SIDDAGANGA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME & SYLLABUS

OF

VII & VIII SEMESTER

B.E.

Electronics & Telecommunication Engg.

2024 - 25

Vision of the Dept.:

To become center of excellence in Electronics & Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

Mission of the Dept.

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)

The graduates of Electronics & Telecommunication Engineering are able to:

- Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Telecommunication Engineering and allied disciplines.
- Pursue higher education by lifelong learning in the areas of Telecommunication Engineering and allied disciplines.
- Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

PROGRAM SPECIFIC OUTCOMES (PSOs):

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.
- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' grade & ISO 9001:2015 Certified)

B.E. in Electronics and Telecommunication Engineering

SCHEME OF TEACHING AND EXAMINATION NEP 1 Scheme

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	PCC	N7ET01	Wireless Communication	ETE	42	0	0	48	3	50	50	100	3
2.	PEC	NETExx	Professional Elective Course-II	ETE	42	0	0	48	3	50	50	100	3
3.	PEC	NETExx	Professional Elective Course-III	ETE	42	0	0	48	3	50	50	100	3
4.	OEC	NOExx	Open Elective Course-II		42	0	0	48	3	50	50	100	3
5.	AEC	NSH09	Research Methodology & Intellectual Property Rights	ETE	28	0	0	32	3	50	50	100	2
6.	Project	N7ETMP	Project Work	ETE	0	0	270	30	3	100	100	200	10
			Total		-	-	-	-	**18**	**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									
VIII Semester													
1.	Seminar	N8ETTS	Technical Seminar	ETE	One contact hour /week for interactionbetween the faculty and students.			30	-	100	--	100	1
2.	Internship	N8INT	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty andstudents.				-	100	100	200	15
3.	NCMC	NMC01	National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.				-	50	50	100	0
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga and Pranayama	Yoga									
		NMC04	NCC	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**		**100**	**0**

Professional Elective -II		**Professional Elective - III**	
NETE05	Ad-Hoc Wireless Networks	NETE09	Satellite Communication
NETE06	Artificial Neural Network	NETE10	Machine learning
NETE07	Nano Scale Device Fabrication	NETE11	Optical Fiber Communication
NETE08	Speech Processing	NETE12	Cryptography and Network Security
		NETE13	Analog VLSI Design

Note: **PCC**: Professional Core Course, **PEC**: Professional Elective Course, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

WIRELESS COMMUNICATION

Contact Hours/ Week:	: 3 (L)	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	N7ET01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Analyze the concepts of wireless communication.
2.	Realize knowledge of basic wireless communication parameters and their design.
3.	Apply the wireless communication concepts to design wireless communication systems.
4.	Realize the knowledge of latest developments in the field of wireless communication.

UNIT I

Introduction to Wireless Communication Systems: Examples of Wireless Communication Systems, Introduction to 2G, 3G, 4G, 5G and 6G Standards. Wireless Networks, WLL, WLANs, Bluetooth and PANs. The Cellular Concept – System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity. Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems

10 Hours

UNIT II

Mobile Radio Propagation: Large Scale Path Loss Introduction to Mobile Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design Using Path Loss Models, Outdoor Propagation Models.

Mobile Radio Propagation: Small-Scale Fading and Multipath: Small- Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, and Types of Small-Scale Fading

8 Hours

UNIT III

Principles of Wireless Communications: The wireless communication environment, Modelling of wireless channel, System model for narrowband signals, Rayleigh fading wireless channel, BER performance of wireless systems for various modulations, Intuition for BER in a fading channel, Channel estimation in wireless systems

8 Hours

UNIT IV
Equalization: introduction, Fundamentals of Equalization, Linear and Non Linear Equalizers. **Diversity in Wireless Communications:** Diversity Techniques, Multiple receive antenna system model, Symbol detection in multiple antenna systems, BER in multi-antenna wireless systems, Diversity Order
8 Hours

UNIT V
Orthogonal Frequency Division Multiplexing (OFDM): **Introduction to OFDM**, Subcarrier concept, OFDM signal generation, IFFT/FFT operations in OFDM, Addition of cyclic prefix, End-to-End system model for OFDM. **Multiple-Input Multiple-Output (MIMO):** Introduction to MIMO, MIMO system model, MIMO Zero Forcing (ZF) Receiver, MIMO MMSE Receiver Introduction to 5G architecture and applications.
8 Hours

TEXT BOOKS		
1	Theodore S. Rappaport	Wireless Communications - Principles and Practice, updated 2nd edition, Pearson Education, 2010.
2	Aditya K Jagannatham	Principles of Modern Wireless Communication Systems, 1st edition Mc. Graw-Hill Education (India), 2015

REFERENCE BOOKS		
1	Dr. Kamilo Feher	Wireless digital Communications, PHI, 1st edition, 1995.
2	William C.Y. Lee	Wireless and Cellular Telecommunication, 3rd edition, McGraw Hill, professional, 2005

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyze the wireless standards and cellular concepts.
CO2	Evaluate the power received/ path loss for outdoor propagation models.
CO3	Analyze the Rayleigh fading channel and its performance.
CO4	Analyze the performance of various diversity techniques and equalizers.
CO5	Analyze the performance of OFDM techniques and MIMO system.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	3	1				1						2
	2		2	1			1	1						2
	3	2	2					1						2
	4		2	1										2
	5	1	2											2
	Avg.	**2**	**2**	**1**			**1**	**1**						**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

AD HOC WIRELESS NETWORKS

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE05	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Provide students the fundamental concepts, issues.
2.	Design in developing the architecture and protocols in MAC layer, Network layer, Transport layer for ADHOC wireless networks.
3.	Introduction to security implementation issues in ADHOC wireless networks.

UNIT I

AD HOC NETWORKS: Introduction, Application of Ad-Hoc wireless networks, Issues in Ad hoc wireless networks, Ad hoc wireless internet

10 Hours

UNIT II

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS:
Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols. MACAW protocol, Busy Tone Multiple Access Protocols, Media Access with Reduced Handshake, Five-Phase Reservation Protocol, Distributed Priority Scheduling and Medium Access in Ad Hoc Networks.

8 Hours

UNIT III

ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS-1:
Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, DSDV protocol, Cluster-Head Gateway Switch Protocol, DSR protocol, AODV protocol, TORA protocol, Location-Aided protocol.

8 Hours

UNIT IV

ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS-2:
Hybrid routing protocol, ZRP protocol, routing protocols with efficient flooding, OLSR protocol, Fisheye State Protocol, Multicast Routing in Ad-Hoc Wireless networks: Multicast Ad-Hoc on demand Distance vector routing protocol, Core assisted mesh protocol.

8 Hours

UNIT V
TRANSPORT LAYER PROTOCOLS FOR AD HOC WIRELESS NETWORKS AND OTHER MODELS OF AD HOC NETWORKS: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, TCP-F protocol, TCP Bus, ATCP. **UAV Networks:** Introduction, FANETs, Handover types. Wireless Sensor Network: Introduction, WSN coverage-OGDC Algorithm, Topology management in WSN, MAC protocols for WSN, Routing protocol for WSN.
8 Hours

TEXT BOOKS		
1	C. Siva Ram Murthy, B.S.Manoj	Ad hoc wireless Networks, Pearson Education, 2nd Edition, reprint 2005

REFERENCE BOOKS		
1	Ozan K.Tonguz, Gianguigi Ferrari	Ad hoc wireless Networks, Wiley, 2007
2	Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du	Ad hoc wireless Networking Kluwer academic publishers. 2004.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Outline the fundamental concepts and issues in Ad Hoc Wireless Networks.
CO2	Analyze the MAC protocols of Ad Hoc Wireless Networks.
CO3	Classify and analyze various Routing protocols of Ad Hoc Wireless Network.
CO4	Identify and Analyze optimized Routing protocols of Ad Hoc Wireless Networks
CO5	Analyze various transport layer protocols of Ad Hoc Wireless Networks and outline the concepts of UAV and WSN technologies.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2				1						1	
	2	2	2					2						2
	3	2	2	2			1						1	2
	4	2	1							2			1	2
	5	2						2					1	2
	Avg.	**2**	**1.8**	**2**			**1**	**2**		**2**			**1**	**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ARTIFICIAL NEURAL NETWORK

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE06	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand basic differences between human and machine intelligence, the attractive features of the biological neural networks to realize some of features through parallel and distributed processing models
2.	Explain the biological and mathematical foundations of neural network models
3.	Learn different learning models to train an artificial neural network
4.	Identify various pattern recognition tasks & select suitable neural network architectures
5.	Design, build and train neural networks to solve various pattern recognition tasks

UNIT I

Review of Linear algebra: Linear combination of vectors, linearly dependent and independent set of vectors, Vector space, subspace, basis, rank, Eigen vectors, orthogonal vectors, inner product, outer product.(No questions will appear in the end exam from these topics)

Basics of Artificial Neural Networks: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts Model, Perceptron, Adaline, topology, Supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron

10 Hours

UNIT II

Functional units of ANN & Single layer perceptron: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by i) Feed-forward ii) Feed-back iii) competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks, Linear separability, Perceptron convergence theorem

8 Hours

UNIT III

Multi-Layer perceptron: Linear Inseparability**:** Hard problems, MLFFNN: Back propagation learning, Draw backs of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (**CNN**).

8 Hours

UNIT IV
Feedback Neural Networks: Analysis of pattern storage networks, The Hopfield Model, Energy analysis of Hopfield model, State transition diagram, Pattern storage: Hard problems, Stochastic Networks and simulated annealing. **Competitive learning network**: Basic competitive learning, Analysis of pattern clustering Networks. Analysis of Feature Mapping Network
8 Hours
UNIT V
Architectures for complex pattern recognition tasks: Bidirectional associative memory, Architecture of Radial basis function (RBF) networks, Theorems for function approximation, RBF networks for function approximation, Covers theorem on separability of patterns, The XOR problem, RBF Networks for pattern Classification, comparison of RBF with MLP networks **Introduction to Generative AI**: Overview of Generative Models, Natural Language Processing (NLP) Applications
8 Hours

TEXT BOOKS		
1	B. Yegnanarayana	Artificial neural networks, PHI, 2010.
2.	Ian Goodfellow, Yoshua Bengio, Aaron Courville	Deep Learning, MIT Press, 2016, ISBN-13: 978-0262035613

REFERENCE BOOKS		
1	Simon Haykin	Neural Networks for Pattern Recognition, Pearson Education Limited, 3rd Edition, 2016
2	Robert J. Schalkoff	Artificial Neural Networks, Mcgraw-Hill Inc., 2011

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Distinguish between human and machine intelligence
CO2	Analyze various learning methods of neural networks.
CO3	Illustrate the use of feed-forward neural network for simple pattern recognition tasks.
CO4	Illustrate use of feed-back neural network for pattern storage problems.
CO5	Apply Radial basis function networks for complex pattern recognition tasks

E-Resources:

1 https://onlinecourses.nptel.ac.in/noc22_cs73/course

2 https://onlinecourses.nptel.ac.in/noc22_cs124

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO's	1				1									
	2	1	2	1										
	3	1	1	2	2									
	4	2	2	2	2									
	5	2	2	2	2									
	Avg.	1.2	1.8	1.6	1.8									

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

NANOSCALE DEVICE FABRICATION

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE07	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Introduce the foundations of micro/nanoscale fabrication with emphasis on understanding the nano-scale properties of materials and living systems, and then analyzing their engineered products and processes.
2.	Learn the need and functioning of clean room facilities that are essential in nanotechnology enterprises.
3.	Apply the methods of fabrication technology, and to analyze the nano-electronics products.
4.	Learn about safety and safe working procedures in the domain of nanotechnology.

UNIT I
Nanoscale science and technology: Explain the science and engineering behind nanotechnology. Understand nanoscale fabrication basics: electrostatic, hydrogen, Van der Waals, and shear interaction, surfactants, self-assembly, diffusion, absorption, and adsorption properties
10 Hours

UNIT II
Nanotechnology facility development and safety: Building and equipment requirements; clean room technology; Air handling units, safety data sheet (SDS), cleanroom behavior, hazard and safety. Waste disposal practices and guidelines
8 Hours

UNIT III
Nano scale fabrication process: CAD tools for device design; thin film deposition, doping, anneling, sintering, ion implantation, and characterization; photolithography and e-beam lithography: photo and e-beam resists, mask writing, exposure, development and inspection; etching techniques, mask pattern transfer on wafer-spin coating and baking, development and inspection. Metal layer evaporation and liftoff, insulation of the devices, opening of contact pad; and device packing on the system.
8 Hours

UNIT IV
Properties at nano scale: Electrical characterization of the fabricated devices: equipment and test, electrical and thermal conductivity, thermal expansion; reflectance, refractive index PL (semiconductor band gap, band structure, and impurity states), inspection and morphological imaging (optical microscopes, electron microscopy, thermal analysis of the films, AFM, STEM, cryo-electron microscopy), material defect structures.
8 Hours

UNIT V
Nano scale device and applications: Types of nano scale devices, structures, and systems (CMOS, nano-transistors, Schottky device, nanowires based, lab-on-chip electrodes); System-on-Chip bonding and packaging (basic application only), micro-electro-mechanical-systems (MEMS)**.**
8 Hours

TEXT BOOKS		
1	S. A. Campbell	Fabrication Engineering at the Micro- and Nanoscale (Oxford Series in Electrical and Computer Engineering, 4th Edition , ISBN- 978-0199861224, Oxford University Press, 2012.
2	D. G. Bucknall	Nanolithography and patterning techniques in microelectronics, 2nd Edition, ISBN- 78-1-85573-931-4. Woodhead Publishing, 2005.

REFERENCE BOOKS		
1	M. Ohring	Materials Science of Thin Films: Deposition and Structure, Second Edition, , ISBN-13: 978-0-12-524975-1, Academic Press, 2002
2	D. K. Schroder	Semiconductor Material and Device Characterization, Third Edition, , ISBN-13: 978-0-471-73906-7, Wiley-IEEE Press, 2006
3	S. K. Ghandhi	VLSI Fabrication Principles; Silicon and Gallium Arsenide, Second Edition, ISBN-10: 9814-12-694-2. John Wiley & Sons, 1994

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain the science and engineering behind the nano scale fabrication
CO2	Illustrate the requirements of clean-room specifications
CO3	Evaluate the processes in in VLSI fabrication from thin-film deposition to packaging.
CO4	Analyze the physical and electrical specifications of nano scale devices.
CO5	Evaluate the applications of Nano scale devices, structures and systems.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	1	1										
	2	2	2	1										
	3	2	2	2	2									
	4	2	1	2	2									
	5	2	2	2	2									
	Avg.	**2**	**1.6**	**1.6**	**1.6**									

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SPEECH PROCESSING

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE08	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the characteristics of speech signal
2.	Apply signal processing concepts to speech signal,
3.	Get an insight into an application on speech/speaker recognition and speech enhancement.

UNIT I

Digital Models for the Speech Signal: Introduction, The process of speech production, The acoustic theory of speech production, Lossless tube models, Digital models for the speech signals

10 Hours

UNIT II

Time-Domain Models for Speech Processing: Introduction, Time-dependent processing of speech, Short-time energy and average magnitude, Short-time average zero-crossing rate, Speech vs. silence discrimination using energy and zero-crossings, Pitch period estimation using a parallel processing approach, The short-time autocorrelation function, The short-time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Short-Time Fourier Analysis: Fourier transform interpretation, Linear filtering interpretation, Sampling rates of STFT in time and frequency, Filter bank summation method of short-time synthesis, Overlap addition method of short-time synthesis

8 Hours

UNIT III

Homomorphic Speech Processing: Homomorphic systems for convolution, The complex spectrum of speech, Pitch detection, Formant estimation, vocoders

8 Hours

UNIT IV

Linear Prediction Analysis of Speech: Basic principles of linear predictive analysis, Computation of the gain for the model, Solution of the LPC equations, Comparisons between the methods of solution of the LPC analysis equations, Frequency domain interpretations of linear predictive analysis, Synthesis of speech from linear predictive parameters, Applications of LPC parameters: pitch detection and formant analysis using LPC parameters

	8 Hours

UNIT V
Applications of Speech Processing, **Automatic Speech Recognition:** Speech recognition systems (Isolated word recognition, connected word recognition and large vocabulary word recognition) **Speech Recognition:** Introduction, Spectral features for speaker recognition, Speaker recognition algorithm. **Speech Enhancement**: Background, Nature of interfering sounds, Speech enhancement techniques, Spectral subtraction
8 Hours

TEXT BOOKS		
1	Lawrence R. Rabiner and Ronald W. Schafer	Digital Processing of Speech Signals, 2nd Edn.,Indian Reprint, Pearson Education India, Edition I, 2003

Reference Books:		
1	Thomas F. Quatieri	Discrete-Time Speech Signal Processing: Principles And Practice, Pearson Education India, Edition I, 2012
2	Lawrence R. Rabiner, Biing-Hwang Juang, B. Yegnanarayana	Fundamentals of Speech Recognition, Pearson Education India, Edition I, 2008.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the mechanism of speech production & its representation digitally
CO2	Classify the phonemes depending upon the manner and place of articulation
CO3	Make use of short-term analysis for speech signals
CO4	Extract the information of the speech signals in terms of cepstral features Analyze the speech signals using linear predictive coding.
CO5	Apply speech processing concepts in various applications of speech

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	1	1	2		2			1		1		1	
	2	3	2			2			1		1		1	
	3	2	2	1		2			1		1		2	
	4	1	2			2			1		1		2	
	5	3	2	1		2			1		1		2	
	Avg.	**2**	**2**	**2**		**2**			**1**		**1**		**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SATELLITE COMMUNICATION

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE09	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Calculate Orbital mechanics of the satellites.
2.	Introduce Satellite link components in a broadband communication system.
3.	Design the satellite subsystems.
4.	Study satellites constellation for applications such as meteorological data collection, search, navigation and rescue, GPS, etc.

UNIT I

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation, INTELSAT. ORBITS: Introduction, Kepler laws, definitions, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits, Geostationary orbit: Introduction, antenna, look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits.

10 Hours

UNIT II

PROPAGATION IMPAIRMENTS AND SPACE LINK: Introduction, atmospheric losses, ionospheric effects, rain attenuation, other impairments. SPACE LINK: Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR. Intermodulation, Inter-satellite Links.

8 Hours

UNIT III

SUBSYSTEMS: SPACE SEGMENT- Introduction, power supply units, attitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem. EARTH SEGEMENT- Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx – Rx earth station.

8 Hours

UNIT IV
INTERFERENCE AND SATELLITE ACCESS: Introduction, interference between satellite circuits, Energy dispersal, coordination. Satellite access, single access, preassigned and Demand assigned FDMA, SCPC (spade system), Bandwidth and Power limited TWTA operation, TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA, CDMA.
8 Hours

UNIT V
DBS, SATELLITE MOBILE AND SPECIALIZED SERVICES: Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV, MPEG Compression, FEC, ODU and IDU, Link Analysis, HDTV, Video Frequency Bandwidth, satellite mobile services, VSAT, Radarsat, GPS, orbcomm and Iridium Satellite systems.
8 Hours

TEXT BOOKS		
1	Dennis Roddy	Satellite Communications, 4th Ed, McGraw- Hill International edition, 2017.
2	Timothy Pratt, Charles Bostian and Jeremy Allnutt	Satellite Communications, 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.

REFERENCE BOOKS		
1	K. N. Raja Rao	Satellite Communication: Concepts and applications, 2nd Ed. PHI Learning Pvt. Ltd., 2013.
2	W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson	Satellite Communication Systems Engineering, 2nd Ed., Pearson Education., 2007.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply Kepler laws of planetary motion to develop orbital mechanics for a satellite.
CO2	Identify and analyze components of Losses during the signal propagation between earth station and satellite.
CO3	Perform computations related to antenna gain, look angles for a given communication satellite.
CO4	Design the subsystems of Satellites and Earth Stations and establish the satellite communication links.
CO5	Apply appropriate tools and computation techniques for evaluating the performance of satellite communication systems.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	3											3
	2	3	2	1										3
	3	3	2											3
	4	3	3	3	1			2						3
	5	3	3	3	1	1		2						3
	Avg.	**3**	**2.6**	**2.33**	**1**	**1**		**2**						**3**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

MACHINE LEARNING

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE10	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Learn a spectrum of machine learning algorithms with a sound mathematical background
2.	Understand technical know-how of applying these algorithms for different real-world applications

UNIT I

Introduction: What is machine learning? Examples of machine learning applications **Supervised Learning:** Learning a Class from Examples, VC-dimension, PAC learning, Noise, Learning multiple classes, Regression, Model selection and generalization, Dimensions of a Supervised Machine Learning Algorithm. **Bayesian Learning:** Classification, losses and risks, Discriminant functions**,** Utility Theory

10 Hours

UNIT II

Parametric Methods: Maximum Likelihood Estimation, Evaluating an estimator, Bayes' estimator, parametric classification, Regression.
Multivariate methods: Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution

8 Hours

UNIT III

Dimensionality Reduction: Subset Selection, Principal components Analysis, Linear Discriminant Analysis. **Clustering:** Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters

8 Hours

UNIT IV

NonparametricMethods: Non-parametricDensityEstimation,Generalization to Multivariate Data, Nonparametric Classification. **Decision Trees:** Introduction, Univariate Trees, Pruning, Rule Extraction from Trees

8 Hours

UNIT V
Linear Discrimination: Introduction, Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Support Vector Machines: Optimal separating Hyperplane.**MultilayerPerceptrons**:Introduction,ThePerceptron,TrainingaPerceptron, Learning Boolean Functions, Multilayer Perceptrons, Backpropagation Algorithm: Nonlinear regression
8 Hours

TEXT BOOKS		
1	Alpaydin Ethem	Introduction to Machine Learning, 2nd Edn. PHIPvt.Ltd-New Delhi,2010

REFERENCE BOOKS		
1	S.Theodoridis and K. Koutroumbas	Pattern Recognition, Academic Press, 4th Ed., 2009.
2	Earl Gose, Richard Johnsonbaugh and Steve Jost	Pattern Recognition and Image Analysis, Prentice-Hall of India, 1st edition, 2003.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Classify machine learning algorithms and approaches, and use Bayesian decision theory to determine the discriminant function for a two-class problem.
CO2	Apply linear regression models to predict the value of a continuous valued output given a training data consisting of univariate/multivariate input features.
CO3	Apply learning algorithms based on Clustering to perform dimensionality reduction.
CO4	Analyse the time and space complexity using density estimation, classification and regression of non parametric approaches.
CO5	Apply different learning algorithms using linear discriminants from a given labelled training sample.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	3	1				1						2
	2		2	1			1	2						2
	3	2	2					1						2
	4		2	2										2
	5	1	2											2
	Avg.	**1.6**	**2.2**	**1.3**			**1**	**1.3**						**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

OPTICAL FIBER COMMUNICATION

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE11	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Understand the fundamentals of optical communication system.
2.	Analyze the propagation of light through optical fiber, the losses that occur in the optical fiber, and system design
3.	Analyze and evaluate the performance of optical fiber communication systems, focusing on key metrics such as bit error rate (BER), signal-to-noise ratio (SNR), and power budget.
4.	Understand the various components and devices used in optical fiber communication systems, such as light sources optical amplifiers, photodetectors, and modulators

UNIT I

Introduction: The evolution of fiber optic systems, elements of an optical fiber transmission link, advantages of optical fiber communication, applications.

Optical Laws: Ray theory transmission, total internal reflection acceptance angle, numerical aperture and skew rays.

Electromagnetic Analysis: Electromagnetic mode theory and propagation, single mode and multimode fibers, TE and TM modes, b-V curves.

Optical fibers: Types of fiber based on structure, Fiber material, fiber cables and fiber fabrication.

10 Hours

UNIT II

Transmission Characteristic of Optical Fiber

Attenuation: Absorption, scattering losses, bending losses.

Dispersion: Pulse broadening, Modal dispersion, bit rate-length product, waveguide dispersion, material dispersion and polarization Mode dispersion.

Optimization of Fiber: Dispersion shifted and dispersion flattened fibers, fractional power in the core, single mode fiber cut-off wavelength and mode field diameter.

8 Hours

UNIT III
Optical Sources and Power launching and Coupling **Optical Sources**: sources for optical fiber communication, light emitting diode, internal and external quantum efficiencies, LED characteristics, LASER diode and Threshold condition. **Power launching and coupling**: Source to fiber power launching, Lensing schemes, LED coupling to single mode fibers, fiber splicing.
8 Hours

UNIT IV
Optical detectors and Receiver Operation **Optical Detectors:** Working principle and characteristics of detectors PIN and APD, noise analysis in detectors. **Receiver Operation**: Receiver structure, bit error rate of optical receivers, and receiver performance. **Power Budgeting of fiber link**: link power budget, rise time budget, transmission distance for single mode links
8 Hours

UNIT V
Optical Fiber Components and Optical Network **Optical fiber components:** Directional coupler, power splitter, WDM coupler, polarization controllers, fiber Bragg gratings, Mach Zehnder Interferometer, erbium doped fiber amplifier. **Optical Networks:** SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, Operational principle of WDM, WDM network elements and Architectures.
8 Hours

TEXT BOOKS		
1	Gerd Keiser	Optical Fiber Communication, 5th Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS		
1	G P Agarwal	“Fiber Optic Communication System”, 4th Ed, John Wiley and sons, 2010
2	J. M. Senior	"Optical Fiber Communication, Principles and Practice", 3rd edition, Prentice Hall of India, 1994.
3	G P Agarwal	“Fiber Optic Communication System”, 4th Ed, John Wiley and sons, 2010

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Design and analyze different types of optical fibers.
CO2	Analyze the mechanisms of signal transmission in optical fibers, such as attenuation and dispersion losses.
CO3	Design and analyze different types of optical sources (lasers, LEDs) used in fiber optic systems, and explain their characteristics.
CO4	Design and analyze various types of optical detectors used in fiber optic systems, and apply the design considerations for optical receivers.
CO5	Analyze different optical components and optical networks used in optical communication system.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2											2
	2	2	1											2
	3	2	1											2
	4	2	2											2
	5	2	1											2
	Avg.	**2**	**1.4**											**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

CRYPTOGRAPHY & NETWORK SECURITY

Contact Hours/ Week:	3(L)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE12	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the basic concept of Cryptography and Network Security along with their mathematical models.
2.	Analyze security issues, services, goals and mechanisms.
3.	Compare various key management and distribution protocols
4.	Analyze public key cryptosystems, authentication protocols and key agreement protocols
5.	Develop code to implement cryptographic algorithms

UNIT I

COMPUTER AND NETWORK SECURITY CONCEPTS: Computer Security concepts, The OSI Security Architecture, Security Attacks, Services and Mechanisms, A Model of Network Security.

SYMMETRIC CIPHERS: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machine, Steganography

10 Hours

UNIT II

BLOCK CIPHER AND THE DATA ENCRYPTION STANDARD: Traditional Block Cipher Structures, The Data Encryption Standard, DES Example, Strength of DES, Block Cipher Design principles.

ADVANCED ENCRYPTION STANDARDS: Finite field Arithmetic, AES Structure, AES Transformation

Functions, AES key Expansion, An AES Example, AES Implementation.

BLOCK CIPHER OPERATION: Multiple Encryption and triple DES, Electronic Code Book, Cipher Block

8 Hours

UNIT III

RANDOM BIT GENERATION AND STREAM CIPHERS: Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation using a block cipher, Stream Cipher, RC4.

ASYMMETRIC CIPHERS: Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Other Public Key Cryptosystems: Diffie-Hellman Key Exchange.

CRYPTOGRAPHIC DATAINTEGRITY ALGORITHMS: Cryptographic Hash Functions: Applications of Cryptographic hash functions, Two simple hash Functions, Secure Hash Algorithm
8 Hours
UNIT IV
MESSAGE AUTHENTICATION CODES: Authentication Requirements, Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, DIGITAL SIGNATURES: Digital Signatures, NIST Digital Signature Algorithm. KEY MANAGEMENT AND DISTRIBUTION: Symmetric Key distribution using Symmetric encryption, Symmetric Key distribution using Asymmetric encryption, Distribution of public keys,
8 Hours

UNIT V
TRANSPORT-LEVEL SECURITY: Web Security considerations, Transport Layer Security, HTTPS. **ELECTRONIC MAIL SECURITY:** Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security. **IP SECURITY**: Overview, IP Security Policy **Cybersecurity** : Overview & Cybersecurity Principles
8 Hours

TEXT BOOKS		
1	William Stallings.	Cryptography and Network Security, Seventh Edition, Prentice Hall of India, 2017
2.	Wenyuan Xu, Ruoxi Jia, Cliff Wang, and Shouhuai Xu	Principles of Cyber-Physical Systems Security: Foundations, Principles, and Applications, 1st Edition, 2017, Wiley-IEEE Press **ISBN-13:** 978-1119223648

REFERENCE BOOKS		
1	Charlie Kaufman, Radia Perlman, Mike Speciner,	Network Security: Private Communication in a Public World, 3th Edition, Pearson Education Asia,2022
2	AtulKahate	Cryptography and Network Security, Tata Mc GrawHill,4th Edition 2019

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of mathematics to perceive the foundations of Cryptography and network security and explain the security principles.
CO2	Design solutions for problems on classical encryption techniques and illustrate symmetric and asymmetric cryptographic algorithms.
CO3	Develop solutions for problems on public key cryptosystems.
CO4	Analyze different authentication protocols, integrity protocols and key agreement protocols.
CO5	Apply the knowledge of engineering fundamentals to comprehend existing network security protocols.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	1	1		1								2
	2	2	2	1										2
	3	2	2	1		1								2
	4	2	2	1										2
	5	2	1											2
	Avg.	**2**	**1.6**	**1**		**1**								**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ANALOG VLSI DESIGN

Contact Hours/ Week:	3(L)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	NETE13	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Design CMOS Op-amp Amplifiers.
2.	Design Two stage OP amp circuits
3.	Introduce Switched capacitor circuits
4.	Design and analysis of ADC, DAC.

UNIT I

CMOS amplifiers: Current sources, current mirrors, amplifiers with active loads, CG and CD amplifiers, Cascode amplifiers and double Cascode and Folded Cascode amplifiers. Cascode and Wilson current mirrors,

10 Hours

UNIT II

Differential amplifiers: The MOS differential pair and their small signal operation. Non-ideal characteristics of Differential amplifiers, differential amplifiers with active load and frequency response differential amplifiers

8 Hours

UNIT III

CMOS amplifiers: Design of CMOS Op-amp, Compensation of op-amps, and two stage Op-amps and Cascode Op-amps.

8 Hours

UNIT IV

Comparators and Switched Capacitors: Open loop comparators, Performance improvement of Open loop comparators, High speed comparators, Switched Capacitors: Switched Capacitor circuits, Switched Capacitor amplifiers, Switched Capacitor amplifiers, Switched Capacitor filters.

8 Hours

UNIT V

Data converters: Digital to Analog converters: Introduction to Digital to analog converters, serial and parallel converters, resolution extension techniques. Analog to Digital converters- Introduction to Analog to digital converters, Serial ADC, Medium and High speed ADCs.

8 Hours

TEXT BOOKS		
1	Phillip E.Allen, Douglas R. Holberg	CMOS Analog Circuit Design, Oxfard University Press, 3rd Edition 2013
2	Adel S. Sedra, Kenneth Carless Smith	"Microelectronic Circuits", Oxford University. 7th Edition. 2017

REFERENCE BOOKS		
1	Hurst, and S. Lewis,	Analog Integrated Circuit Design, John Wiley & Sons, 1997 Analysis and Design of Analog Integrated Circuits, John Wiley and Sons, 6th Edition, 2013

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Design basic MOSFET amplifiers and write their transfer functions.
CO2	Design and Analyze the Differential amplifiers with active loads
CO3	Analyze and develop 2 stage Differential amplifiers for the given specifications.
CO4	Analyze and differentiate the performance of RC filters to Switched capacitor filters.
CO5	Design of ADC and DAC using two stage Opamp circuits

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2	2									2	
	2	2	2	2									2	
	3	2	2	2									2	
	4	2	2	2									2	
	5	2	2	2									2	
	Avg.	**2**	**2**	**2**									**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

RESEARCH METHODOLOGY AND IPR

Contact Hours/ Week	:	2(L)+0(T)+0(P)	Credits:	2
Total Lecture Hours	:	28	CIE Marks:	0
Subject Code	:	NSH09	SEE Marks:	0

Course objectives:
This course will enable students to:

1.	Understand the knowledge on basics of research and its types.
2.	Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
3.	Acquire the knowledge of Ethics in Engineering Research.
4.	Know the concepts of Intellectual Property Rights in engineering.
5.	Acquire the knowledge to apply for the granting patents and its procedure.

UNIT-I

Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

6 Hours.

UNIT-II

Research Problem: Effective literature studies approaches, analysis Plagiarism, and Research ethics.

6 Hours.

UNIT-III

Technical Writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

6 Hours.

UNIT-IV

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

6 Hours.

UNIT-V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

6 Hours.

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Identify based on the knowledge the basics of research and its types.
CO2	:	Apply knowledge to write Literature Review, Technical Reading, Attributions and Citations.
CO3	:	Follows the knowledge of Ethics in Engineering Research
CO4	:	Apply the concepts of Intellectual Property Rights in engineering
CO5	:	Apply IPR knowledge for the granting patents and its procedure for new innovative product for grants.

TextBooks:

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Wayne Goddard and Stuart Melville	Research methodology: an introduction, 2nd Edition, 2014, Juta Academic Lt.D. ISBN 9780702156601.
2.	Stuart Melville and Wayne Goddard	Research methodology: an introduction for science & engineering students, 2nd Edition, Juta Academic,
2.	Ranjit Kumar	Research Methodology: A Step by Step Guide for beginners, 4th Edition, SAGE Publications India Pvt Ltd, 2023, ISBN: 9789351501336

ReferenceBook:

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	T. Ramappa	Intellectual Property Rights Under WTO", S. Chand, 2008
2.	Robert P. Merges, Peter S. Menell, Mark A. Lemley	Intellectual Property in New Technological Age", 2016.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	3	3		2							3	3
	2	3	3	3		2							3	3
	3	3	3	3		2							3	3
	4	3	3	3		2							3	3
	5	3	3	3		2							3	3
	Avg.	**3**	**3**	**3**		**2**							**3**	**3**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation