive.nptel.ac.in/courses/108/101/108101092/
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://www.mathworks.com/products/matlab.html
	https://www.scilab.org/

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/ talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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COURSE NAME:Antennas and Wave Propagation Lab

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPCL 51	Antennas and Wave Propagation Lab	---	2	---	---	1	---	1

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPCL51	Antennas and Wave Propagation Lab	---	---	---	25	25	50

Prerequisite : Antennas and Wave Propagation Laboratory
1. Fundamentals of Electromagnetics

Lab Objectives:

1	To study the radiation mechanism of an antenna and its various parameters.
2	To study the radiating principles of various Special types of Antennas.

Lab Outcomes:

1	To understand the radiation mechanism of an antenna and its basic parameters like radiation pattern, directivity, gain etc.
2	To understand the radiation properties of Antenna Array and Special Antennas such as Yagi Uda Antenna, Horn Antenna, Reflector Antenna, Microstrip Antenna etc.

Antennas and Wave Propagation laboratory	
Sr. No.	**Title of Experiment**
1	To plot the radiation pattern of the Dipole antenna.
2	To plot the radiation pattern of Yagi Uda antenna.
3	To simulate the FRIIS Transmission Equation.
4	To simulate the principle of Pattern Multiplication of two dipoles.
5	To plot the Array Factor pattern for a Uniform Linear Broadside array.
6	To plot the Array Factor pattern for a Uniform Linear Endfire array.
7	To plot the radiation pattern of a log Periodic antenna.
8	To plot the radiation pattern of a Helical antenna.
9	To plot the radiation pattern of the Parabolic Reflector antenna.
10	To design, simulate, fabricate and test Microstrip antenna.

Term Work:	
1	Term work should consist of 8 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total **25 Marks** (Experiments: 20-marks, Attendance Theory & Practical: 05-marks)
Practical & Oral Exam:	

1	Based on the experiments, practical exam and oral should be conducted
2	Total **25 Marks**

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COURSE NAME: MICROPROCESSOR AND MICROCONTROLLERS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC52	Microprocessor and Microcontrollers	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

Microprocessor and Microcontrollers (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC52	Microprocessor and Microcontrollers (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPC52	Microprocessor and Microcontrollers (Theory)	20	20	60	---	---	100

Course Prerequisite: Digital System Design	
Course Objectives:	
1	To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2	To understand the architecture of 8051
3	To understand the architecture of the ARM7 core
4	To write programs for 8051 microcontrollers.
5	To understand the design of Microcontroller Applications.

Course Outcomes: After successful completion of the course students will be able to:	
1	Learn the architecture and pin configuration of 8086 Microprocessor
2	Understand the detailed architecture of 8051.
3	Understand the detailed architecture of ARM7 Core.
4	Write programs for 8051 microcontrollers.
5	Design an application using a microcontroller.

Module		**Content**	**Hr**
1		**8086 Microprocessor**	**5**
	1.1	Introduction to 8086, features, architecture, pin description, memory banking, memory segmentation, External memory interfacing, bus cycle.	
	1.2	Maximum mode bus cycle, memory interfacing, Minimum mode System configuration, Maximum mode system configuration, Interrupts processing	
2		**8051 Microcontroller**	**10**
	2.1	Comparison between Microprocessor and Microcontroller	
	2.2	Features, architecture and pin configuration	
	2.3	CPU timing and machine cycle	
	2.4	Input / Output ports	
	2.5	Memory organization	
	2.6	Counters and timers	
	2.7	Interrupts	
	2.8	Serial data input and output	

3		**8051 Assembly Language Programming and Interfacing**	**11**
	3.1	Addressing modes, Need of Assembler & Cross Assemble, Assembler Directives	
	3.2	Instruction Set	
	3.3	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts	
	3.4	Interfacing with LEDs, Relay and Keys	
4		**ARM7**	**4**
	4.1	Introduction & Features of ARM 7	
	4.2	Concept of Cortex-A, Cortex-R and Cortex-M	
	4.3	Architectural inheritance, Pipelining	
5		**ARM7 Instruction Set**	**6**
	5.1	Programmer's model	
	5.2	Brief introduction to exceptions and interrupts handling	
	5.3	Instruction set: Data processing, Data Transfer, Control flow	
6		**ARM7 based microcontroller**	**3**
	6.1	Understanding features, architecture & addressing modes of STM32.	
		Total	**39**

Textbooks:	
1	Krishna Kant, "Microprocessors and Microcontrollers", Prentice Hall of India, 2013.
2	M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
3	C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010.
4	Steve Furber, "ARM System on chip Architecture", Pearson,2nd edition, 2001
Reference Books:	
1	Doughlas V.Hall, —Microprocessors and Interfacing, Programming and Hardware, TMH, 2012.
2	"MCS@51 Microcontroller, Family User's Manual" Intel
3	James A. Langbridge, "Professional Embedded Arm Development", Wrox, John Wiley Brand & Sons Inc., Edition 2014
4	Warren Gay, "Beginning STM32, 2018 edition.
Access to software:	
	https://www.st.com/resource/en/datasheet/stm32f205rf.pdf
	https://www.tutorialspoint.com/index.htm https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.htm
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://www.geeksforgeeks.org/arithmetic-instructions-8086-microprocessor/
	https://onlinecourses.nptel.ac.in/noc20_ee11/preview
	https://nptel.ac.in/courses/108105102

Internal Assessment:

1) Assessment consists of one Mid Term Test of **20 marks** and Continuous Assessment of **20 marks**.
2) Mid Term test is to be conducted when approximately 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: Microprocessor and Microcontrollers Lab

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPCL52	Microprocessor and Microcontrollers Lab	---	2	---	---	1	---	1

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPCL52	Microprocessor and Microcontrollers Lab	---	---	---	25	25	50

Lab Objectives:	
1	To understand development tools of microcontroller based systems.
2	To learn programming for different microcontroller operation & interface to I/O devices.
3	To develop microcontroller based applications.
4	To learn programming and application based on STM32 board
Lab Outcomes:	

After successful completion of the course students will be able to:	
1	Understand different development tools required to develop microcontroller based systems.
2	Write assembly language programs for arithmetic and logical operations, code conversion & data transfer operations.
3	Write assembly language programs for general purpose I/O, Timers & Interrupts.
4	Interface & write programs for Input and Output devices
5	Develop microcontroller based Applications.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Perform Arithmetic and Logical Operations (Using Immediate, Direct and Indirect addressing)
2	Code Conversion
3	Transfer of data bytes between Internal and External Memory
4	Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc.
5	Interfacing of Matrix Keyboard, LED, 7 Segment display, LCD, Stepper Motor, UART
6	Interfacing of STM32 with LED, Seven segment display, LCD, Keypad & Motors
7	Interfacing of STM32 with sensors like gas sensors, proximity sensors & temperature senator.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total **25 Marks** (Experiments: 20-marks, Attendance Theory & Practical: 05-marks)
Practical & Oral Exam:	
1	Based on the experiments, practical exam and oral should be conducted
2	Total **25 Marks**

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COURSE NAME: DIGITAL SIGNAL PROCESSING

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC53	Digital Signal Processing	03	02	---	03	01	---	04

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Institute of Technology

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Department of Electronics and Telecommunication Engineering

Digital Signal Processing (Theory)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPC53	Digital Signal Processing	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPC53	Digital Signal Processing	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
26ETPC53	Digital Signal Processing	3
Prerequisite: Mathematics for Communication		
Course Objectives:		
1	To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.	

2	To develop a thorough understanding of discrete fourier transforms and its use in spectral analysis and frequency domain filter designing.
3	To design and realize IIR filters and FIR filters, introduce the effects of finite word lengths on the filters.
4	To introduce applications of digital signal processing in the field of biomedical and audio signal processing.
Course Outcomes:	
1	Classify and analyze different types of signals and systems.
2	Analyze LTI signals and systems in the transform domain.
3	Understand the concepts of discrete fourier transforms, fast Fourier transform and apply in system analysis. Recall the system representations and understand the relation between different transforms.
4	Design digital IIR and FIR filters and Comprehend the impact of finite word length effects on the digital filters.
5	Interpret the different realization structures of digital IIR and FIR filters.
6	Apply signal processing concepts, algorithms in applications related to the field of real-world signal processing.

Module		Content	Hrs
1		**Fundamentals of Discrete Time Signals and Systems**	6
	1.1	**Introduction to analog and discrete signals:** Definition, Basic Elementary signals - exponential, sine, step, impulse, ramp, rectangular, triangular. Operations on signals. **Classification of Signals:** Even and odd signals, periodic and non-periodic signals, deterministic and non-deterministic signals, energy	

		and power signals.	
	1.2	**Discrete systems and classification of systems:** Discrete system representation, system with and without memory, causal and non-causal system, linear and nonlinear system, time invariant and time variant system, stable system.	
2		**Time domain analysis of discrete time systems**	**5**
	2.1	**Linear Time Invariant (LTI) systems:** Representation of discrete time systems using difference equations, impulse response, system stability and causality.	
	2.2	Use of convolution sum for analysis of LTI systems, properties of convolution sum, impulse response of interconnected systems, analogy between convolution and correlation.	
3		**Discrete Time Fourier Transform and Fast Fourier Transform**	**8**
	3.1	Discrete Time Fourier transform (DTFT), Discrete Fourier transform (DFT), Properties of DFT, DFT as a linear transformation, Relationship of the DFT to other transforms.	
	3.2	**Analysis of discrete time LTI systems using z-Transform:** Systems characterized by linear constant coefficient difference equation, transfer function, plotting poles and zeros of a transfer function, frequency response, causality and stability of systems, total response of a system.	
	3.3	Fast Fourier Transform: Radix-2 Fast Fourier Transforms (FFT), Radix-2 decimation in time , Inverse FFT , Introduction to decimation in frequency FFT algorithms, difference between DFT and FFT.	
4		**IIR Digital Filters**	**7**
	4.1	LTI systems as frequency-selective filters like low pass, high pass, band pass, notch, comb, and all-pass filters, Analog filter approximations for Butterworth Filters.	

	4.2	Mapping from s-plane to the z-plane - impulse invariant and bilinear transformation, Design of IIR Butterworth digital filter -from analog filter using impulse invariant and bilinear transformation techniques.	
5		**FIR Digital Filters**	**9**
	5.1	Characteristics of linear phase FIR digital filters, Symmetric and antisymmetric FIR filter, Location of the zeros of linear phase FIR filters, Minimum, maximum and mixed phase systems.	
	5.2	Design of FIR filters using Window techniques (Rectangular, Hanning, Bartlett).	
	5.3	Realization structures for IIR and FIR systems: Direct form 1, direct form 2, Cascade form and parallel form structures.	
	5.4	Introduction to the effects of Finite Word Length Effects on Digital Filters.	
6		**Applications of Digital Signal Processing**	**4**
	6.1	Introduction to Bio-medical signals: ECG, EEG, EMG, and EOG features. Removal of Artifacts and Interferences in ECG and EEG.	
	6.2	Introduction to Speech Processing analysis using DSP, Voiced and Unvoiced speech signal feature extraction: Energy and Zero Crossing Rate.	
		Total	**39**

Textbooks:	
1	Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education
2	Emmanuel C. Ifeachor, Barrie W. Jervis," Digital Signal Processing", A Practical Approach", Pearson Education
3	A Nagoor Kani "Digital Signal Processing", 2nd Edition, Tata Mc Graw Hill Education Private Limited
4	Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
Reference Books:	
1	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach ", 4th Edition McGraw Hill Education (India) Private Limited, 2013
2	Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education, 3rd Edition, 2010
3	L. R. Rabiner and B. Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India, 2006
4	S Salivahan, C Gnanapriya, "Digital Signal Processing", McGraw Hill Education (India) limited, 4 th Edition, 2015
5	Monson H Hayes, "Digital Signal Processing", Schaum's Outline Series, 2 nd Edition, 2011
6	Rangaraj M. Rangayyan, "Biomedical Signal Analysis- A Case Study Approach", Wiley 2002
7	Fundamentals of Speech Recognition, L Rabinar, B. H. Juang, and B. Yegnanarayana, Pearson Publications, 2008.

NPTEL/Swayam Courses:	
1	**Digital Signal Processing, Prof. T. K. Basu, IIT Kharagpur, https://archive.nptel.ac.in/courses/108/105/108105055/**

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 Marks

*For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	The question paper will be of 60 marks.
2	The question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: Digital Signal Processing Laboratory

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPCL53	Digital Signal Processing Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPCL53	Digital Signal Processing Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
26ETPCL53	Digital Signal Processing Lab	1

Prerequisite: C Programming Language.	
Lab Objectives:	
1	To carry out basic discrete signal processing operations
2	To implement and design FIR filters and IIR filters.

3	To implement applications related to the field of biomedical signal processing and audio signal processing. To develop troubleshooting abilities among students
Lab Outcomes:	
1	Perform basic discrete time signal processing operations such as Linear Convolution, Circular Convolution, Autocorrelation, Cross Correlation, etc. and interpret the results.
2	Demonstrate their ability towards interpreting and performing frequency analysis of different discrete time sequences and systems.
3	Design and implement the FIR and IIR Filters for given specifications.
4	Implement and analyze applications related to the field of biomedical signal processing and audio signal processing.

Suggested Experiments: Students are required to complete 8 to 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1 *	To plot exponential, sine, step, impulse, ramp, rectangular, triangular, and perform operations on signals.
2 *	To classify system with and without memory, causal and non-causal system, linear and nonlinear system, time invariant and time variant system, stable system.
3 *	To perform linear convolution of two signals, auto correlation of non-periodic signals, periodic signals and random noise and interpret the results obtained.
4 *	To obtain cross correlation of a signal with its delayed and attenuated version (Concept of radar signal processing).
5 *	To determine impulse, magnitude, phase response and pole-zero plot of given transfer functions.
6*	To perform circular convolution and linear convolution of two sequences using DFT.

7 *	To perform the DFT of DT sequence and sketch its magnitude and phase spectrum or To Generate a discrete time signal having minimum three frequencies and analyse its frequency spectrum.
8	Implementation of fast Fourier transform algorithm to find DFT of a discrete time sequence.
9 *	Design of IIR digital filters and use the designed filter to filter an input signal which has both low and high frequency components or real-world signals like ECG/EEG, speech signal etc).
10	Design FIR filter using windowing method and use the designed filter to filter an input signal which has both low and high frequency components or real-world signal like ECG/EEG, speech signal etc.
11	Design of minimum phase, maximum phase and mixed phase systems.
12 *	To verify the location of zeros in symmetric and antisymmetric FIR filters.
13	To generate the ECG signal and detect the characteristic points
14	To extract delta, theta, alpha, sigma, and beta waveforms from EEG signals.
15*	Musical tone generation.
16	DTMF tone generation and detection.
17*	Speech signal analysis for voiced and invoice segments using energy and zero crossing rate.

Useful Links:	
1	Virtual Laboratory-http://vlabs.iitkgp.ernet.in/dsp/ for demonstration of concepts like DFT and its inverse, FIR filter using windowing method etc
2.	Virtual Laboratory: DSP Toolkit https://bmsip-iitr.vlabs.ac.in/exp/dsp-toolkit/theory.html?

Term Work:

1	Term work should consist of 8 to 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks journal writeup, : Performance and Knowledge and skills in the experimentation: 05- marks, Regularity in Practicals: 05-marks)

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Department of Electronics and Telecommunication Engineering

COURSE NAME: DIGITAL & IPTV ENGINEERING

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETP E511	Digital & IPTV Engineering	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

Digital & IPTV Engineering (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE511	Digital & IPTV Engineering (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid Term Test	CA				
26ETPE511	Digital & IPTV Engineering (Theory)	20	20	60	---	---	100

Course Prerequisite: Basics of various Television standards and operation TCP/IP Protocol Basics of conventional video camera and standards	
Course Objectives:	
1	To provide in depth knowledge about Digital Television system
2	To familiarize students about various types of advanced types of Video cameras and Displays
3	To introduce the students to different television standards and applications

4	Acquaintance with HDTV and 3D TV system
5	To familiarize the students to IPTV, its architecture, protocols and hardware
6	To Introduce students to IP delivery networks, threats and mitigation
Course Outcomes: After successful completion of the course students will be able to:	
1	To understand the fundamentals and working principles of advanced digital television systems
2	To enable to choose or develop an appropriate camcorder and displays devices based on applications
3	To become familiar with current digital advanced TV standards
4	To understand fundamentals of IPTV
5	To acquire knowledge of IPTV and develop hardware and communication protocols
6	To provide customized IPTV services to end user with knowledge of IP delivery networks, threats and mitigation

Module		Content	Hrs
1		**Fundamentals of Digital Television**	9
	1.1	Fundamentals of colour television, Compatibility, and reverse compatibility, colour perception, Three colour theory, luminance, hue and saturation. Interlaced scanning, Composite video signal	
	1.1	Introduction to Digital TV, Digital TV signals and parameters	
	1.2	Digital TV transmitter and receiver its merits and demerits	
	1.3	MAC Signals and advanced MAC Signal Transmission	
	1.4	Digitization, Chroma subsampling, Digital audio compression techniques and video compression techniques MPEG1, MPEG2, H.264, MPEG- 4, AVC, H.265, SMPTE 421M	
	1.5	Set Top Box with recording	
2		**Digital Video Cameras, Displays and Streaming media device**	6
	2.1	Colour TV Digital cameras, Camcorders, Handycams, and Digicams	
	2.2	LED, LCD, OLED, PLASMA, Quantum Dot LED Displays	
	2.3	Chromecast	
	2.4	Consumer applications: DVD, Blu-Ray Disc	
3		**Digital TV standards and advanced TV**	8
	3.1	DVB-T, and its successors	
	3.2	ISDB –T	
	3.3	ATSC	
	3.4	ISD TV	
	3.5	DTMB	
	3.6	Ultra HDTV	
	3.7	CCTV	
	3.8	Direct to Home TV(DTH)	
	3.9	Smart TV and its functions	
	3.10	3D TV	

4		**IPTV**	**4**
	4.1	Introduction to IPTV	
	4.2	IPTV hardware	
	4.3	Features of IPTV	
	4.4	Architecture of IPTV	
	4.5	Bandwidth requirement	
	4.6	IPTV Set top Box, Smart TV comparison	
5		**IPTV Protocols and Applications**	**6**
	5.1	Internet Group Management Protocol (IGMP)	
	5.2	Real-Time Streaming Protocol (RTSP)	
	5.3	Real-Time Messaging Protocol (RTMP)	
	5.4	Hypertext Transfer Protocol (HTTP)	
	5.5	Applications of IPTV	
	5.6	IPTV Delivery: Broad cast, Unicast, Multicast	
	5.7	IPTV Streaming: Time Shifted Stream-On -the- fly streaming	
6		**IPTV Network Security: Threats and Countermeasures**	**6**
	6.1	Threats on IPTV Delivery Networks, Theft or Abuse of Network Assets, Theft of Service, Theft of IPTV-Related Data, Disruption of Service, Privacy Breach, Compromise of Platform Integrity	
	6.2	Security Issues of IPTV Delivery Networks: Protocols, Vulnerabilities, Countering the threats	
	6.3	Advantages and disadvantages of IPTV	
	6.4	Future of IPTV	
		Total	**39**

Textbooks:	
1	A. M. Dhake, *"Television and video Engineering,"* Tata McGraw Hill Publication, Second Edition, 2017.
2	Kelth jack, *"Video Demystified"*, Hand book for Digital Engineers, Newness, Elsevier, 4th Edition, 2005.
3	Marcelo S. Alencar, *"Digital Television Systems"*, Cambridge University Press, March 2009
4	Gilbert Held, *"Understanding IPTV"*, CRC Press, Auerbach Publication, First Edition, 2007.
Reference Books:	
1	D. Gerbarg, *" The digital evolution of Television",* Springer, (Author: Darcy Gerbarg Publication: Springer eBook, Publisher: Springer Nature, Date: Jan 1, 2009)
2	Maris Jos Abisolo, "Applications and Usability of interactive TV", Springer (Publisher: Springer International Publishing AG, ISBN: 9783319389066, Number of pages: 161, 1st edition 2016.)
3	Suliman Mohamed Fati, Saiful Azad, Al-Sakib Khan Pathan, *"IPTV Delivery Network"*, Wiley Publications, 2018
4	R. G. Gupta, *"Television Engineering & Video Systems"*, McGraw Hill Publication, Second Edition, 2017.
5	Morteza Sasani Ghamsari, *"Quantum dot based light emitting diodes"*, Google book, 2020

Internal Assessment:

1. Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2. Mid Term Test is to be conducted when approx. 50% syllabus is completed.
3. Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

Digital & IPTV Engineering (Laboratory)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPEL511	Digital & IPTV Engineering Laboratory	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPEL511	Digital & IPTV Engineering Laboratory	--	--	--	--	25	25	50

Prerequisite: Principles of Communication Engineering, Analog Electronics	
Lab Objectives:	
1	Understand the principles, architecture, and operation of modern Digital Television systems and standards.
2	Analyze various digital video acquisition, display, and streaming technologies used in contemporary multimedia systems.
3	Study and compare international Digital TV standards, HDTV, UHDTV, Smart TV, and emerging television technologies.

4	Understand IPTV architecture, hardware, delivery mechanisms, and communication protocols used in multimedia networking.
5	Analyze IPTV network security threats, mitigation techniques, and design IPTV-based multimedia service solutions.
Lab Outcomes:	
1	Explain the operation and components of Digital Television systems, compression techniques, and set-top box technologies.
2	Evaluate digital cameras, display technologies, and streaming devices for specific multimedia applications.
3	Compare and analyze various Digital TV broadcasting standards and advanced television technologies.
4	Demonstrate understanding of IPTV architecture, hardware, protocols, and multimedia content delivery mechanisms.
5	Identify IPTV security threats and propose suitable countermeasures for secure multimedia service deployment.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Study of monochrome television transmitter and receiver
2	Study the composite video signal for different patterns
3	Study patterns and waveforms from VGA input using LCD kit
4	Study of remote control pulses
5	Study of various patterns and their waveforms on the scope.
6	Study of Audio Waveform using LCD Trainer
7	To study receiver sections by using fault simulation switches
8	Study of Digital Video Compression Techniques
9	Chroma Subsampling Analysis
10	To study DTH receiver
11	Study of Set-top-box
12	Performance Evaluation of Various Display Technologies
13	Study of Digital Camera and Camcorder Specifications
14	Comparative Study of Digital Television Standards

15	Case Study on UHDTV and 3D Television Systems
16	Implementation of IPTV Streaming Using VLC Media Server
17	Packet Analysis of IPTV Protocols Using Wireshark

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total **25 Marks** (Experiments: 20-marks, Attendance Theory & Practical: 05-marks)
Practical & Oral Exam:	
1	Based on the experiments, practical exam and oral should be conducted.
2	Total **25 Marks**

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Department of Electronics and Telecommunication Engineering

COURSE NAME: CONTROL SYSTEM FOR SPACE CRAFTS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE512	Control System for space crafts	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

Control System for space crafts(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE512	Control System for space crafts (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPE512	Control System for space crafts (Theory)	20	20	60	---	---	100

Course Prerequisite: Matrices and Differential Calculus, Integral Calculus and Complex Numbers	
Course Objectives:	
1	To build a strong foundation in mathematics, provide students with mathematics fundamentals necessary to formulate, solve and analyse complex engineering problems.
2	To prepare students to apply reasoning informed by the contextual knowledge to engineering practice, to work as part of teams on multi-disciplinary projects.

Course Outcomes: After successful completion of the course students will be able to:	
1	Construct the mathematical models of the physical systems.
2	Analyze the system using transient response and steady-state specifications.
3	Determine the stability of the system in the frequency domain.
4	Determine the controllability and observability properties of the system.
5	Design the controller and observer via pole-placement techniques.
6	Design the linear state-feedback control for a spacecraft that has a nonlinear model.

Module		**Contents**	**Hrs.**
1		**Introduction to Control Systems and Mathematical Modelling**	6
	1.1	Introduction to Control Systems: The block diagram representation of open loop and closed loop control systems. Linear vs Nonlinear Systems, Linear time invariant vs Linear time varying systems.	
	1.2	Mathematical Modelling: Modelling of electrical and mechanical systems in time domain, linearization of the system at the operating point, state space representation of linear systems with physical variables. Frequency domain modelling : Transfer function.	
2		**Time response analysis of first and second order LTI systems**	6
	2.1	Time response analysis: Pole-zero mapping of first and second order systems and their implications, standard test signals, time response of first and second order systems, time response specifications	
	2.2	Steady state analysis: steady state errors and error constants.	
3		**Frequency domain stability analysis**	8

	3.1	Stability analysis : Stability analysis using Routh stability criterion, Root locus technique.	
	3.2	Stability analysis using Bode plots.	
4		**State space analysis**	7
	4.1	State space representation in various in canonical forms, invariance of eigenvalues and non-uniqueness of state space representation,	
	4.2	Controllability and observability properties, state transition matrix and solution to the state equations.	
	4.3	Concept of stability via Lyapunov theorems, Lyapunov equation, stability analysis via Lyapunov equations for physical systems.	
5		**State Feedback control and observer design**	6
	5.1	Concept of state feedback control, computation of state feedback gain via comparison of characteristic equations and Ackermann's formula.	
	5.2	Need of observer, full order observer design.	
6		**Case Study : Control of Spacecraft**	6
	6.1	Modelling of spacecraft, linearization to get a LTI model.	
	6.2	State Feedback Controller design using modern control schemes.	
Total			**39**

Textbooks:	
1	I. J. Nagrath, M. Gopal, "Control System Engineering", 5th edition, New Age International Publishers.
2	B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi.
3	Franklin Powell, "Digital Control of Dynamic Systems", Addison-Wesley Publications.
Reference Books:	
1	K. Ogata, "Modern Control Engineering", PHI, New Delhi.
2	Norman S. Nise, "Control System Engineering", John Wiley and Sons.
3	B. C. Kuo, "Automatic Control Systems", PHI, New Delhi.

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks

3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

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Department of Electronics and Telecommunication Engineering

Control System for space crafts (Laboratory)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
26ETPEL512	Control System for space crafts (Laboratory)	--	2	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPEL512	Control System for space crafts (Laboratory)	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
26ETPEL512	Control System for space crafts (Laboratory)	1

Prerequisite: Engineering Mathematics , Signals and Systems

Lab Objectives: The Control System for space crafts Laboratory aims to enable students

1	To understand the fundamental concepts of control systems and mathematical modelling of physical systems.
2	To analyze the time-domain and frequency-domain response of linear time-invariant (LTI) systems.
3	To evaluate system stability using classical control techniques such as Routh Criterion, Root Locus, and Bode Plot.

4	To develop state-space models and analyze controllability, observability, and stability of dynamic systems.
5	To design state feedback controllers and observers for modern control applications, including spacecraft control systems.
Lab Outcomes: Upon successful completion of the Control System for space crafts Laboratory, students will be able to	
1	Model electrical and mechanical systems and obtain their transfer function and state-space representations using simulation tools.
2	Analyze the transient and steady-state responses of first and second-order systems for various standard test inputs.
3	Investigate the stability of control systems using Routh-Hurwitz Criterion, Root Locus, and Bode Plot techniques.
4	Determine controllability, observability, and stability characteristics of state-space systems using computational tools.
5	Design and implement state feedback controllers and full-order observers for practical engineering systems such as spacecraft attitude control models.

Suggested Experiments: Students are required to complete 8 experiments.	
Sr. No.	**Name of the Experiment**
1	Time response analysis of the first and second order system.
2	Frequency response analysis of the first and second order system.
3	Study step, ramp, and impulse responses; determine time-domain specifications using MATLAB.
4	Determine static error constants (Kp, Kv, Ka) and evaluate steady-state errors for different system types.
5	**Root Locus Analysis and Design**: Implement MATLAB programs to determine system stability and compare results with pole locations.
6	**Frequency Response Analysis Using Bode Plots**: Determine gain margin, phase margin, bandwidth, and assess system stability.

7	Computation of State Transition Matrix and Solution of State Equations
8	Analysis of relative stability of the system.
9	State Feedback Controller Design using Pole Placement Technique

1	Term work should consist of 8 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
	Total 25 Marks

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Department of Electronics and Telecommunication Engineering

COURSE NAME: MICROELECTRONICS

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPE513	Microelectronics	03	02	--	03	01	--	4

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Department of Electronics and Telecommunication Engineering

Microelectronics(Theory)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPE513	Microelectronics	03	–	--	03	–	--	03

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPE513	Microelectronics	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
26ETPE513	Microelectronics	4
Prerequisite: Electronics Devices and Circuits		
Course Objectives:		
1	To understand integrated circuit biasing using MOSFET.	
2	To analyze a single stage active load MOS amplifier.	

3	To understand implementation of passive components in ICs.
4	To analyze active load differential amplifier
5	To understand the Basics of IC Design and Fabrication.
Course Outcomes:	
1	To introduce the physics of semiconductor materials for understanding the device modeling of semiconductor devices.
2	Analyze various constant current source circuits using MOS .
3	To design and implement an active load MOS amplifier.
4	To design and implement an active load differential amplifier.
5	Analyze how scaling influences parasitic elements such as capacitances and resistances, especially in modern high-speed ICs.
6	To develop an understanding of how different fabrication steps work together to create functional ICs

Module		Content	Hrs
1		**Semiconductor Electronics**	**04**
	1.1	Physics of Semiconductor Materials, Band Model of Solids, Thermal-Equilibrium Statistics, Carriers in Semiconductors.	
	1.2	Drift Velocity, Mobility and Scattering, Drift & Diffusion Current, Hall-Effect.	
2	2.1	**Integrated Circuit Biasing & Active Loads using MOSFET**	
	2.2	Current Mirror, cascade current source, Wilson current source, bias independent current source using MOSFET, DC analysis and small signal analysis of MOSET, DC analysis and small signal analysis of MOS active load, DC analysis and small signal analysis of MOS advanced active load	**07**

3		**Single Stage MOS Active Load amplifiers**	
	3.1	CS amplifier with resistive load, CS amplifier with current source load, CS amplifier with diode connected load, Common gate circuit, Cascode amplifier, Double Cascoding, Folded Cascode.	**07**
4		**Active Load MOSFET Differential Amplifier**	
	4.1	Basic MOS Differential Amplifier, DC transfer characteristics, small signal equivalent analysis, MOS differential amplifier with active load, MOS differential amplifier with cascode active load	**07**
5		**Basic Circuit Element**	**06**
	5.1	Monolithic resistors construction and characteristics- Diffused resistors, Epitaxial resistors, pinched resistors, Ion implantation resistors.	
	5.2	MOS resistors, monolithic capacitors-Junction Capacitor, MOS capacitors, poly-poly capacitors, MOS device as capacitor,IC Inductors.	
6		**Introduction to IC Fabrication**	**08**
	6.1	General classification of Monolithic Circuits, Definition of LSI , MSI, VLSI. Thin film Technology, Thin film conductor material , resistor material and substrate material, Thin film processing techniques, thin film resistor and capacitor design guidelines,Concept of sheet resistance.	
	6.2	Various important steps of Mos bipolar IC fabrication Crystal growing, wafer cleaning, oxidation, annealing, patternization using photolithography technique, diffusion, metallization, ion-implantation etc (only qualitative treatment)	
		Total	**39**

Textbooks:	
1	A. Sedra, K. Smith, adapted by A. Chanorkar —"Microelectronic Circuits-Theory and Application Advanced engineering mathematics", Oxford Higher Education, 7th Edition
2	D. Neamen, —"Electronic Circuits Analysis and Design", McGraw Hill Education, 3rd Edition
3	B. Razavi, —"Design of Analog Integrated Circuits", McGraw Hill Education, Indian Edition.
4	Integrated circuits - K.R. Botkar (9th Edition),Khanna Publication.
Reference Books:	
1	B. Razavi, "R F Microelectronics", Pearson Publication, 2nd Edition
2	Physics of Semiconductor Devices by S. M. Sze and Kwok K. Ng, 3rd Edition, (John Wiley & Sons, 2002).
3	"Microelectronics: Semiconductor Devices and Circuits" by Jacob Millman and Arvin Grabel, 2nd Edition, McGraw-Hill Education-1987
4	Semiconductor Device Fundamentals by Robert F. Pierret, Addison-Wesley Publishing, 1996
NPTEL/Swayam Courses:	
1	https://onlinecourses.nptel.ac.in/noc21_ee86/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 Marks

*For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

Microelectronics(Lab)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPEL51	Microelectronics	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Practical				Term Work	Pract & Oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
26ETPE513	Microelectronics	--	--	--	**--**	25	25	50

Lab Code	Lab Name	Credit
	Microelectronics	**1**

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Department of Electronics and Telecommunication Engineering

Prerequisite: 1. Digital system design 2. Electronics Devices and Circ
Lab Objectives: 1. To understand the operation and design of MOSFET current source circuits. 2. To analyze DC and small-signal characteristics of MOS active loads. 3. To study the performance of single-stage MOS amplifiers with different active loads. 4. To design and evaluate cascode and folded-cascode amplifier configurations. 5. To analyze differential amplifier characteristics and active-load implementations. 6. To develop simulation and circuit-analysis skills using EDA tools such as LTspice, Cadence, or Multisim.
Laboratory Outcomes After successful completion of the laboratory, students will be able to: 1) Design and analyze MOSFET current mirror and current source circuits. 2) Evaluate DC operating points and small-signal parameters of active loads. 3) Analyze gain, bandwidth, and output resistance of MOS amplifiers. 4) Design cascode and folded-cascode amplifiers for improved performance. 5) Implement and analyze MOS differential amplifiers with active loads. 6) Compare theoretical and simulated results for analog IC building blocks.

Suggested Experiments: Students are required to complete at least 9 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**

1*	To observe the input and output characteristics of enhancement type NMOS transistors.
2*	To observe the input and output characteristics of enhancement type PMOS transistors.
3*	To design and simulate CS amplifiers employing resistive load.
4*	To design and simulate CS amplifiers using active load.
5*	To design and study the MOSFET Wilson Current Mirror.
6*	To design and study Cascode Current Source.
7*	To obtain DC transfer characteristics of MOS Differential Amplifiers.
8*	To simulate MOS Differential Amplifier with Active Load.
9*	To design and study the MOSFET Current Mirror.
10	To simulate a MOS differential amplifier with cascode active load.
11	To obtain the layout of a CMOS inverter.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

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Department of Electronics and Telecommunication Engineering

COURSE NAME: INFORMATION & WEB APP MANAGEMENT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETMM51	Information & Web App Management	04	---	---	04	---	---	04

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Department of Electronics and Telecommunication Engineering

Information and Web App Management (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETMM51	Information & Web App Management	04	---	---	04	---	---	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETMM51	Information & Web App Management (Theory)	20	20	60	---	---	100

Course Prerequisite: Computer Networks, Cryptography, Ethical hacking & forensic	
Course Objectives:	
1	To focus on cybercrime and need to protect information.
2	Understand the types of attacks, how to tackle the amount of risk involved and access control techniques
3	Discuss the role of industry standards and legal requirements with respect to compliance.
4	The terms, concept and countermeasures of application Security, Threats, and Attacks

5	Understand the Secure Application Design and Architecture
6	Interpret different threat modeling approaches
Course Outcomes: After successful completion of the course students will be able to:	
1	Understand the scope of policies and measures of information security.
2	Apply risk assessment methodology and the role of access control to Identity management.
3	Interpret various standards available for information security.
4	Enumerate the terms of application Security, Threats , Attacks and describe the countermeasures for the threats discussed.
5	Explain the Secure Application Design and Architecture.
6	Review the different Security Scanning -testing techniques and threat modeling approach

Module		Content	Hrs
1		**Basics of Information Security**	**6**
	1.1	Basics Principles of Confidentiality, Integrity & Availability. Administrative Measures and Technical Measures, People, Process, Technology, IT ACT 2000, IT ACT 2008	
	1.2	Standards available for InfoSec: Cobit, ISO 27001, OWASP, OSSTMM	
2		**Risk Management and IAM**	**10**
	2.1	Threat, Threat-Source, Vulnerability, Attacks . Risk Assessment Frameworks: ISO 31010, NIST-SP-800-30, OCTAVE	
	2.2	Concepts of Identification, Authentication, Authorization and Accountability. Access Control Models: Discretionary, Mandatory, Role based and Rule-based.	

	2.3	Access Control Techniques: Constrained User, Access control Matrix, Content-dependent, Context – dependent	
	2.4	Threats to Access Control: Various Attacks on the Authentication Systems.	
3		**Operation Security**	**10**
	3.1	Concept of Availability, High Availability, Redundancy and Backup.	
	3.2	Calculating Availability, Mean Time Between Failure (MTBF), Mean Time to Repair (MTTR)	
	3.3	Disaster Recovery:Metric for Disaster Recovery, Recovery Time Objective (RTO), Recovery Point Objective (RPO), Work Recovery Time (WRT), Maximum Tolerable Downtime (MTD), Business Process Recovery, Facility Recovery (Hot site, Warm site, Cold site, Redundant site), Backup & Restoration	
	3.4	Types of Audits in Windows Environment , Endpoint protection, Shadow Passwords, SUDO users, etc.	
4		**Introduction to Application Security, Threats and Attacks**	**7**
	4.1	Introduction to Web Application Reconnaissance, Finding Subdomains, API Analysis, Identifying Weak Points in Application Architecture	
	4.2	Offence and defence against it: Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), XML External Entity (XXE) Injection, Injection Attacks, Denial of Service (DoS), Cross-Origin Resource Sharing Vulnerabilities	
5		**Secure Application Design and Architecture**	**9**
	5.1	Secure Software Development Lifecycle Averting Disaster Before It Starts, Team Roles for Security, Security in the Software Development	

		Lifecycle	
	5.2	Design Flaw vs. Security Bug, Secure Design Concepts, Segregation of Production Data, Application Security Activities	
6		**Security Scanning-Testing and Threat Modeling**	**10**
	6.1	Testing Your Code, Testing Your Application, Testing Your Infrastructure, Testing Your Database, Testing Your APIs and Web Services, Testing Your Integrations, Testing Your Network, Dynamic Web Application Profiling	
	6.2	Objectives and Benefits of Threat Modeling, Defining a Risk Mitigation Strategy, Improving Application Security, Building Security in the Software Development Life Cycle	
	6.3	Existing Threat Modeling Approaches Security, Software, Risk-Based Variants Threat Modeling Within the SDLC Building Security in SDLC with Threat Modeling, Integrating Threat Modeling Within the Different Types of SDLCs	
		Total	**52**

Textbooks:	
1	Shon Harris, Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill Education, 7 th Edition, 2016.
2	Andrei Miroshnikov, Introduction to Information Security - I, Wiley, 2018
3	Ron Lepofsky, The Manager's Guide to Web Application Security, Apress; 1st ed. edition, 2014
4	Alice and Bob Learn Application Security, by Tanya Janca Wiley; 1st edition (4 December 2020)
5	Web Application Security, A Beginner's Guide by Bryan Sullivan McGraw-Hill Education; 1st edition (16 January 2012)

6	Web Application Security: Exploitation and Countermeasures for Modern Web Applications by Andrew Hoffman Shroff/O'Reilly; First edition (11 March 2020)
7	The Security Development Lifecycle by Michael Howard Microsoft Press US; 1st edition (31 May 2006)
8	Risk Centric Threat Modeling Process for Attack Simulation And Threat Analysis, Tony Ucedavélez and Marco m. Morana, Wiley
9	Iron-Clad Java: Building Secure Web Applications (Oracle Press) 1st Edition by Jim Manico
Reference Books:	
1	Rich-Schiesser, IT Systems Management: Designing, Implementing and Managing World - Class Infrastructures, Prentice Hall; 2 edition, January 2010.
2	Dr. David Lanter – ISACA COBIT – 2019 Framework - Introduction and Methodology
3	NIST Special Publication 800-30, Guide for Conducting Risk Assessments, September 2012
4	Software Security: Building Security In by Gary McGraw Addison-Wesley Professional; 1st edition (January 23, 2006)
5	A Guide to Securing Modern Web Applications by Michal Zalewski
6	Threat Modeling: A Practical Guide for Development Teams by Izar Tarandach and Matthew J. Coles Dec 8, 2020
Online Resources:	
1	https://www.ultimatewindowssecurity.com/securitylog/book/Default.aspx
2	http://www.ala.org/acrl/resources/policies/chapter14
3	https://advisera.com/27001academy/what-is-iso-27001/
4	https://owasp.org/www-project-top-ten/
5	https://owasp.org/www-pdf-archive/OWASP_SCP_Quick_Reference_Guide_v2.pdf
6	https://pentesterlab.com/
7	https://app.cybrary.it/browse/course/advanced-penetration-testing
Any other (Access to AI tools / Data driven insights (if applicable) or any other/Courses):	

1	NPTEL Course: - Introduction to Information Security – I (URL: https://nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/)

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

Semester VI
Syllabus

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Department of Electronics and Telecommunication Engineering

Semester VI Scheme									
Course Type	**Course Code**	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
			Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Programme Core Course (PCC)	26ETPC61	Digital VLSI	3	2	-	3	1	-	4
Programme Core Course (PCC)	26ETPC62	Microwave Engineering	3	2	-	3	1	-	4
Programme Elective(PE)	26ETPE6XX	Program Elective Course-II	3	2	-	3	1	-	4
Programme Elective(PE)	26ETPE6XX	Program Elective Course-III	3	2	-	3	1	-	4
Multidisciplinary Minor (MDM)	26ETMM61	MDM Course -IV	-	4	-	-	2	-	2
Vocational and Skill Enhancement Course (VSEC)	26ETVS61	Skill Lab-II: Embedded Programming for Telecommunication	-	2+2*	-	-	2	-	2
Project	26ETMP61	Major Project -1	-	4	-	-	2	-	2
Total Credits						12	10	-	**22**

** Tutorial for complete class*

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Department of Electronics and Telecommunication Engineering

Program Elective Course -II

Course Code	Name Of The Subject
26ETPE621	EMI & EMC
26ETPE622	IoT & Industry 4.0
26ETPE623	Sensor Technology

Program Elective Course -III

Course Code	Name Of The Subject
26ETPE631	Big Data Analytics
26ETPE632	Neural Network & Fuzzy Logic
26ETPE632	Image Processing

Multidisciplinary Minor (MDM Course IV)

Course Code	Name Of The Subject
26ETMML61	Vulnerability Assessment and Penetration Testing Lab

Semester VI Marks Scheme								
Course Type	**Course Code**	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
Programme Core Course (PCC)	26ETPC61	Digital VLSI	60	20	20	25	25	150
Programme Core Course (PCC)	26ETPC62	Microwave Engineering	60	20	20	25	25	150
Programme Elective	26ETPE6XX	Program Elective Course-II	60	20	20	25	25	150
Programme Elective	26ETPE6XX	Program Elective Course-III	60	20	20	25	25	150
Multidisciplinary Minor (MDM)	26ETMM61	MDM Course -IV	-	-	-	25	25	50
Vocational and Skill Enhancement Course (VSEC)	26ETVS61	Skill Lab-II: Embedded Programming for Telecommunication	-	-	-	25	25	50
Project	26ETMP61	Major Project-1	-	-	-	50	50	100
Total Marks								**800**

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Department of Electronics and Telecommunication Engineering

COURSE NAME: DIGITAL VLSI

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC61	Digital VLSI	03	02	---	03	01	---	04

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Institute of Technology
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Department of Electronics and Telecommunication Engineering

Digital VLSI (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC61	Digital VLSI (Theory)	03	---	---	03	--	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPC61	Digital VLSI (Theory)	20	20	60	--	--	100

Course Prerequisite: Electronic Devices and Circuits, Digital System Design , Linear Integrated Circuits.	
Course Objectives:	
1	To introduce the process flow of VLSI Design.
2	To understand MOSFET operation and layout design techniques
3	To learn VLSI design performance metric and various trade-offs.
4	To design, implement and verify combinational and sequential logic circuits using various MOS design styles.

5	To provide an exposure to RTL design and programming.
Course Outcomes: After successful completion of the course students will be able :	
1	Use various tools and processes used in VLSI Design.
2	Design various CMOS combinational and sequential circuits used in VLSI Design.
3	Analyse the performance parameters of basic building blocks like CMOS inverter.
4	Design memories and layouts using CMOS
5	Evaluate timing requirements of sequential and combinational circuits
6	Design RTL for various combinational and sequential circuits for given specifications.

Module		**Content**	**Hrs**
1		**Review of MOSFET operation and Fabrication**	**4**
	1.1	Overview of VLSI Design Flow, Review of MOSFET operation, MOSFET Capacitances, MOSFET scaling, short channel effects	
	1.2	Fabrication process flow of NMOS and PMOS, Lambda based design rules, stick diagrams.	
2		**Combinational CMOS Logic Circuits**	**4**
	2.1	CMOS inverter operation, Voltage Transfer characteristics (VTC), Noise Margins, Propagation Delay, Power Dissipation, Design of CMOS Inverter, Layout of CMOS Inverter.	
	2.2	Realization of CMOS NAND gate, NOR gate, Complex CMOS Logic Circuits, Layout of CMOS NAND, NOR and complex CMOS circuits.	
3		**MOS Design Logic Styles**	**10**
	3.1	Static CMOS, Pass Transistor Logic, Transmission Gate, Pseudo NMOS, Dynamic Logic, Domino Logic, NORA, Zipper, C2MOS .	

	3.2	Setup time, Hold time, clocked CMOS SR Latch, CMOS JK Latch, MS –JK Flip Flop, Edge triggered D-Flip Flop and realization using design styles .	
	3.3	Realization of Shift Register, MUX.	
4		**Semiconductor Memories**	**7**
	4.1	ROM array, 6T-SRAM (operation, design strategy, leakage currents, sense amplifier), layout of SRAM	
	4.2	Operation of 1T and 3T DRAM Cell, NAND and NOR flash memory	
5		**Data path and system design issues**	**8**
	5.1	1-bit full adder , Ripple carry adder, CLA adder, carry save adder, carry select adder, carry skip adder, Array Multiplier , barrel shifter.	
	5.2	On chip clock generation and distribution, Static timing analysis.	
6		**RTL Design**	**6**
	6.1	High Level state machines, RTL design process	
	6.2	RTL design of Soda dispenser machine, FIR Filter, Sum of absolute differences, Laser Distance measure.	
		Total	**39**

Textbooks:

1. Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.
3. Frank Vahid, "Digital Design with RTL design, VHDL and VERILOG", John Wiley and Sons Publisher 2011.

Reference Books:

1	Neil H. E. Weste, David Harris and Ayan Banerjee, —*CMOS VLSI Design: A Circuits and Systems Perspective*, Pearson Education, 3rd Edition.
2	John P. Uyemura, "*Introduction to VLSI Circuits and Systems*", Wiley, Student Edition, 2013.
3	R. Jacob Baker, "*CMOS Circuit Design, Layout and Simulation*", Wiley, 2nd Edition, 2013
NPTEL/Swayam Courses:	
	https://nptel.ac.in/courses/117/101/117101058/
	https://nptel.ac.in/courses/108/107/108107129/

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks

8.	Multiple Choice Questions (Quiz)	05 marks
*For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.		

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: Digital VLSI (Lab)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPCL61	Digital VLSI Lab	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPCL61	Digital VLSI Lab	--	---	--	25	25	50

Lab Prerequisite: Digital Design, Electronic devices and circuits	
Lab Objectives:	
1	To become familiar with professional tools like AMD Xilinx Vivado, Cadence, Microwind etc.
2	To perform various type of analysis of combinational and sequential CMOS circuits
3	To evaluate performance of given combinational and sequential CMOS circuits
4	To design, implement and verify combinational and sequential CMOS circuits using industrial VLSI design tools.
Lab Outcomes:	

After successful completion of the course students will be able :	
1	Write spice/verilog code for given combinational and sequential CMOS circuits.
2	Perform various analysis like operating point, dc, transient etc of given CMSO circuits.
3	Evaluate performance of given CMOS circuits.
4	Draw layout of given CMOS circuit and also able extract various parasitic using layout tools like Microwind, Cadence, Mentor Graphics.
5	Design, simulate, and verify RTL design using AMD Xilinx Vivado Tool.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr. No.	**Name of the Experiment**
1.	Constant Voltage and Constant field MOSFET scaling
2.	Layout of MOSFET and extraction of parasitic capacitances
3.	Voltage transfer characteristics of CMOS inverter and calculation of Noise Margin and static power
4.	Design of CMOS inverter for given specifications
5.	Layout of CMOS inverter and comparison of pre layout and post layout performance.
6.	Voltage transfer characteristics of 2 input NAND/NOR gate and calculation of noise margins and validation using equivalent inverter approach.
7.	Layout of 2 input CMOS NAND/NOR gate and comparison of pre layout and post layout performance.
8.	Static and transient analysis of Complex CMOS gate.
9.	Layout of complex CMOS gate using Euler path.
10.	Implementation of various combinational and sequential circuits using different design styles.

11.	Design and implementation of NAND based and NOR based ROM array.
12.	Performance analysis of 6T-SRAM Cell
13.	Design of 6T SRAM cell robust read and write operation.
14.	Performance analysis of 1T and 3T DRAM Cell
15.	RTL design of Soda dispenser machine
16.	RTL design of FIR Filter
17.	RTL design of sum of absolute differences
18.	RTL design of Laser based distance measure

Term Work:	
1	Term work should consist of 8 to 10 experiments.
2	Journal may include assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments/Quiz/mock viva/activity: 05-marks)

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Department of Electronics and Telecommunication Engineering

COURSE NAME: MICROWAVE ENGINEERING

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Practical	Theory	Practical	Tut.	Total
26ETPC62	Microwave Engineering	**03**	**02**	**03**	**01**	**--**	**04**

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Department of Electronics and Telecommunication Engineering

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology

(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)

Department of Electronics and Telecommunication Engineering

Microwave Engineering(Theory)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Practical	Theory	Practical	Tut.	Total
26ETPC62	Microwave Engineering	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration(in Hrs)	Term Work	Pract & Oral	Total
		Mid Term Test (MT)	Continuous Assessment (CA)					
26ETPC62	Microwave Engineering	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
26ETPC62	Microwave Engineering	3
Prerequisite: Knowledge of Electromagnetic Engineering		
Course Objectives:		
1	Perceive the concepts of waveguides and analyze the field components in different types of Waveguides.	
2	Categorize different types of microwave components based on their applications.	
3	Imbibe knowledge to use microwave oscillators & amplifiers in microwave communication and compare their characteristics.	

4	Demonstrate the ability to measure different microwave parameters using microwave bench setup.
Course Outcomes:	
1	Describe the types of waveguides, rectangular waveguides and field equations.
2	Understand the coupling mechanisms in waveguides and analyze the waveguide multiport junctions.
3	Explore the microwave linear tubes and analyze with microwave cross field tubes.
4	Understand the microwave solid state devices and avalanche transit time devices.
5	Demonstrate the microwave bench set up and conducting measurements of different parameters

Module		Content	Hrs
1		**Planar transmission lines and lumped impedance Matching**	
	1.1	Planar transmission lines: micro strip line, strip line and coplanar lines analysis and design.	**08**
	1.2	matching network design using distributed line elements and lumped elements	
2		**Waveguides,Planar Lines & Resonators**	**04**
	2.1	Types of waveguides, rectangular waveguides, field equations in rectangular and circular waveguides, modes of TM and TE waves in rectangular and circular waveguides, cut off frequency , Wave impedance in waveguides:, Dominant mode and degenerate modes, mode characteristics of phase velocity, group velocity, wavelength and impedance relations; Illustrative problems.	
	2.2	Cavity resonators: Types of cavity resonators; Rectangular and cylindrical cavity resonator: Dominant modes and resonant frequencies, illustrative problems.	
3		**Waveguide Components**	

	3.1	Coupling mechanisms: Probe, loop, coupling to a cavity resonator, waveguide discontinuities, waveguide irises, tuning screws and posts, matched loads; Waveguide attenuators and phase shifters	**07**
	3.2	Multiport junctions: E plane Tee, H plane Tee, Magic Tee, applications of Magic Tee, hybrid ring; Ferrites, Faraday rotation principle, gyrator, isolator, circulator	
4		**Microwave Tubes**	**10**
	4.1	Microwave linear beam tubes (O type): Limitations of conventional tubes at microwave frequencies; Klystron: Velocity modulation process, bunching process, output power and beam loading. Reflex Klystron: Velocity modulation, power output and efficiency. Helix Traveling Wave tube: Slow wave structures, amplification process, modes of operation of TWT	
	4.2	Microwave cross field tubes (M type): Introduction of cross field devices Magnetrons: Different types, 8-cavity cylindrical travelling wave Magnetron, Hull cut-off and Hartree conditions, modes of resonance and PI-mode operation Backward wave oscillator	
5		**Microwave Semiconductor Devices**	**06**
	5.1	Microwave solid-state devices: Transferred electron devices Gunn- effect diodes, RWH theory, modes of operations, Avalanche transit time devices: IMPATT diode, TRAPATT diode, BARITT diode,	
6		**Microwave Measurements**	04

	6.1	Description of microwave bench: Different blocks and their features, precautions Microwave power measurement for low medium and high microwave power Measurement of attenuation; Frequency standing wave measurements: measurement of low and high VSWR; Cavity Q; Impedance measurements.	
		Total	**39**

Textbooks:	
1	Microwave Devices and Circuits by SAMUEL Y. LIAO(1905-06-29), Pearson
2	Microwave Engineering: Theory and Techniques, 4ed, An Indian Adaptation, David M Pozar,Wiely
3	Microwave Engineering, 4th Edition, Annapurna Das and Sisir K Das, McGraw Hill, 2020
Reference Books:	
1	R.E. Collin —Foundations for Microwave Engineering, IEEE Press, John Wiley

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr. No.	Assessment Tools	Marks
1	*Certificate course for 4 weeks or more: -Coursera/ Udemy/any MOOC	10 Marks (NPTEL)
2	Wins in the event/competition/hackathon	10 Marks
3	Content beyond syllabus presentation	10 Marks
4	Creating Proof of concept	10 Marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
6	GATE Based Assignment test/Tutorials etc	10 Marks
7	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 Marks
8	Multiple Choice Questions (Quiz)	05 Marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End semester Examination	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: Microwave Engineering Laboratory

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
26ETPCL62	Microwave Engineering Laboratory	--	2	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Practical		
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPCL62	Microwave Engineering Laboratory	--	--	--	--	25	25	50

	Lab Name	Credit
	Microwave Engineering Laboratory	1
Prerequisite:		
Lab Objectives:		

1	To become familiar working with rectangular waveguides and doing microwave bench set up.
2	To determine the characteristics of various microwave components
3	To be able to measure wave parameters like impedance, frequency, wavelength using microwave bench and VSWR/power meter
4	To study characteristics and behaviour of various microwave semiconductor devices.
Lab Outcomes:	
1	Able to handle microwave equipment
2	Able to understand microwave measurements and test the characteristics of microwave components
3	Able to understand Waveguide and transmission line measurements
4	Demonstrate working of microwave semiconductor devices
5	Demonstrate the microwave bench set up and conducting measurements of different parameters

Suggested Experiments: Students are required to complete at least 8 to 10 experiments.

Sr. No.	**Name of the Experiment**
1	Measurement of microwave frequency using direct and indirect method.
2	Measurement of guide wavelength

3	Measurement of VSWR of unknown load
4	Measurement of impedance of unknown load.
5	Study of field patterns of various modes inside a rectangular waveguide cavity using Virtual lab
6	Study of field patterns of various modes inside a rectangular waveguide using Virtual lab
7	Find the change in characteristics impedance and reflection coefficients of the transmission line by changing the dielectric properties of materials Embedded between two conductors. using Virtual lab
8	Determination of VI characteristics of Gunn diode using microwave test bench.
9	Measurement of attenuation
10	Measurement of microwave power
11	Characterization of E plane TEE, H plane TEE and Magic TEE
12	Measurement of reflection coefficient using transmission line bench
Term Work:	
1	Term work should consist of 8 to 10 experiments.

2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

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Department of Electronics and Telecommunication Engineering

COURSE NAME: ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATABILITY (EMI & EMC)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE611	EMI & EMC	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

EMI & EMC (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE611	EMI & EMC (Theory)	04	---	---	04	---	---	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPE611	EMI & EMC (Theory)	20	20	60	---	---	100

Course Prerequisite: Basic knowledge of electronic components, circuits, electromagnetic fields and Transmission lines, Power Electronics and Power systems.	
Course Objectives:	
1	To understand EMI problems in subsystem and system level design.
2	To introduce the concepts of electromagnetic interference and electromagnetic compatibility
3	To measure the emission. immunity level from different systems to couple with the prescribed EMC standards
4	To discuss electromagnetic interference measurements and standards

Course Outcomes: After successful completion of the course students will be able to:	
1	Understand various source of Electromagnetic interference
2	Would gain knowledge to understand the concept of Shielding grounding related to product design
3	Design PCBs which are electromagnetically compatible
4	Find solution to EMI Sources, EMI problems in PCB level / Subsystem and system level design
5	To measure emission immunity level from different systems to couple with the prescribed EMC standards

Module		Content	Hrs
1		**Concept of EMI and EMC and Definitions, Natural and Nuclear Sources of EMI**	**06**
	1.1	Practical Experiences and Concerns Transmission Lines, Mains Power Supply, Switches and Relays, Telephone Equipment, Radio Astronomy, Biological Effects, Aircraft Navigation, Military Equipment, Secure Communications, Integrated Circuits	
	1.2	Introduction, Celestial Electromagnetic Noise. Lightning Discharge Cloud-to Ground Discharge, Cloud-to-Cloud Discharge, EM Fields Produced by Lightning, Effects of Lightning Discharge on Transmission Lines Electrostatic Discharge	
	1.3	Charge Accumulation and Discharge, Model ESD Waveform, ESD Equivalent Circuit, Radiated Field from ESD Electromagnetic Pulse EMP from Surface Burst, High Attitude Burst, EMP Induced Voltage, EMP Coupling Through Cable Shields	
2		**EMI From Apparatus and Circuits**	**06**

	2.1	Introduction Electromagnetic Emissions Systems, Appliances, Noise from Relays and Switches Circuit Model, Noise Characteristics, Effects of Interference. Nonlinearities in Circuits Amplifier Nonlinearity, Modulation, Intermodulation, Cross Modulation, Passive Intermodulation	
	2.2	Cros- Talk in Transmission Lines Multiconductor Line, Illustrative Example- Three Conductor Line, Transients in Power Supply Lines Calculation of Induced Voltages and Currents, Surges on Mains Power Supply. Electromagnetic Interference Radiation Coupling, Conduction Coupling, Combination of Radiation and Conduction	
3		**Radiated Interference Measurements**	**08**
	3.1	Introduction Anechoic Chamber, Measurements Using an Anechoic Chamber, Sources of Inaccuracies in Measurement,Transverse Electromagnetic Cell TEM Cell. Measurements Using TEM Cell, Sources of Inaccuracies. Reverberating Chamber Reverberating Chamber, Measurements Using a Reverberating Chamber. Giga-Hertz TEM Cell GTEM Cell, EMC Evaluation Using a GTEM Cell, EMC Evaluation Using a GTEM Cell Comparison of Test Facilities Anechoic Chambers, TEM Cells, Reverberating Chambers, GTEM Cells, Measurement Uncertainties	
	3.2	Conducted Interference measurements, Characterization of Conduction Currents/Voltages Common -Mode and Differential- Mode Interferences, Examples of CM and DM Interferences, Conducted EMI Noise on Power supply Lines Transient on Power Supply Lines, Propagation of Surges in Low Voltage AC Lines, Conducted EMI in Ships and Aircrafts. Conducted EMI From Equipment Instrumentation for Measuring Conducted EMI, Experimental Setup for Measuring Conducted EMI, Measurement of CM and DM Interferences, Immunity to Conducted EMI Detectors and measurement.	
4		**Grounding, Shielding, and Bonding EMC Technology**	**07**
	4.1	Principles and Practice of Earthing, Precautions in Earthing, Measurement of Ground Resistance, System Grounding for EMC, Cable Shield Grounding, Design Example, Additional Practical Examples. Shielding, Shielding Theory and Shielding Effectiveness, Shielding Materials.	

	4.2	Shielding Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Shielding Effectiveness Measurements, Some Practical Examples Electrical Bonding Shape and Material for Bond Strap, General Guidelines for Good Bonds.	
5		**EMI Filters**	**07**
	5.1	Introduction, Characteristics of Filters Impedance Mismatch Effects, Lumped Element Low-Pass Filters, High-Pass Filters, Band-Pass Filters, Band-Reject Filters, Insertion-LOss Filter Design. Power Line Filter Design.	
	5.2	Common-Mode Filter, Differential-Mode Filter, Combined CM and DM Filter, Inductor Design, Leakage Inductance of CM Choke, Reduction of Leakage Inductance, Power Line Filter Design Example. Filter Installation. Filter Evaluation.	
6		**Standards and Regulations**	**05**
	6.1	Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards	
	6.2	**EMI Test Methods and Instrumentation** Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, shielded chamber, shielded anechoic chamber, EMI test receivers, Spectrum analyser, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.	
		Total	**39**

Textbooks:

1	V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, New York, 2017.
2	Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006
Reference Books:	
1	Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009
2	Daryl Gerke and William Kimmel, "EDN"s Designer"s Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
3	W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
4	Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005
Access to software and virtual labs:	
	https://onlinecourses.nptel.ac.in/noc24_ee67/preview
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks

2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: EMI & EMC Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE611	EMI & EMC (Lab)	03	02	---	03	01	---	04

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Course Code	Course Name	Examination Scheme						
		Theory				Practical		
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPE611	EMI & EMC Laboratory	--	--	--	--	**25**	**25**	**50**

	Lab Name	Credit
	EMI & EMC Laboratory	1
Prerequisite:		
Lab Objectives:		
1	To understand the fundamental concepts of **Electromagnetic Interference (EMI)** and **Electromagnetic Compatibility (EMC)** through simulation-based experiments.	
2	To analyze conducted and radiated electromagnetic disturbances using frequency-domain and time-domain simulation techniques.	
3	To design and evaluate EMI mitigation methods, including shielding techniques and EMI filters, using MATLAB/Simulink.	
4	To develop practical skills in modeling, simulation, and analysis of electromagnetic phenomena	

	and signal integrity issues using MATLAB, Simulink, and GNU Octave.
Lab Outcomes: Upon successful completion of the laboratory, students will be able to:	
1	Simulate and analyze various EMI phenomena, including conducted EMI, switching noise, lightning impulses, ESD, and EMP.
2	Design and evaluate the performance of EMI filters and shielding methods for electromagnetic interference reduction.
3	Analyze common-mode and differential-mode noise, transmission line effects, and PCB crosstalk using appropriate simulation models.
4	Apply MATLAB/Simulink and GNU Octave tools to model, analyze, and interpret EMC/EMI-related engineering problems effectively.

Suggested Experiments: Students are required to complete at least 8 to 10 experiments.

Sr. No.	**Name of the Experiment**
1	Simulation of conducted EMI in RLC circuits using frequency-domain analysis
2	FFT-based spectral analysis of switching noise in digital circuits
3	Simulation of lightning impulse waveform (1.2/50 μs) and parameter analysis
4	Modeling Electrostatic Discharge (ESD) waveform using the Human Body Model (HBM)
5	Simulation of electromagnetic pulse (EMP) and its induced voltage on transmission lines

6	Cable shielding effectiveness analysis using transfer impedance models
7	Common-mode and differential-mode noise analysis in power electronic circuits
8	Design and simulation of RC, LC, and π EMI filters
9	Frequency response of EMI filters using Bode plots
10	Simulation of PCB trace crosstalk using coupled transmission line models
11	Power spectral density (PSD) estimation of noisy signals using Welch's method
12	Comparison of shielding materials by simulating attenuation versus frequency

Term Work:

1	Term work should consist of 8 to 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

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Department of Electronics and Telecommunication Engineering

COURSE NAME: IoT & Industry 4.0

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETP E612	IoT & Industry 4.0 (Theory)	03	02	---	03	01	---	04

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IoT & Industry 4.0 (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETP E612	IoT & Industry 4.0 (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETPE612	IoT & Industry 4.0 (Theory)	20	20	60	---	---	100

Course Prerequisite: Mini Project (Microcontrollers/Embedded System), Skill based Lab Course	
Course Objectives:	
1	To provide the introduction to Internet of Things
2	To illustrate the protocols of Internet of Things (IoT)
3	To provide the concepts of data management and data analytics in IoT

4	To provide the introduction to Industry 4.0 standard
5	To provide the introduction to IIoT and Applications
6	To overview the applications of Industry 4.0
Course Outcomes: After successful completion of the course students will be able to:	
1	To discuss case studies and use cases of IoT design
2	To compare various communication protocols for IoT
3	To understand various methods for data handling in IoT-based applications
4	To understand the various frameworks and concepts for industry 4.0 standards.
5	To understand case studies on applications of IIoT.
6	To understand advanced technologies and applications of Industry 4.0

Module		Content	Hrs
1		**Introduction to IoT**	**04**
	1.1	Introduction :- Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT Communication models, M2M, Difference between IoT and M2M.	
	1.2	Components (Things) in IoT :- Introduction - Sensors, Characteristics and categories, Introduction - Actuators	
2		**Design Principles & Connectivity**	**08**
	2.1	Design Principles & Web Connectivity :- Web Communication Protocols for connected devices, Web connectivity using Gateway, SOAP, REST, HTTP, RESTful and Web Sockets (Publish—Subscribe), MQTT, AMQP, CoAP Protocols, Internet Connectivity : - Internet connectivity, Internet based communication	

3		**Data Handling in IoT and Design Methodology**	**08**
	3.1	Data Handling in IoT :- Data Acquiring and Storage, Organizing the Data, Transactions and Business Processes, Analytics Data Collection, Storage and Computing Using Cloud Platform, Introduction to Cloud Computing, Virtualization, Cloud Models, Cloud Services	
	3.2	Design Methodology :- Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, Application Development	
	3.3	IoT Case :- Case Studies: Home Automation (Smart lighting, home intrusion detection), Cities (Smart Parking), Environment (Weather monitoring, weather reporting Bot.	
4		**Introduction to Industry 4.0**	**08**
	4.1	Industry 4.0:- Introduction - Industrial Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories	
	4.2	Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality	
5		**Introduction to Industrial IoT (IIoT) Protocols and Security**	**06**
	5.1	IIoT Protocols :- Introduction - Profibus, HART, DeviceNet, LORA, LORAWAN	
	5.2	Security and Fog Computing :- Fog Computing in IIoT, Security in IIoT-Part I, Part II	
6		**Industry 4.0 Technologies and Applications**	**05**
	6.1	Inventory management, Supply Chain management, Plant Safety and Security	

	6.2	Industrial IoT Application domains: Healthcare, Smart Cities, Manufacturing Industries, Food Industry.	
		Total	**39**

Textbooks:	
1	ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach, Universities Press.
2	Raj Kamal, Internet of Things: Architecture and Design Principles", McGraw Hill Education, First edition
3	Sudip Misra, Chandana Roy and Anandarup Mukherjee, 'Introduction to Industrial Internet of Things and Industry 4.0', CRC Press, Edition 2020.
4	Andrew Minteer," Analytics for the Internet of Things(IoT)",Kindle Edition
5	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress
6	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cybermanufacturing Systems", Springer
Reference Books:	
1	Alp Ustundag Emre Cevikcan," Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing
2	G. R. Kanagachidambaresan, R. Anand, E. Balasubramanian, V. Mahima, Internet of Things for Industry 4.0. EAI/Springer Innovations in Communication and Computing
3	The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications)
4	The Internet of Things (MIT Press) by Samuel Greengard
5	Adrian McEwen, Hakim Cassimally,: Designing the Internet of Things", Paperback, First Edition

Suggested reference material	
1.	https://onlinecourses.nptel.ac.in/noc20_cs69/preview
2.	Self-Learning: Recommended list of tools for self-learning 1. Node Red - https://nodered.org/ 2. M2MLabs Mainspring - http://www.m2mlabs.com/ 3. Tensor Flow - https://www.tensorflow.org/ 4. Things Speak - https://thingspeak.com/

Internal Assessment:

7) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
8) Mid Term test is to be conducted when approx. 50% syllabus is completed.
9) Duration of the midterm test shall be one hour

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks

7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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IoT & Industry 4.0 Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETP E612	IoT & Industry 4.0 Lab	---	2	---	---	1	---	1

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETP E612	IoT & Industry 4.0 Lab	---	---	---	25	25	50

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Prerequisite: 1. Use of Basic Electronics and Sensors 2. Microcontrollers and Embedded Systems 3. Programming Fundamentals 4. Cloud fundamentals	
Lab Objectives:	
1	To provide hands-on experience in interfacing IoT devices, sensors, and actuators for real-time data acquisition and control applications.
2	To develop the ability to implement IoT communication protocols, web services, and Internet connectivity for connected device communication.
3	To enable students to collect, store, process, and visualize IoT data using cloud platforms and analytics tools.
4	To design and develop IoT-based solutions for smart home, smart city, environmental monitoring, healthcare, and industrial applications.
Lab Outcomes:	
1	Interface and program IoT hardware platforms, sensors, and actuators to develop real-time monitoring and control systems.
2	Implement IoT communication using protocols such as HTTP, REST, MQTT, CoAP, and WebSockets for data exchange between connected devices.
3	Develop cloud-connected IoT applications for data acquisition, storage, visualization, and analytics.
4	Design, implement, and evaluate IoT solutions for smart home, smart city, environmental, healthcare, and industrial monitoring applications.

IoT & Industry 4.0 Lab	
Sr. No.	**Title of Experiment**
1	To interface temperature/ humidity/ ultrasonic distance/ PIR / IR sensor with NodeMCU (ESP8266) and obtain output on serial monitor with timestamp.
2	Build an automation system of your own using at least two sensors and two actuators
3	LED Control using Bluetooth Module and an ESP32 with a smartphone
4	LED control with Relay and ESP32 / Piezo Buzzer / Servo motor
5	Interfacing Various Sensors like LDR, ultrasonic, DHT etc (data collection) and pushing data on to Thingspeak Cloud

6	Temperature and Humidity monitor using Blynk
7	Implementing Publish-Subscribe model using MQTT protocol and DHT11 sensor
8	Publishing sensor data from ESP32 to AWS IoT Cloud.
9	To control an LED connected to ESP8266 from voice signal using google Assistant on mobile along with IFTTT and BLYNK App.
10	**Case Study on topics :** Smart Factory Monitoring System, Smart Inventory Management System, Digital Twin of a Manufacturing Process, Cold Chain Monitoring in Food Industry, Plant Safety and Security System etc.

Term Work:	
1	Term work should consist of 8 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total **25 Marks** (Experiments: 20-marks, Attendance Theory & Practical: 05-marks)
Practical & Oral Exam:	
1	Based on the experiments, practical exam and oral should be conducted
2	Total **25 Marks**

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Institute of Technology
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Department of Electronics and Telecommunication Engineering

COURSE NAME-Sensor Technologies and Applications

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETP E613	Sensor Technologies and Applications	03	02	---	03	01	---	04

Sensor Technologies and Applications (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETP E613	Sensor Technologies and Applications (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				

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Department of Electronics and Telecommunication Engineering

NETPE613	**Sensor Technology (Theory)**	**20**	**20**	**60**	**---**	**---**	**100**

Course Code:	**Course Title**	**Credit**
NETPE613	Sensor Technologies and Applications	3

Prerequisite:

1. Engineering Physics-II
2. Electronic Devices & Circuits
3. Linear Integrated Circuits
4. Engineering Mathematics

Course Objectives:

1	To understand various physical parameters and its sensing techniques.
2	To discuss working of different types of transducers and sensors.
3	To familiarize about MEMS sensors and Actuators.
4	To introduce wireless sensing technologies.
5	To develop understanding about signal conditioning using ADC and DAC.
6	To provide insight into various sensor applications.

Course Outcomes:

1	Comprehend the transduction principle of various sensors.
2	Select sensors suitable for required application.

3	Analyse wireless sensing techniques.
4	Design the data acquisition system.
5	Identify signal conditioning method for particular application.
6	Create an application using various sensor technologies.

Module		Content	Hrs
1		**Introduction**	**7**
	1.1	**Overview of sensors and their role in modern systems.**	
	1.2	**Classification of Sensors:** **Primary physical quantity sensed**: Temperature, pressure, force, displacement, light, sound, etc. **Transduction principle**: Resistive, capacitive, inductive, piezoelectric, optical, etc. **Material and technology used**: MEMS, nano-sensors, fiber optic sensors. **Application domain**: Biomedical, automotive, industrial automation, aerospace, environmental monitoring. The sensors are classified with criteria like primary physical quantity to be sensed, transduction principle, material and technology used and application.	
	1.3	**Criteria to choose a Sensor:** Accuracy, Environmental condition, Range, Calibration, Resolution, Cost and Repeatability.	
	1.4	**Digital sensors:** Principle of digital sensing, sampling, quantization, and digital output. **Comparison with analog sensors:** Signal integrity, Ease of interface with digital systems. Noise resistance.	

	1.5	**Smart Sensors:** Definition and key features, Built-in signal processing, Communication capabilities, Low power, consumption, Self-diagnostic and self-calibration features.	
	1.6	**Overview of sensors in IoT applications, AI-integrated sensors, Predictive sensing.**	
2		**Types of Sensors**	**8**
	2.1	**Temperature Sensors :** RTD, Thermocouple PT100, and Thermistors sensor, Semiconductor PN junction sensors-LM35, Thermopile.	
	2.2	**Proximity Sensors :** Inductive (LVDT), Capacitive, Photoelectric and Ultrasonic sensors.	
	2.3	**Chemical Sensors :** Gas , Smoke, Conductivity and pH sensor.	
	2.4	**Other Sensors :** Optical, Infrared (IR), Sound, Motion, Pressure , Level , Moisture, Humidity, Laser , Image and GPS sensor.	
3		**MEMS Sensors and Actuators**	**5**
	3.1	**MEMS SENSORS:** miniaturized devices that integrate mechanical and electrical components for sensing applications. General design methodology, techniques for sensing, Pressure sensor, Mass Flow sensor, Acceleration sensor, Angular Rate sensor and Gyroscopes, Micro machined microphones, Chemical sensors, Taguchi Gas sensor, and Combustible Gas sensors.	
	3.2	**MEMS ACTUATORS:** Techniques for actuation, Digital Micro mirror Device, Micro Machined Valves.	
4		**Wireless Sensing Technologies**	**4**

	4.1	**Bluetooth:** Concepts of Pico net, Scatter net, Link types, Network connection establishments.	
	4.2	**ZigBee:** components, architecture, network topologies.	
	4.3	**Ultra Wide Band (UWB),** Near Field Communication (NFC) and RFID: technical requirements, components and characteristics.	
	4.4	**WLAN and ISA Standards:** Equipment, WLAN topologies. ISA100.11a standard (Wireless Networking Standard for Industrial Automation)	
	4.5	**WirelessHART:** Wireless Highway Addressable Remote Transducer protocol.	
5		**Data Acquisition and Signal Conditioning**	**6**
	5.1	**Fundamentals of Data Acquisition:** Analog and Digital data acquisition system with different configurations, Data loggers, Noise and interference which affect accuracy and signal integrity.	
	5.2	**Signal Conditioning:** Wheatstone Bridge, Flash ADC, R2R DAC.	
	5.3	Utilization of Signal conditioning circuits for Temperature, Pressure, Optical, Strain gauges, Displacement and piezoelectric Transducers.	
6		**Sensor Applications**	**9**
	6.1	Automobile sensors, Tire Pressure Monitoring System for Preventive Safety in Cars.	
	6.2	Smart Agriculture and Environmental Monitoring.	
	6.3	Radio sensors for industrial applications, Ground Penetrating Radars, Underwater sensing.	

	6.4	LIDAR in Autonomous Vehicles: Object detection, distance calculation, Enabling 360° environmental perception and safety enhancement.	
	6.5	Biomedical Sensing Applications-Biomedical Wearables	
		Total	**39**

Textbooks:	
1	D.V. S. Murthy, "Transducers and Instrumentation", PHI Learning, 2nd Edition, 2013.
2	D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003.
3	Antti V. Raisanen, Arto Lehto, "Radio Engineering for Wireless Communication and Sensor Applications", Artech House mobile communications series, USA, 2003.
4	Ramon Pallas Areny, John G. Webster, Sensors and Signal Conditioning, 2nd edition, John Wiley and Sons, 2000.
5	Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann Series in Networking, Elsevier, 2010.
6	James J. Allen, Micro Electro Mechanical System Design, Taylor and Francis, 2005
Reference Books:	
1	Nadim Maluf, Kirt Williams, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2004.
2	A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpatrai & Co., 19th Edition, 2011.
3	Nathan Ida, Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction, Second Edition, IET Control, Robotics and Sensors Series 127, 2020
4	C.S. Rangan, G.R. Sarma, V.S. Mani, Instrumentation Devices and System, TMH, 1997.
5	Jacob Fraden Handbook of Modern Sensors Physics, Designs, and Applications, Fourth Edition, Springer, 2010
6	Richard Zurawski, Industrial Communication Technology Handbook, CRC press, 2nd Edition, 2014.

For Module-6 and advanced topics also refer to IEEE, Elsevier, Springer journal papers and magazines related to the specific topics.

NPTEL Course:

1. Sensors and Actuators, Prof. Hardik J. Pandya, IISc Bangalore, : https://nptel.ac.in/courses/108/108/108108147/

2. Aditya K. Jagnnatham, IIT Kanpur, LTE, WLAN, Bluetooth and Future, : https://www.youtube.com/watch?v=vjhp0zTXEsc

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks

7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Sensor Technologies and Applications Lab

Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**			**Credits Assigned**			
		Theory	**Pract**	**Tut**	**Theory**	**Pract**	**Tut**	**Total**
	Sensor Technologies and Applications Lab	--	2	--	--	1	--	1

Course	**Course Name**	**Examination Scheme**					
		Theory			**Term**	**Pract & oral**	**Total**
		Internal Assessment	**End Sem**	**Exam Duration**			

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Department of Electronics and Telecommunication Engineering

Code		Mid Test (MT)	CA*	Exam	(Hrs)	Work		
	Sensor Technologies and Applications(Lab)	-	-	-	-	**25**	**25**	**50**

Prerequisite: 1. Usage of basic Electronic instruments and components. 2. Fundamentals of Electronic Devices and circuits	
Lab Objectives:	
1	To understand various physical parameters and its sensing techniques.
2	To discuss working of different types of transducers and sensors.
3	To familiarize about MEMS sensors and Actuators.
4	To introduce wireless sensing technologies.
5	To develop understanding about signal conditioning using ADC and DAC.
6	To provide insight into various sensor applications.

Lab Outcomes: Students should able to	
1	Comprehend the transduction principal of various sensors.
2	Select sensors suitable for required application.

3	Analyse wireless sensing techniques.
4	Design the data acquisition system.
5	Identify signal conditioning method for particular application.
6	Create an application using various sensor technologies.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Study and characteristics of RTD (PT100), Thermistor and LM35 Temperature Sensors.
2	Measurement of temperature using Thermocouple and comparison with RTD and LM35.
3	Study and calibration of LVDT (Linear Variable Differential Transformer) for displacement measurement.
4	Interfacing and testing of Ultrasonic Sensor for distance measurement.
5	Study of Capacitive and Inductive Proximity Sensors and their applications.
6	Measurement of environmental parameters using Humidity and Moisture Sensors.
7	Interfacing and characterization of Gas/Smoke Sensor (MQ series) for air quality monitoring.
8	Measurement of liquid characteristics using pH Sensor and Conductivity Sensor.
9	Study of MEMS Accelerometer and Gyroscope Sensors for motion and orientation detection.
10	Design and analysis of Wheatstone Bridge Signal Conditioning Circuit for resistive sensors.
11	Study of Flash ADC and R-2R Ladder DAC characteristics and applications in data acquisition systems.

12	Wireless sensor data transmission using Bluetooth Module (HC-05/HC-06).
13	Implementation of a ZigBee/RFID/NFC based sensing and identification system.
14	Mini Project: IoT-based Smart Agriculture or Environmental Monitoring System using multiple sensors and wireless communication.
15	Interfacing of LIDAR Sensor for Distance Measurement
16	Interfacing of GPS Sensor Interfacing and Location Tracking
17	Simulation of Tire Pressure Monitoring System (TPMS) Simulation
18	Interfacing of Biomedical Wearable Sensor for Heart Rate Monitoring
19	Biomedical Wearable Sensor for SpO_2 Monitoring

Term Work:
Term work should consist of 10 experiments.
Journal must include at least 2 assignments.
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

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(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)

Department of Electronics and Telecommunication Engineering

VIVEKANAND EDUCATION SOCIETY'S
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(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)

Department of Electronics and Telecommunication Engineering

COURSE NAME: Big Data Analytics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETPE 621	Big Data Analytics	03	02	---	03	01	---	04

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Electronics and Telecommunication Engineering

Big Data Analytics(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW / PR	Tut	Total
NETPE 621	Big Data Analytics	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETPE621	Big Data Analytics	20	20	60	---	---	100

Course Prerequisite: Basic knowledge of Database Management System	
Course Objectives:	
1.	To Provide an Overview of an exciting growing field of Big Data Analytics.
2.	To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
3.	To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.
Course Outcomes:	

After successful completion of the course students will be able to:	
1.	Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2.	Understand the building blocks of Big Data Analytics.
3.	Acquire fundamental enabling techniques like Hadoop, MapReduce and NoSQL in solving real world problems.
4.	Apply advanced techniques for emerging applications like stream analytics, link analysis, finding similar and frequent items.
5.	Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc

Big Data Analytics Theory

Module		**Content**	**Hrs**
1		**Introduction to Big Data Analytics**	**4**
	1.1	Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data a business approach	
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.	
2		**Hadoop**	**6**
	2.1	Introduction to Hadoop, Core Hadoop Components, Physical Architecture, Hadoop limitations.	
	2.2	Hadoop Ecosystem-Apache HBase, Hive, HCatalog, Pig, Mahout, Oozie, Zookeeper, Sqoop etc.	
3		**MapReduce**	6

	3.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, MapReduce Execution,	
	3.2	Relational-Algebra Operations such as Selections, Projections, Union, Intersection, and Difference by MapReduce.	
4		**NoSQL**	**6**
	4.1	Introduction to NoSQL, NoSQL business drivers, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family	
	4.2	Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	
5		**Techniques for Big Data Analytics**	**13**
	5.1	**Finding Similar Item:** Nearest Neighbor Search, Similarity of Documents, Distance Measures: Euclidean, Jaccard , Cosine, Edit and Hamming Distance with its Examples	
	5.2	**Mining Data Streams:** Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis, Filtering streams: The Blooms filter.	
	5.3	**Link Analysis:** Page Rank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank.	
	5.4	**Frequent Itemset Mining:** Market-Basket Model, Apriori Algorithm, Algorithm of ParkChen-Yu.	
		Big Data Analytics Applications	
6	6.1	**Recommendation Systems:** Introduction, A Model for Recommendation Systems: Collaborative-Filtering System, Content based system and its Examples.	4

	6.2	**Mining Social-Network Graphs:** Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques	
		Total	**39**

Textbooks:	
1	Radha Shankarmani and M Vijayalakshmi —Big Data Analytics‖, Wiley
2	Alex Holmes —Hadoop in Practice‖, Manning Press, Dreamtech Press
3	Dan Mcary and Ann Kelly —Making Sense of NoSQL‖ – A guide for managers and the res of us, Manning Press.
Reference Books:	
1	Bill Franks —Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley
2	Chuck Lam —Hadoop in Action‖, Dreamtech Press
Access to software	
	https://www.cloudera.com/products/stream-processing.html
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified
	https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
	https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html
	https://www.pdfdrive.com/data-science-and-big-data-analytics-e58447171.html
	https://nptel.ac.in/courses/106104189
	https://www.coursera.org/specializations/big-data#courses
	https://www.digimat.in/nptel/courses/video/106106169/L01.html
	https://www.coursera.org/learn/nosql-databases#syllabus

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
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Department of Electronics and Telecommunication Engineering

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation in the class	05 Marks

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
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Department of Electronics and Telecommunication Engineering

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

Big Data Analytics Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW / PR	Tut	Total
NETPE 621	Big Data Analytics	—	02	---	—	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETPE621	Big Data Analytics	–	—	–	25	25	50

Sr. No.	Lab Objectives:
1	Understand and configure Big Data platforms such as Hadoop and perform distributed data storage and management using HDFS.
2	Design and implement MapReduce programs for processing and analyzing large datasets in a distributed computing environment.

3	Perform data storage, retrieval, and analytical operations using NoSQL databases such as MongoDB.
4	Apply Big Data Analytics techniques and Spark-based machine learning algorithms for solving real-world data analysis, clustering, recommendation, and pattern mining problems.
Sr. No	**Lab Outcomes:** After successful completion of the laboratory course, students will be able to:
1	Configure Hadoop ecosystem tools and perform file management operations in HDFS.
2	Develop and execute MapReduce applications for large-scale data processing and analysis.
3	Implement NoSQL database operations and analytical queries using MongoDB for handling semi-structured and unstructured data.
4	Apply Spark-based analytics techniques such as similarity analysis, clustering, frequent itemset mining, and recommendation systems to extract meaningful insights from big data.

Suggested list of experiments

1	Installation of Hadoop, understanding different Hadoop Modes, startup script and configuration files
2	Study of Hadoop Distributed File System (HDFS) Operations: such as create directory, upload, download, delete files/ directories, HDFS commands etc.
3	Use of Sqoop tool to transfer data between Hadoop and relational database servers. a. Sqoop - Installation. b. To execute basic commands of Hadoop ecosystem component sqoop.
4	To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands
5	Implementation of word count/ frequency using Map-Reduce operations
6	Implementation of matrix multiplication using Map-Reduce operations
7	Implementation of relational Operations such as selection, projection, union, intersection
8	Implementation of NoSQL database CRUD operations using MongodB

9	Analyze large datasets using Count – Sort – Limit – Skip – Aggregate using MongoDB.
10	Find similarity between documents/users using Euclidean Distance, Jaccard Similarity , Cosine Similarity
11	Implementation of Frequent Itemset Mining using Apriori Algorithm
12	Implementation of Clustering and Recommendation System using Spark
13	Data Stream Algorithms (any one): Implementing DGIM algorithm using any Programming Language Implement Bloom Filter using any programming language Implement Flajolet Martin algorithm using any programming language
14	Create Big data analytics application dashboard using Hive and Impala
15	Design and Develop Big data application using Mllib and Spark
16	Mini project on any one topic or similar applications: Social Media Trend Analyzer , Movie Recommendation System, Network Traffic Analytics, E-Commerce Recommendation Engine , Smart City Traffic Analytics, Health Care System, Stock Market Prediction, Movie Recommendation, **(Use standard Datasets available on the web)**
Term Work	
1	Lab work: Total 10 experiments out of 15 are to be submitted as a part of TW submission and A Mini project.
2	The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Project Assessment: 10-marks)

Practical & Oral Exam	
1	Based on the subject and related lab , Total 25 Marks

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Department of Electronics and Telecommunication Engineering

COURSE NAME: NEURAL NETWORKS AND FUZZY LOGIC

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETPE622	Neural Networks and Fuzzy Logic	03	02	---	03	01	---	04

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Electronics and Telecommunication Engineering

NEURAL NETWORKS AND FUZZY LOGIC (THEORY)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETPE622	Neural Networks and Fuzzy Logic	03	–	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETPE622	Neural Networks and Fuzzy Logic	20	20	60	---	---	100

Prerequisite: Computer Networks and Operating Systems.

Course Objectives:	
1	To introduce the concepts and understanding of artificial neural networks
2	To provide adequate knowledge about supervised and unsupervised neural networks
3	To expose neural networks based methods to solve real world complex problems
4	To study Machine Learning, Deep Learning and Applications
5	To introduce fuzzy logic and fuzzy inference systems
6	To provide knowledge about applications of Fuzzy Logic.
Course Outcomes:	
1	Comprehend the concepts of biological neurons and artificial neurons
2	Analyse the feed-forward and feedback neural networks and their learning algorithms.
3	Comprehend the neural network training and design concepts.
4	Comprehend the concept of SVM and CNN.
5	Comprehend the concept of fuzzy logic and fuzzy systems.
6	Analyse the application of neural networks and fuzzy logic to real world problems.

Module		**Content**	**Hrs**
1		**Introduction to Neural Networks and their Basic Concepts**	
	1.1	Biological neuron and Artificial neuron,	6

	1.2	McCulloch-Pitts Model, Activation Function, various types of Activation Functions and types of Neural Network Architectures.	
	1.3	Prerequisites for Training of Neural Networks. Linearly Separable and Linearly Non-Separable Systems with examples, Concepts of Supervised Learning, Unsupervised Learning, and Reinforcement Learning.	
	1.4	Brief survey of applications of Neural Networks.	
2		**Supervised Learning Neural Networks**	**7**
	2.1	Perceptron - Single Layer Perceptron, Multilayer Perceptron and their Architecture.	
	2.2	Error Functions: Mean Square Error and Sum Squared Error. Gradient Descent, Generalized delta rule, Error back propagation, LMS Algorithm, Stopping Criterions for Training.	
3		**Unsupervised Learning Neural Networks**	**7**
	3.1	Competitive Learning Network – Kohonen Self-Organizing Networks – Architecture, Training Algorithm.	
	3.2	Discrete Hopfield Network- Hopfield Matrix, Testing Algorithm, K-Means Clustering Algorithm.	
4		**Machine Learning and Deep Learning**	**5**
	4.1	Basic concept of Machine Learning, Support Vector Machine (SVM) - Introduction and SVM based Binary Classifier.	
	4.2	Basic concept of Deep Learning, Convolution Operation, Overview of CNN Architecture, Input layer, Convolution layers, Pooling layers, Padding, Strided Convolutions. Rectified Linear Unit (ReLU), One Layer	

		of a Convolutional Network, Fully Connected Layers, Complex Image Classification using CNN.	
5		**Fundamentals of Fuzzy logic and Fuzzification**	
	5.1	Fundamentals, properties, and rules. Fuzzy set operations (Union, Intersection, Complement, Difference).	**7**
	5.2	Fuzzy relations: Classical relation, cartesian product,, cardinality, operations, properties, and composition. Membership functions, Fuzzification.	
6		**Methods of Defuzzification, Fuzzy Inference System**	**7**
	6.1	Defuzzification Methods -- Mean of Maxima and Centroid (Centre of Area) Methods, Fuzzy Inference System with reference to Mamdani Model.	
	6.2	Brief Review of Applications of Fuzzy Logic to Speed Control of DC Motor, Train Break, and Washing Machine.	
		Total	**39**

Textbooks:

1. S. N. Sivanandam and S. N. Deepa, Introduction to Soft Computing, Wiley India Publications, 3rd Edition.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson Prentice Hall, 3rd Edition
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI Learning Pvt. Ltd, 2003.

4.	Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, Practical Convolutional Neural Networks by , Packt Publishing, 2018.
5.	Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India Publications, 3rd Edition.
Reference Books:	
1.	Hagan, Demuth, and Beale, Neural Network Design, Thomson Learning, 2nd Edition.
2.	Simon Haykin, Neural Network- A Comprehensive Foundation, Pearson Education, 2nd Edition.
3.	Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2005.
4.	William W. Hsieh, Machine Learning Methods in the Environmental Sciences: Neural Network and Kernels, Cambridge University Press, 2009.
5.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
6.	S. N. Sivanandam, S. Sumathi, and S. N. Deepa, Introduction to Neural Network using Matlab, Tata McGraw-Hill Publications, 2006.
7.	Mehrotra Kishan, Mohan C. K. Ranka Sanjay, Elements of Artificial Neural Networks, Penram International Publishing Pvt. Ltd, 2nd Edition.
8.	J. M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishers, 2006.
9.	Bart Kosko, Neural Networks and Fuzzy Systems, Pearson Education, 2007.

Access to software and virtual labs:	
1.	**Artificial Neural Networks Lab by IIIT Hyderabad**: This virtual lab provides hands-on experience in understanding the basics of ANN models and the pattern recognition tasks they perform. cse22-iiith.vlabs.ac.in
2.	**Soft Computing Tools in Engineering Lab by IIT Kharagpur**: This lab offers an introduction to neural networks and includes a perceptron example to help understand the fundamentals. scte-iitkgp.vlabs.ac.in
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	**Fuzzy Logic and Neural Networks by IIT Kharagpur** https://onlinecourses.nptel.ac.in/noc25_ge15/preview

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks

7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

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Department of Electronics and Telecommunication Engineering

Neural Networks and Fuzzy Logic Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETPE622	Neural Networks and Fuzzy Logic Lab	–	02	---	–	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETPE622	Neural Networks and Fuzzy Logic Lab	---	---	---	25	25	50

Prerequisite: Computer Networks and Operating Systems.	
Lab Objectives:	
1	The laboratory course aims to:
2	Provide hands-on experience in implementing artificial neural network models and learning algorithms.
3	Enable students to understand and analyse supervised and unsupervised learning techniques.
4	Develop skills in designing and training neural network models for pattern recognition, classification, and clustering applications.
5	Introduce machine learning and deep learning concepts through practical implementation of SVM and CNN models.
6	Familiarize students with fuzzy sets, fuzzy logic operations, and fuzzy inference systems.
Lab Outcomes: Upon successful completion of the laboratory course, students will be able to:	
1	Implement and analyse activation functions and basic neural network architectures.
2	Design and train feed-forward and feedback neural networks for classification, clustering, and pattern recognition tasks.
3	Develop supervised and unsupervised learning models for solving real-world problems.
4	Implement machine learning and deep learning algorithms such as SVM and CNN for classification and object recognition applications.
5	Design fuzzy sets, membership functions, fuzzy inference systems, and de-fuzzification

	techniques.
6	Develop intelligent systems based on neural networks and fuzzy logic for engineering applications.

Suggested Experiments: Students are required to complete at least 08 experiments.	
Sr. No.	**Name of the Experiment**
1.	To plot, analyse Sigmoidal, Tansigmoidal, Hardlimiter, and ReLU activation functions.
2.	Design of Linearly Separable Binary Patterns Using Perceptron Network.
3.	Classification of Non-Linearly Separable Binary Patterns Using Multilayer Perceptron (MLP) Neural Network.
4.	Pattern Clustering Using K-Means Clustering Algorithm.
5.	Binary Pattern Storage and Restoration Using Discrete Hopfield Neural Network.
6.	Image Classification Using Support Vector Machine (SVM).
7.	Object Recognition Using Convolutional Neural Network (CNN).
8.	Implementation of an Unsupervised Learning Algorithm and Performance Analysis.
9.	Design and Implementation of Kohonen Self-Organizing Feature Maps (SOFM).
10.	Demonstration of Union and Intersection Operations on Fuzzy Sets.
11.	Demonstration of Difference and Complement Operations on Fuzzy Sets.

12.	Implementation and Analysis of Various Fuzzy Membership Functions.
13.	Design and Implementation of a Fuzzy Inference System (FIS).
14.	Implementation and Comparison of De-fuzzification Methods.
15.	Design and Implementation of a Fuzzy Controller for a DC motor speed control.
16.	Design and Implementation of a Fuzzy Logic Controller for a Washing Machine.

Software/Tools:
MATLAB/Simulink with Neural Network and Fuzzy Logic Toolboxes, Python-based Machine Learning Libraries, or equivalent software tools may be used for simulation and implementation of the above experiments.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: IMAGE PROCESSING AND MACHINE VISION

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETPE 623	Image Processing and Machine Vision	03	02	---	03	01	---	04

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Department of Electronics and Telecommunication Engineering

COURSE NAME: IMAGE PROCESSING AND MACHINE VISION THEORY

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
	Image Processing and Machine Vision	03	–	---	03	–	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
	Image Processing and Machine Vision (Theory)	20	20	60	--	--	100

Course Prerequisite: Signals and Systems , Discrete Time Signal Processing , Python Programming Skill Lab	
Course Objectives:	
1	To teach the fundamentals and mathematical models in digital image processing and Machine Vision
2	To teach quality enhancement of image through filtering operations
3	To teach the students image morphology and restoration techniques
4	To expose the students to segmentation techniques in image processing and Machine Vision

5	To teach the techniques of extracting image attributes like regions and shapes
6	To learn classification and recognition algorithms for machine vision
Course Outcomes: After successful completion of the course students will be able to:	
1	Understand fundamentals of image processing and machine vision.
2	Enhance the quality of image using spatial and frequency domain techniques for image enhancement
3	Learn image morphology and restoration techniques
4	Learn image segmentation techniques based on principle of discontinuity and similarity using various algorithms
5	Represent boundaries and shapes using standard techniques
6	Classify the object using different classification methods

Module		**Content**	**Hrs**
1		**DIGITAL IMAGE FUNDAMENTALS AND POINT PROCESSING**	**5**
	1.1	Introduction –Steps in Digital Image Processing, concept of spatial and intensity resolution, Relationships between pixels	
	1.2	Point Processing: Image Negative, Log Transform, Power Law transform, Bit plane slicing, Contrast stretching, Histogram equalization and Histogram Specification	
2		**IMAGE ENHANCEMENT**	**10**
	2.1	**Spatial Domain filtering:** The Mechanics of Spatial Filtering, Smoothing Spatial Filters-Linear Filters-Averaging filter, Order-Statistic Filters- Median filter, Application of Median filtering for Noise removal Sharpening Spatial Filters- The Laplacian, Unsharp Masking and High boost	

		Filtering, Using First-Order Derivatives —The Gradient- Sobel, Prewitt and Roberts	
	2.2	**Frequency Domain Filtering:** Introduction to 2-D DFT and its application in frequency domain filtering, Wavelet transform, Haar transform	
	2.3	Frequency Domain Filtering Fundamentals, Fourier Spectrum and Phase angle, Steps for Filtering in the Frequency Domain, Correspondence Between Filtering in the Spatial and Frequency Domains, Frequency domain Image Smoothing and sharpening filter - Ideal, Butterworth, Gaussian	
3		**IMAGE MORPHOLOGY AND RESTORATION**	**6**
	3.1	**Morphology:** Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Boundary extraction, Hole filling, Thinning and thickening	
	3.2	**Restoration:** A Model of the Image Degradation/Restoration Process, Noise models, Principle of Inverse filtering.	
4		**IMAGE SEGMENTATION**	**6**
	4.1	Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, Canny's edge detection algorithm, Edge linking: Local processing.	
	4.2	Thresholding: Foundation, Role of illumination and reflectance, Basic global thresholding.	
	4.3	Region Based segmentation: Region Growing, Region Splitting and merging.	
5		**INTRODUCTION TO IMAGE DESCRIPTORS**	**6**
	5.1	Introduction to Texture, Co-occurrence matrix, Chain code.	
	5.2	Image Feature Selection, Best Features and Their Properties, Feature Variance, Feature Correlation, Dimension Reduction.	
		MACHINE VISION ALGORITHMS	**6**

6	6.1	Knowledge representation, Object detection using Template Matching, Confusion Matrix.	
	6.2	K-means clustering algorithm, Support Vector Machine for binary classification case; Support Vectors and Hyper plane.	
		Total	**39**

Textbooks:	
1	Milan Sonka , Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Cengage Engineering, 3rd Edition, 2013
2	Gonzales and Woods, "Digital Image Processing", Pearson Education, India, Third Edition,
3	R. O. Duda and P. E. hart, Pattern classification and scene analysis, Wiley Interscience publication
4	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
5	Kenneth R. Castleman, Digital Image Processing, Pearson Publications, 2012.
Reference Books:	
1	Anil K. Jain, "Fundamentals of Image Processing", Prentice Hall of India, First Edition, 1989.
2	W Pratt, "Digital Image Processing", Wiley Publication, 3rd Edition, 2002
3	Forsyth and Ponce, Computer vision: A modern approach, PHI
4	Frank Y Shish, Image Processing and Pattern Recognition: Fundamentals and Techniques, Wiley Wiley-IEEE Press, 2010

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Department of Electronics and Telecommunication Engineering

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of **20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following
***For sr.no.1, the date of certification exam should be within the term and in case a student is Unable to complete the certification, the grading has to be done accordingly.**

Sr. No	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition / Hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each

4	Any three questions out of five need to be solved.

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Department of Electronics and Telecommunication Engineering

COURSE NAME: IMAGE PROCESSING AND MACHINE VISION LABORATORY

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Pract	Tut	Total
	IMAGE PROCESSING AND MACHINE VISION LAB	---	02	---	--	01	---	1

IMAGE PROCESSING AND MACHINE VISION LAB

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
	IMAGE PROCESSING AND MACHINE VISION LAB	--	---	--	25	25	50

Course Prerequisite:	
Course Objectives:	
1	To understand the fundamental concepts of digital image processing and implement point processing techniques, histogram calculation, and histogram equalization.
2	To study and implement spatial and frequency domain filtering techniques, including sharpening, unsharp masking, and Ideal, Gaussian, and Butterworth filters for image enhancement.

3	To perform morphological operations such as erosion, dilation, and boundary detection, and analyze their applications in image processing.
4	To implement image segmentation, edge detection, image restoration, shape detection, recognition, and classification techniques using standard algorithms.
5	To develop programming skills for designing, implementing, and evaluating image processing algorithms using appropriate software tools such as MATLAB or Python (OpenCV).
Course Outcomes:	
1	Implement point processing operations, histogram analysis, and histogram equalization to enhance digital images.
2	Apply spatial and frequency domain filtering techniques to perform image enhancement, noise reduction, and sharpening.
3	Perform morphological operations and edge detection using Prewitt, Sobel, Roberts, and Canny operators for image analysis.
4	Analyze and implement image segmentation, restoration, and shape detection techniques using methods such as chain code and co-occurrence matrix.
5	Design and evaluate image recognition and classification systems by applying appropriate image processing and machine learning techniques.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Sr. No.	**Name of the Experiment**
1.	To write and execute image processing programs using point processing method.
2.	To write a program for histogram calculation and equalization.
3.	Write and execute programs for image frequency domain filtering like Ideal, Gaussian and Butterworth filters.
4.	Write and execute programs for image spatial domain filtering like sharpening, unsharp masking etc.

5.	Experiment on Morphology: erosion, dilation, boundary detection etc.
6.	To study Image Segmentation using Prewiit, Sobel and Roberts/ Canny Edge operators.
7.	To understand various image noise models and to write programs for image restoration.
8.	Experiment of Shape detection like Chain code, Co-occurrence matrix.
9.	Experiment on Segmentation.
10.	Experiment On Recognition.
11.	Experiment on Classifier.

Term Work:	
1	Term work should consist of 8 to 10 experiments performed using Python Programming. 7. At least 6 comprehensive experiments using Python Coding. 8. At least 2 Experiment on Simulink and MATLAB
2	Marks could be allocated for Cody, Hacker Rank community Programming.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Suggested Marking Scheme : Total 25 Marks : (Experiments: -marks – 15-20 Marks, Attendance Theory & Practical: 2-5-marks, Cody/Hacker rank programming – 3- 5 Marks

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Department of Electronics and Telecommunication Engineering

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology

(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)

Department of Electronics and Telecommunication Engineering

COURSE NAME: VULNERABILITY ASSESSMENT AND PENETRATION TESTING LAB

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETM ML61	Vulnerability Assessment and Penetration Testing Lab	--	04	---	--	02	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETMM L61	Vulnerability Assessment and Penetration Testing Lab	--	--	--	25	25	50

Lab Prerequisite: C programming, Python programming, Computer networks, Basics of Network Security, Ethical Hacking & Digital Forensics	
Lab Objectives:	
1	To identify security vulnerabilities and weaknesses in the target applications
2	To discover potential vulnerabilities which are present in the system in network using vulnerability

	assessment tools.
3	To identify threats by exploiting them using penetration test attempt by utilizing the vulnerabilities in a system
4	To recognize how security controls can be improved to prevent hackers gaining access controls to database
5	To test and exploit systems using various tools and understands the impact in system logs
6	To write a report with a full understanding of current security posture and what work is necessary to both fix the potential threat and to mitigate the same source of vulnerabilities in the future
Lab Outcomes: After successful completion of the course students will be able to:	
1	Understand the structure where vulnerability assessment is to be performed.
2	Apply assessment tools to identify vulnerabilities present in the system in network.
3	Evaluate attacks by executing penetration tests on the system or network
4	Analyse a secure environment by improving security controls and applying prevention mechanisms for unauthorised access to database.
5	Create security by testing and exploit systems using various tools and remove the impact of hacking in system
6	Formation of documents as per applying the steps of vulnerabilities of assessment and penetration testing

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Department of Electronics and Telecommunication Engineering

VULNERABILITY ASSESSMENT AND PENETRATION TESTING LAB

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. Security Software and tools	1. Internet Connection

Module		Content	Hrs
		Pre-requisites: Computer networks, Basics of Network Security, Ethical Hacking & Digital Forensics	**2**
1		**Human Security (Social Engineering) Assessment**	**8**
	1.1	**Visibility Audit: C**ollecting information through social media and internet. Collecting contact details (like phone number, email ID, What's App ID, etc)	
	1.2	**Active Detection Verification:** Test if the phone number, email id etc are real by test message. Test whether the information is filtered at point	

		of reception. Test if operator / another person assistance can be obtained	
	1.3	**Device Information:** IP Address, Port details, Accessibility, Permissions, Role in business **Trust Verification:** Test whether the information can be planted in form of note / email / Message (Phishing)	
	1.4	**Test Subjects:** College Staff, Reception, PA to Director / Principal. To conduct information gathering to conduct social engineering audit on various sections in your college. **Self-Learning Topics:** Networking Commands	
2		**Network & Wireless Security Assessment**	**8**
	2.1	**Network Discovery:** Using various tools to discover the various connected devices, to get device name, IP Address, relation of the device in network, Detection of Active port, OS Fingerprinting, Network port and active service discovery **Tools:** IP Scanner, Nmap etc	
	2.2	**Network Packet Sniffing:** Packet Sniffing to detect the traffic pattern, Packet capturing to detect protocol specific traffic pattern, Packet capturing to reassemble packet to reveal unencrypted password **Tools:** Wireshark **Self-Learning Topics:** Learning the CVE database for vulnerabilities detected	
3		**Setting up Pentester lab**	**9**
	3.1	Including an attacker machine preferably Kali and in the same subnet victim machines either DVWA/ SEEDlabs/ multiple VULNHUB machines as and when required. Understanding Categories of pentest and legalities/ ethics.	
	3.2	Installed Kali machine on VM environment with some VULNHUB	

		machines and we can find out vulnerability of Level 1-VULNHUB machine like deleted system files, permissions of files. **Self learning Topics:** Vulnerability exploitation for acquire root access of the Kioptrx machine	
4		**Database and Access Control Security Assessment**	**9**
	4.1	**Database Password Audit:** Tool based audit has to be performed for strength of password and hashes. **Tools:** DBPw Audit	
	4.2	**Blind SQL Injection:** Test the security of the Database for SQL Injection **Tools:** BSQL Hacker	
	4.3	**Password Audit:** Perform the password audit on the Linux / Windows based system **Tools:** Cain & Able, John the ripper, LCP Password Auditing tools for Windows	
	4.4	**Active Directory and Privileges Audit:** Conduct a review of the Active Directory and the Group Policy to assess the level of access privileges allocated. **Tools:** SolarWinds **Self-Learning Topics:** Federated Database security challenges and solutions	
5		**Log Analysis**	**6**
	5.1	Conduct a log analysis on Server Event Log / Firewall Logs / Server Security Log to review and obtain insights Tools: graylog, Open Audit Module. **Self-Learning Topics:** Python and R-Programming scripts	
		Compliance and Observation Reporting	**10**

6	6.1	**License Inventory Compliance:** Identify the number of licenses and its deployment in your organization. Tools: Belarc Advisor, Open Audit	
	6.2	Report Writing: NESSUS tool Report should contain: a. Vulnerability discovered b. The date of discovery c. Common Vulnerabilities and Exposure (CVE) database reference and score; those vulnerabilities found with a medium or high CVE score should be addressed immediately d. A list of systems and devices found vulnerable e. Detailed steps to correct the vulnerability, which can include patching and/or reconfiguration of operating systems or applications f. Mitigation steps (like putting automatic OS updates in place) to keep the same type of issue from happening again	
	6.3	**Purpose of Reporting:** Reporting provides an organization with a full understanding of their current security posture and what work is necessary to both fix the potential threat and to mitigate the same source of vulnerabilities in the future. **Self-Learning Topics:** Study of OpenVAS, Nikto, etc	
		Total	**52**

Textbooks:	
1	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws Paperback – Illustrated, 7 October 2011 by Dafydd Stuttard
2	Hacking: The Art of Exploitation, 2nd Edition 2nd Edition by Jon Erickson

3	Important links of Vulnhub: Vulnhub Kioptrix Download Link: https://www.vulnhub.com/entry/basic-pentesting-1,216/ https://www.vulnhub.com/entry/kioptrix-level-1-1,22/ Installation Video: https://youtu.be/JupQRHtfZmw Walkthrough/solutions Video: https://youtu.be/Qn2cKYZ6kBI
Useful links:	
1	www.leetcode.com
2	www.hackerrank.com
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html
4	www.codechef.com

Term Work:

1) Term work should consist of assessment for minimum 10 experiments.
2) Journal must include at least 2 assignments
3) Total 50 marks **(Split up)**

COURSE NAME: SKILL LAB -II : EMBEDDED PROGRAMMING FOR TELECOMMUNICATION

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETV S61	Skill Lab -II : Embedded Programming for Telecommunication	---	2+2*	---	---	02	---	02

Skill Lab -II : Embedded Programming for Telecommunication

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Department of Electronics and Telecommunication Engineering

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETV S61	Skill Lab -II : Embedded Programming for Telecommunication	--	2+2*	---	--	02	---	02

*2 Hours Tutorial + Project work[Not necessarily classroom teaching]

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETVS61	Skill Lab -II : Embedded Programming for Telecommunication	--	--	--	25	25	50

Course Prerequisite: Microprocessor and Microcontrollers, Digital VLSI, Skill Lab -1: Telecommunication software Tools lab	
Course Objectives:	
1	Provide hands-on experience with Raspberry Pi and Xilinx FPGA boards.
2	Teach embedded programming, FPGA design, and sensor interfacing.
3	Enable students to develop real-world applications using embedded systems.
4	Foster teamwork and problem-solving skills through a capstone project.
Course Outcomes: After successful completion of the course students will be able :	

1	Design and implement embedded systems using Raspberry Pi and Xilinx SDK with FPGA boards.
2	Interface sensors and peripherals using communication protocols like I2C, SPI, and UART.
3	Develop FPGA-based systems using the MicroBlaze soft-core processor.
4	Build real-time embedded applications integrating hardware and software.
5	Complete a capstone project demonstrating end-to-end embedded system design and development.
6	Design and implement embedded systems using Raspberry Pi and Xilinx SDK kit with FPGA boards.

Skill Lab -II : Embedded Programming for Telecommunication

Module		Content	Hrs
1	**Introduction to Embedded Systems and Tools:** **Objective:** Familiarize students with embedded systems concepts, tools, and development environments.		**6**
	1.1	I. Overview of embedded systems and their applications. Introduction to Raspberry Pi and Xilinx SDK with Boolean FPGA boards. a. Setting up development environments: b. Raspberry Pi: Raspbian OS, Python, and C programming. II. Xilinx SDK: Vivado IDE, FPGA programming flow. III. Basic GPIO interfacing on Raspberry Pi and Boolean FPGA boards. IV. Introduction to communication protocols: UART, I2C, SPI.	
	1.2	**LAB 1:** 12. Install and configure Raspbian OS on Raspberry Pi. 13. Write a simple LED blink program on Raspberry Pi and Boolean FPGA boards. **14. SDK Experiment:** a) Create a Vivado project and use IP Integrator to develop a basic embedded system for a target board.	

		b) Adding Peripherals in Programmable Logic c) Writing Basic Software Applications: Write a basic C application to access the peripherals. d) Software Debugging Using SDK **Reference :** https://www.amd.com/en/corporate/university-program/vivado/vivado-workshops/vivado-embedded-design-flow-zynq.html	
2	**Embedded Programming with Raspberry Pi** **Objective:** Develop proficiency in programming and interfacing sensors/ actuators using Raspberry Pi.		**6**
	2.1	I. Python and C programming for embedded systems. II. Interfacing sensors (e.g., temperature, humidity, motion) with Raspberry Pi. III. PWM and motor control using Raspberry Pi. IV. Introduction to Linux-based embedded systems.	
	2.2	**LAB 2 :** 1. Interface a temperature sensor (e.g., DHT11) and display readings. 2. Control a DC motor using PWM signals. 3. Develop a simple web server on Raspberry Pi to display sensor data.	
3	**FPGA MicroBlaze Interfacing with I2C and SPI Protocols** **Objective:** Learn to design and implement FPGA-based systems using the MicroBlaze soft-core processor and interface it with I2C and SPI-based sensors.		**8**
	3.1	I. Introduction to MicroBlaze soft-core processor. II. I2C protocol and interfacing with accelerometer and temperature sensors. III. SPI protocol and interfacing with moisture sensors. IV. Sensor data processing and display using MicroBlaze.	
	3.2	**LAB 3:[Perform at least 3 Labs of SDK from below]** 1. Set up MicroBlaze in Vivado and Xilinx SDK. 2. Interface an I2C-based accelerometer (e.g., MPU6050) and read data.	

		3. Interface an SPI-based moisture sensor and read data. 4. Interface an I2C-based temperature sensor and read data. 5. Integrate and UART based datalogger system for display sensor data on a serial terminal or LCD.	
4	**Communication Protocols and Interfacing** **Objective**: Explore communication protocols and their implementation in embedded systems.		**7**
	4.1	I. Deep dive into UART, I2C, and SPI protocols. II. Interfacing sensors and peripherals using communication protocols. III. Wireless communication: Bluetooth and Wi-Fi with Raspberry Pi. IV. Implementing custom communication protocols on Boolean FPGA boards.	
	4.2	**LAB 4:[Perform at least 2 labs of Raspberry pi and 3 Labs of SDK below]** 1. Interface an I2C-based accelerometer with Raspberry Pi. 2. Establish SPI communication for Raspberry Pi 3. Develop a Bluetooth-controlled LED system using Raspberry Pi. 4. Using SDK 4. Create a SoC-Based System using Programmable Logic 5. Debugging using Vivado Logic Analyzer cores 6. Extending Memory Space with Block RAM 7. Direct Memory Access using CDMA 8. Configuration and Booting 9. Profiling and Performance Tuning **Reference :** https://www.amd.com/en/corporate/university-program/vivado/vivado-workshops/vivado-adv-embedded-design-zynq.html	
5	**Raspberry Pi with OpenCV and IoT Camera Applications** **Objective:** Learn to implement computer vision and IoT applications using Raspberry Pi and OpenCV with a camera module.		**6**
	5.1	I. Introduction to OpenCV and its applications in embedded systems.	

		II. Setting up OpenCV on Raspberry Pi. III. Capturing and processing images/videos using Raspberry Pi camera. IV. IoT integration: Streaming video over the internet. V. Object detection and face recognition using OpenCV.	
	5.2	**LAB 5: 5 Marks [Perform at least 3 labs from below]** 1. Install OpenCV on Raspberry Pi and set up the camera module. 2. Capture and display live video feed using OpenCV. 3. Implement motion detection using OpenCV. 4. Stream video over a local network using Flask or MQTT. 5. Develop a simple face recognition system using OpenCV.	
6		**Capstone Project:**	**15**
	6.1	**Project Guidelines:** I. Students will work in teams to design an embedded system using Raspberry Pi or Xilinx SDK with Boolean FPGA boards. II. The project should integrate hardware, software, and communication protocols.	
	6.2	**Project Activities:** 1. Project planning and requirement analysis. 2. Hardware and software design. 3. Integration and testing. 4. Final presentation and demonstration.	
		Total	**48**

Reference Books:	
1	"Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C" by Yifeng Zhu – For embedded programming concepts.
2	"FPGA Prototyping by Verilog Examples" by Pong P. Chu – For FPGA design and Verilog programming.
3	"Raspberry Pi Cookbook" by Simon Monk – For Raspberry Pi-based projects.

4	"Learning OpenCV 4 Computer Vision with Python" by Joseph Howse – For OpenCV and computer vision applications.
5	"Designing Embedded Systems with 32-Bit PIC Microcontrollers and MikroC" by Dogan Ibrahim – For embedded system design principles.
Useful Links	
1.	https://www.amd.com/en/corporate/university-program/workshops.html
2.	https://learn.circuit.rocks/introduction-to-opencv-using-the-raspberry-pi

Internal Assessment:

1. **Term Work Consists of**
   - I. 5 Labs mentioned in syllabus &
   - II. Capstone Project
2. Total (25 Marks) = 5 Labs + Capstone Project

3. **Lab Reports and Activities : 12.5 Marks**
   - I. LAB 1 to LAB 5 each carry 5 Marks
   - II. It includes LAB performance and Journal Submission.
4. **Capstone Project : 12.5 Marks**
   1. Implementation of Project : 5 Marks
      - I. Defining specification and selecting sensors : 1 Mark
      - II. Literature survey, block diagram/architecture : 1 Marks
      - III. Implementing of hardware : 3 Marks
   2. Validation and Testing : 2 Marks
   3. PCB design : 2 Marks
   4. Making Model using 3 D Printing : 2 Marks
   5. Idea pitching of working Prototype : 1.5 Marks

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Department of Electronics and Telecommunication Engineering

Suggested Project List

Sr. No	Projects	Description	Components Needed

FPGA Based Projects

1. Magnetometer-based Digital Compass
   a. Use an HMC5883L magnetometer to build a digital compass.
2. Clap Switch
   a. Use a Sound sensor to turn on and off LEDs
3. Weather Station
   a. Collects and displays environmental data on a PC via UART or an LCD screen.
4. Smart Fan Using BMP280
   a. Automatically controls a fan based on temperature using the BMP280 sensor
5. Water Level Detection
   a. The Ultrasonic sensor detects the level of water in a tank.
6. Weighing Machine
   a. Measuring Weight using HX711 ADC Module and Load Cells
7. FPGA-based digital audio processor with IoT integration
8. FPGA-Based Temperature Monitoring System
   a. Read temperature data via I2C sensor.
   b. Display temperature on LCD and trigger alerts.
9. MicroBlaze-Based Real-Time Data Logger
   a. Store sensor data in FPGA memory.
   b. Send logged data via UART to a PC for analysis.
10. MicroBlaze-Based Real-Time Data Logger
    a. Store sensor data in FPGA memory.
    b. Send logged data via UART to a PC for analysis.
11. MicroBlaze-Based Custom CPU Implementation
    a. Implement a basic RISC processor using MicroBlaze.
    b. Run simple embedded C programs on the soft core.
12. MicroBlaze-Based Motor Control System

a. Control a stepper motor using PWM signals.
b. Implement speed variation using FPGA logic.

13. MicroBlaze & FPGA-Based Voice Recognition System
    a. Process voice commands and control an LED or motor.
    b. Use DSP functions within MicroBlaze for analysis.
14. MicroBlaze-Based VGA Display Controller
    a. Generate graphical output on a VGA screen.
    b. Implement a basic GUI for FPGA-based applications.

Raspberry Pi Based Project

1. Smart home automation system with IoT camera.
    a. Control lights, fans, and appliances via web or mobile.
    b. Use MQTT/Google Assistant integration.
2. IoT-based weather monitoring station with video streaming.
3. Autonomous robot with sensor fusion and computer vision.
4. Smart Security Camera with Motion Detection
    a. Detect motion and capture intruder images.
    b. Send alerts via email or SMS.
5. Face Recognition-Based Door Lock
    a. Train a model to recognize faces and unlock doors.
    b. Use OpenCV and dlib for face recognition.
6. Smart Attendance System
    a. Recognize faces and mark attendance automatically.
    b. Store attendance logs in a CSV file or cloud database.
7. License Plate Recognition System
    a. Capture and recognize vehicle number plates.
    b. Use OCR (Tesseract) to extract text from images.
8. Hand Gesture Recognition
    a. Detect different hand gestures for controlling devices.
    b. Use OpenCV with Mediapipe for gesture tracking.
9. Face Detection System
    a. Detect human faces in a live video feed.
    b. Use Haar cascades or DNN-based face detection.

10. Object Tracking System
    a. Track a moving object using color-based tracking.
    b. Use OpenCV's MeanShift or CamShift algorithms.
11. Edge Detection using Canny Algorithm
    a. Capture real-time video and apply edge detection.
    b. Useful for applications like lane detection in self-driving cars.
12. Motion Detection and Alert System
    a. Detect movement using frame difference method.
    b. Send an alert when significant motion is detected.
13. Smart Traffic Monitoring System
    a. Detect and count vehicles using OpenCV.
    b. Send real-time traffic data to a cloud dashboard.
14. AI-Powered Smart Mirror
    a. Recognize user faces and display personalized content (weather, news).
    b. Use OpenCV, IoT, and voice assistants.
15. Live Streaming & Remote Monitoring System
    a. Stream live video from Raspberry Pi camera to a remote PC or mobile.
    b. Use Flask for web-based video streaming.
16. Smart Farming with Plant Disease Detection
    a. Capture plant images and detect diseases using image processing.
    b. Send alerts via an IoT-based system.
17. Blind Assistance System
    a. Identify objects and read out their names using OpenCV and text-to-speech.
    b. Implement OCR to read signs and books aloud.
18. Autonomous Line Following Robot
    a. Use IR sensors and OpenCV to follow a path.
    b. Implement PID control for accuracy.
19. Raspberry Pi as a WiFi Router
    a. Convert Pi into a wireless access point.
20. SPI/I2C Communication Between Raspberry Pi & FPGA
21. Implement real-time data exchange between FPGA & Pi.

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Major Project I

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETM P61	Major Project I	-	08	-	-	04	-	04

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NETM P61	Major Project I	-	08	-	-	04	-	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Presentation & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
NETM P61	Major Project I	--	--	--	50	50	100

Course Prerequisite: Basics of subjects learned in previous semesters
Course Objectives:

1.	To enable the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a social real life problem or an issue, and mapped with 17 sustainable development goals (SDGs) to transform our world via a substantial piece of work which is to be carried out over an extended period.
2.	To enable the students to demonstrate to proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.
Course Outcomes: This course is designed to equip students with fundamental research methodology skills. By the end of the course, students will be able to:	
1.	To undertake problem identification, formulation and design engineering solutions to social problems following a systematic approach.
2.	To demonstrate a sound technical knowledge of selected problem/ issue.
3.	To demonstrate the knowledge, skills and attitudes of a professional engineer.
4.	Develop and test a working prototype or simulation, demonstrate real-world application of the selected problem/issue in a forum/ community involving poster presentations etc.

Guidelines for Major Project I: The following guidelines are to be adhered to for the Major Project I

1. **Selection of Topic**
   - Choosing the right project topic is crucial. It should aim to solve a real-life problem within the available time frame.
2. **Scope of the Project**
   - Projects must address issues relevant to the **Electronics and Telecommunication** domain.
   - Topics should aim to contribute toward solving real-world problems and must be **aligned with one or more of the 17 Sustainable Development Goals (SDGs)** listed at the end of this document.
3. **Type of Project**

- Both practical and theoretical **Research and Development (R&D)** projects are encouraged.
- Projects should demonstrate innovation, relevance, and technical depth.

4. **Team Composition**
   - Each project must be completed by a group of **2 to 3 students**.
   - Projects must be **original**, although students may take inspiration from external sources like **society, NGOs, companies, or surveys**. However, the final implementation must reflect a **unique and customized approach**.
5. **Project Location and Industry Involvement**
   - Projects may be undertaken in collaboration with **research institutes, companies, or other organizations**, with proper consultation and approval from the **internal guide and Head of Department (HoD)**.
   - If the project is conducted outside the institute, the internal guide must **visit the site once a month** to monitor progress.
   - The **final working prototype or project must be demonstrated within the institute** during evaluation.
6. **Project Topic Approval**
   - Students must consult both the **internal guide** and, if applicable, the **external guide** for topic selection.
   - Final approval of project topics will be granted by the **HoD and senior faculty members**.
7. **Progress Monitoring**
   - Students are required to submit a **weekly progress report** to the internal guide.
   - The internal guide will monitor progress regularly and maintain an **attendance and progress record**, which will be considered for **term work evaluation**.
8. **Evaluation Criteria:**
   The following aspects will be assessed during the presentation of the project.
   - **Quality of Literature Review and Novelty of the Topic:**
     Depth of research and originality in the topic selection.
   - **Relevance to Specialization:**
     How well the topic aligns with the student's field of study.

- **Understanding and Clarity of Problem Definition:**
  Demonstrated understanding of the topic and clear articulation of the research problem.
- **Prototype/Simulation Development and Result Significance:**
  Quality of the prototype or simulation, and the importance of the results achieved.
- **Quality of Written and Oral Presentation:**
  Overall presentation skills, including clarity, structure, and communication of ideas.

Final Year Project Report Format (To be prepared in LaTeX)

Each group must submit a well-structured project report at the end of the semester. The report should include, at a minimum, the following sections:

Abstract

- A concise summary of the project, highlighting the problem addressed, methodology, key innovations, and expected outcomes.
- Limit to 200–300 words.

Introduction

- Brief background of the project topic.
- Relevance and motivation for selecting the topic.
- Real-world application and expected impact.

Literature Survey

a) Review of Existing Systems/Approaches: Summary of current technologies, methods, or systems related to the problem domain.

b) Research Gap / Limitations of Existing Systems: Identify shortcomings, challenges, or gaps in the current approaches.

c) Problem Statement and Objectives: Clearly define the problem to be solved. List specific objectives your project aims to achieve.

d) Scope of the Project: Define boundaries and focus of the project. State what the project will and will not cover.

Proposed System / Solution

a) System Analysis / Conceptual Framework / Algorithm: Explain the theoretical or conceptual approach. Include block diagrams or system architecture if applicable.

b) Hardware and Software Requirements: List components and tools with specifications.

c) System Design Details: Include flowcharts, circuit diagrams, UML diagrams, or other design models as relevant.

d) Methodology: Describe the step-by-step approach for problem-solving.. Include justifications for methods chosen.

Implementation Plan for Next Semester: Detailed roadmap for completion in the following semester. Include milestones, Gantt chart or timeline, and division of responsibilities among team members.

Conclusion: Summarize key findings so far and potential outcomes.Highlight the technical contributions and real-world implications.

References

- List all cited work in a **standard citation format (IEEE, APA, or ACM)**.
- Use BibTeX for LaTeX integration and maintain academic integrity.

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List of 17 Sustainable Development Goals (SDGs)

No Poverty
Zero Hunger
Good Health and Well-being
Quality Education
Gender Equality
Clean Water and Sanitation
Affordable and Clean Energy
Decent Work and Economic Growth
Industry, Innovation and Infrastructure
Reduced Inequality
Sustainable Cities and Communities
Responsible Consumption and Production
Climate Action
Life Below Water
Life on Land
Peace, Justice and Strong Institutions
Partnerships for the Goals