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

Final Year (Sem VII & Sem VIII) Syllabus (2026 'NEP&Autonomy' Scheme)

Batch [2023-2027]

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

Semester VII Scheme								
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
		Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Programme Core Course (PCC)	5G and 6G Technologies	3	2	-	3	1	-	4
Programme Core Course (PCC)	Optical Fiber Communication	3	2	-	3	1	-	4
Programme Elective Course(PEC)	Program Elective Course - IV	3	2	-	3	1	-	4
Programme Elective Course(PEC)	Program Elective Course - V	3	2	-	3	1	-	4
Project	Major Project - II	-	4	-	-	2	-	2
Research Methodology	Research Methodology	4	-	-	4	-	-	4
TOTAL		**16**	**12**	**-**	**16**	**6**	**-**	**22**

Program Elective Course -IV

Course Code	Name Of The Subject
26ETPE741	Network Management in Telecommunication
26ETPE742	Wireless Network
26ETPE743	Cloud Computing & Security

Program Elective Course -V

Course Code	Name Of The Subject
26ETPE751	Radar & Satellite Communication
26ETPE752	Advance DSP
26ETPE753	Quantum Communication

Semester VII Marks Scheme							
Course Code	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
Programme Core Course (PCC)	5G and 6G Technologies	60	20	20	25	25	150
Programme Core Course (PCC)	Optical Fiber Communication	60	20	20	25	25	150
Programme Elective Course(PEC)	Program Elective Course - IV	60	20	20	25	25	150
Programme Elective Course(PEC)	Program Elective Course - V	60	20	20	25	25	150
Project	Major Project - II	-	-	-	50	100	150
Research Methodology	Research Methodology	-	-	50	50	-	100
						Total Marks	**850**

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

Semester VIII Scheme								
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
		Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Internship	Internship	-	-	-	-	-	-	12
Programme Core Course (PCC)	Online Mooc Course I*	-	-	-	-	-	-	2
Programme Core Course (PCC)	Online Mooc Course II*	-	-	-	-	-	-	2
TOTAL								**16**

***can be changed with the permission of Head of the Department based on availability of MOOC Courses**

Semester VIII Marks Scheme							
Course Code	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
Internship	Internship	-	-	-	-	-	200
Programme Core Course (PCC)	Online Mooc Course I*	-	-	-	-	-	100
Programme Core Course (PCC)	Online Mooc Course II*	-	-	-	-	-	100
						Total Marks	**400**

***can be changed with the permission of Head of the Department based on availability of MOOC Courses**

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

Proposed Mooc Courses

Course Type	Online Mooc Courses
Online Mooc Course	GRC & DPDPA
Online Mooc Course	Cooling Technologies/Green Technologies

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: 5G&6G Technologies

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC71	5G & 6G Technologies	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

5G&6G Technologies Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC71	5G&6G Technologies	03	--	---	03	--	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPC71	5G&6G Technologies	20	20	60	-	-	100

Course Prerequisite: Basics of Communication Engineering	
Course Objectives:	
1	To introduce fundamental concepts of cellular communication systems and system design principles and to understand GSM architecture, its evolution.
2	To explain third and fourth generation mobile communication technologies.
3	To familiarize students with fifth-generation mobile communication requirements, use cases, and physical layer concepts.
4	To understand 5G network architecture, including core and radio access network components.
5	To expose students to advanced 5G candidate technologies
6	To introduce emerging sixth-generation (6G) wireless communication concepts.

Course Outcomes: After successful completion of the course students will be able to:	
1	Explain fundamental concepts of cellular communication systems and GSM architecture
2	Analyze GSM evolution and 3G technologies including UMTS and CDMA2000
3	Describe LTE architecture, protocols, and advanced 4G concepts.
4	Understand 5G requirements, use cases, and physical layer technologies
5	Analyze 5G core and RAN architectures
6	Evaluate advanced 5G candidate technologies and emerging 6G concepts

5G&6G Technologies

Module		**Content**	**Hrs**
1		**Fundamentals of Mobile Communications and GSM**	**10**
	1.1	**Cellular Concept and System Design Fundamentals** • Evolution of cellular technology • Cellular concept and frequency reuse • Channel assignment strategies • Handoff mechanisms • Interference analysis and system capacity • Trunking theory and Grade of Service (GoS) • Techniques for improving coverage and capacity in cellular systems • Numerical problems related to cellular system design	
	1.2	**Global System for Mobile Communication (GSM)** • GSM network architecture • GSM air interface specifications • GSM signaling protocol architecture • GSM identifiers • GSM logical, physical, and traffic channels • Authentication and security in GSM • Handoff procedures in GSM	

	1.3	**GSM Evolution** • GPRS architecture and operation • EDGE architecture • Radio interface specifications of GPRS and EDGE	
2		**3G & 4G Technologies**	**06**
	2.1	**Universal Mobile Telecommunication System (UMTS) &CDMA2000** • UMTS network architecture • Air interface specifications • CDMA2000 architecture overview	
	2.2	**Long Term Evolution (LTE)** • LTE network architecture • Power control mechanisms • Handover procedures in LTE • Limitations and disadvantages of 4G systems	
	2.3	**Advanced 4G Concepts** • **Multi-Antenna Techniques:** Smart antennas, Multiple Input Multiple Output (MIMO) systems • **Cognitive Radio:** Architecture and spectrum sensing techniques • **Software Defined Radio (SDR):** Architecture, components, and applications	
3		**5G Technology**	**06**
	3.1	**Introduction to 5G** • Features and performance requirements of 5G • 5G service categories: eMBB, URLLC, and mMTC • 5G use cases: o Robotic surgery o Autonomous and driverless vehicles o Industrial Internet of Things (IIoT) o Tactile Internet o 5G-IoT applications o Augmented Reality (AR) and Virtual Reality (VR) in 5G	

	3.2	**New Radio (NR) Physical Layer** • Waveforms used in 5G NR • Modulation schemes • Channel coding techniques	
4		**5G Network Architecture**	**08**
	4.1	**5G Core Network** • Control and User Plane Separation (CUPS) architecture: Migration from 4G core to 5G core • 5G reference point architecture • Functions of core network elements: AMF, SMF, UPF, PCF, UDM • Service-Based Architecture (SBA) • Functions of SBA components: NRF, AF, AUSF, NEF, NSSF, Network Function Virtualization(NFV)	
	4.2	**5G Radio Access Network (RAN)** • Frequency bands and channel bandwidths supported by 5G NR • 5G NR numerologies • Subcarrier spacing and resource block structure • Carrier Aggregation (CA) • Bandwidth Parts (BWP)	
5		**5G Candidate Technologies**	**06**
	5.1	• Millimeter-wave communication • Massive multiple antenna technologies (Massive MIMO) • Non-Orthogonal Multiple Access (NOMA) • Heterogeneous networks: small cells and device-to-device (D2D) communication	
6		**Introduction to 6G Technologies**	**03**
	6.1	• Vision and motivation for 6G • 6G use cases and applications • Terahertz (THz) communication • AI-native wireless networks • Intelligent Reflecting Surfaces (IRS)	

		• Integration of sensing, communication, and computing	
Total			**39**
Textbooks:			
1	T. L. Singal "wireless communications", Mc Graw Hill Education.		
2	Theodore S. Rappaport "wireless communications - principles and practice", Pearson, Second edition.		
3	Andreas F. Molisch "wireless communications" WileyIndia Pvt. Ltd., Second edition.		
4	Sassan Ahmadi , "5G NR, Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards", Academic Press		
5	Ajit Singh "5G Technologies, Architecture, Design, Implementation, Security, Challenges," kindle edition.		
6	Evolution of interface towards 5G, NPTEL		
7	AFIF OSSEIRAN Ericsson Jose F. Montserrat Patrick Marsch, "5G Mobile and Wireless Communications Technology"		
Reference Books:			
1	Upena Dalal "Wireless and Mobile Communication", Oxford university Press		
2	Vijay K. Garg "Wireless Communications and Networking", Morgan–Kaufmann series in Networking-Elsevier.		
3	J. H. Reed, Software-Defined Radio, Prentice-Hall, 2002		
4	W. C. Y. Lee, Mobile Communication, Wiley		
5	David Tse, Pramod Viswanath "Fundamentals of Wireless Communication" published by Cambridge University Press		
Web Resources:			
	https://www.3gpp.org/specifications-technologies **https://nptel.ac.in/courses/108105134**		

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	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10
2.	Wins in the event/competition/hackathon	10
3.	Content beyond syllabus presentation	10
4.	Creating Proof of concept	10
5.	Mini Project / Extra Experiments/ Virtual Lab	10
6.	GATE Based Assignment test/Tutorials etc	10
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5
8.	Multiple Choice Questions (Quiz)	5

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.

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

5G&6G Technologies Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPCL71	5G&6G Technologies Laboratory	--	02	---	--	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPCL71	5G&6G Technologies Laboratory	--	--	--	25	25	50

Lab Prerequisite: Basics of Communication Engineering, MATLAB/ Scilab/Python programming

Lab Objectives:

1	Analyze the performance of cellular systems by evaluating the effects of cluster size, sectorization, and interference (C/I ratio) on communication quality.
2	Understand and compare different radio propagation models and channel effects (diffraction, fading, multipath) and their impact on coverage and signal quality.
3	Apply Erlang traffic models to analyze call blocking probability, delay, and system capacity in wireless networks.

4	Design and simulate communication systems such as GSM, CDMA, OFDM/OFDMA, and MIMO using MATLAB.
5	Explore modern wireless technologies including Massive MIMO, millimeter-wave communication, beamforming, and 5G NR concepts.
6	Develop proficiency in MATLAB for modeling, simulation, visualization, and performance evaluation of wireless communication systems.
Lab Outcomes: After successful completion of the laboratory students will be able to:	
1	Analyze and interpret the performance of cellular and wireless communication systems using key metrics such as C/I ratio, BER, SNR, and channel capacity.
2	Develop models for wireless communication systems including GSM, CDMA, OFDM, MIMO, and evaluate their behavior under various channel conditions.
3	Design and evaluate different communication techniques such as spread spectrum, diversity schemes, and detection algorithms to improve system performance.
4	Apply theoretical concepts of propagation, traffic engineering, and signal processing to practical simulation scenarios.
5	Demonstrate understanding of emerging technologies such as Massive MIMO, mmWave communication, and 5G NR numerology.
6	Utilize MATLAB and related tools effectively for simulation, visualization, and analysis of modern wireless communication systems.

Suggested Experiment List : Course teachers can design their own experiments based on the prescribed syllabus on the following guidelines.	
1	To simulate the impact of cluster size (N) on Carrier-to-Interference (C/I) ratio in a cellular system and evaluate the corresponding voice quality.
2	To implement and compare different radio propagation models (Free Space, Okumura-Hata, COST-231) and analyze their effect on coverage distance .
3	To simulate Erlang B and Erlang C models and analyze the effect of traffic delay on call blocking and waiting probability.
4	To simulate sectorized cellular systems (3-sector and 6-sector) in MATLAB and perform worst-case analysis of Carrier-to-Interference (C/I) ratio for cluster sizes N = 7 and N = 4.

5	To generate and analyze pseudo-noise (PN) sequences using linear feedback shift registers (LFSR) for CDMA systems
6	To generate orthogonal Walsh codes using Hadamard matrices and verify their orthogonality properties.
7	To simulate knife-edge diffraction and plot diffraction gain as a function of Fresnel diffraction parameter
8	To simulate a CDMA system with multipath fading and evaluate the performance improvement using a RAKE receiver in terms of Bit Error Rate (BER).
9	To simulate Multiple-Input Multiple-Output (MIMO) systems and plot channel capacity versus Signal-to-Noise Ratio (SNR) for different antenna configurations.
10	To design and simulate an OFDM/OFDMA communication system and analyze system performance under noise and fading conditions.
11	To simulate a complete GSM communication system and evaluate system performance in terms of BER under noisy channel conditions
12	To simulate a complete CDMA communication system and evaluate system performance in terms of BER under noisy channel conditions.
13	To implement energy detection-based spectrum sensing and evaluate detection probability under varying SNR conditions.
14	To simulate a MIMO communication system using different detection techniques (ZF, MMSE) and analyze BER performance
15	To simulate a Massive MIMO system and analyze the performance of beamforming techniques (digital and hybrid) in terms of SNR and spectral efficiency.
16	To implement a millimeter-wave (mmWave) channel model and analyze path loss, blockage effects, and directional transmission characteristics.
17	To simulate 5G New Radio (NR) numerology and analyze the impact of different subcarrier spacing on latency and bandwidth.
18	To simulate 5G New Radio (NR) numerology in MATLAB and analyze the impact of different subcarrier spacing on latency and bandwidth.

19	To design and develop a mobile application for visualization or control of wireless communication system parameters (e.g., SNR, BER plots) using MATLAB App Designer or external frameworks.

Term work	
1	At least 10 experiments covering the entire syllabus and design of one mobile APP is compulsory for Term work sanction.
2	The experiments can be conducted with the help of simulation tools (preferably open source) / communication softwares like NETSim/ MATLAB and breadboard and components.
3	Teachers should refer to the suggested list of experiments and can design additional experiments to acquire practical design skills.
4	Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. **Experiments : 20 Marks** **Mobile App development : 5 Marks** **Total : 25 Marks**

Practical & Oral Exam	
1	Based on the list of experiments, a practical exam should be conducted.
2	**Practical : 15 Marks** **Viva: 10 Marks** **Total : 25 Marks**

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: Optical Fiber Communication

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPC72	Optical Fiber Communication	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

Optical Fiber Communication Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tutorial	Total
26ETPC72	Optical Fiber Communication	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
26ETPC72	Optical Fiber Communication	20	20	60	---	---	100

Prerequisite: Electronic Devices & Circuits
Communication Engineering
Electromagnetics and Transmission lines

Course Objectives: Students will be learning,

1	To develop understanding of fundamental principles, components, and architecture of optical fiber communication systems.
2	To analyze transmission characteristics such as attenuation and dispersion, and explore suitable mitigation techniques.
3	To study and evaluate the performance of optical sources, detectors, and amplifiers used in high-speed communication systems.
4	To understand and compare various optical multiplexing techniques and networking architectures.
5	To expose students to emerging trends such as FTTH, WDM, and next-generation optical communication systems.

Course Outcomes: Students should be able to,	
1.	Explain the working principles of optical fiber communication systems, including light propagation and fiber structures.
2.	Analyze attenuation and dispersion effects in optical fibers and evaluate their impact on system performance.
3.	Design and evaluate point-to-point optical fiber communication links using power and rise-time budget analysis.
4.	Apply optical multiplexing and networking techniques (e.g., WDM, FTTH) in practical communication scenarios.
5.	Assess emerging optical communication technologies and their role in modern high-speed networks such as 5G/6G.

Module		Content	Hrs
1.		**Introduction and Basics of Optical fiber communication**	**08**
	1.1	History, need, advantages and disadvantages of optical fiber communication, Optical Bands and Windows, Structure of optical fiber, Fiber optic applications.	
	1.2	Light Propagation in optical Fiber, Total internal reflection, Numerical aperture and acceptance angle, Step index and graded index fibers, Modes of propagation, Modes in optical fiber.	
	1.3	Fiber Fabrication techniques, Fiber Joints, Connectors and Splices.	
2.		**Transmission Characteristic of Optical Fiber**	**06**
	2.1	Transmission losses in the optical fiber: Attenuation mechanisms (Absorption losses, Radiation losses and linear scattering losses), Measurement of attenuation, OTDR.	
	2.2	Dispersion in Optical fiber, Types of Dispersion and Dispersion compensation techniques, Dispersion-shifted and flattened fibers	
3.		**Optical Sources and Detectors**	**06**
	3.1	Working principle and characteristics of optical sources (LED, LASER, VCEL)	

	3.2	Working principle and characteristics of Optical detectors (PIN, APD)	
4.		**Optical Fiber Communication Systems**	**06**
	4.1	Optical receivers and their performance. Noise in optical receivers Point to point links system considerations, link power budget, and rise time budget	
	4.2	Basic concept of nonlinear effects in optical fibers: Self-Phase Modulation (SPM), Cross Phase Modulation (XPM) , Four Wave Mixing (FWM), Optical solitons.	
5.		**Optical Network Components**	**05**
	5.1	Fiber Optic Devices: Couplers, isolators, circulators, multiplexers, Optical filters, fiber gratings, and switches, wavelength converters, Optical amplifiers, Add-drop multiplexers.	
6.		**Emerging Trends and Applications**	**08**
	6.1	Optical Fiber in 5G and Future 6G Networks Role of optical fiber as the backbone of 5G networks, Fronthaul and backhaul concepts, Need for high bandwidth and low latency in future 6G systems.	
	6.2	Fiber to the Home (FTTH) and Broadband Access Basic concept of FTTH and passive optical networks (PON), Importance of FTTH for high-speed internet and digital services, Applications in smart cities and digital connectivity	
	6.3	Wavelength Division Multiplexing (WDM): Principle of WDM, Enhancement of fiber capacity using multiple wavelengths, Application in long-haul optical communication systems.	
	6.4	Sustainable and Energy-Efficient Optical Communication: Optical fiber as a green communication medium, Energy efficiency advantages over conventional systems	
Total			**39**

Textbooks:	
1 .	John M. Senior, ―Optical Fiber Communication, Prentice Hall of India Publication, Chicago, 3rd Edition, 2013
2 .	Gerd Keiser, ―Optical Fiber Communication, Mc-Graw Hill Publication, Singapore, 4th Edition, 2012.
3 .	T.L.Singhal –Optical Fiber Communication Principles and Applications, Cambridge Press, Edition 2016.
4.	Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, Optical Networks: A Practical Perspective, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
5.	Ivan B. Djordjevin,__Advanced Optical and Wireless Communication Systems,Springer,Edition 2018
6.	Debasish Datta,Optical Networks,Oxword Cambridge University Press,2021
7.	Kaushal, H.Jain, V.K. Kar,S, Free Space Optical Communication ,Springer,2017
Reference Books:	
1.	G Agarwal, Fiber optic communication Systems‖, John Wiley and Sons, 5th Edition, New York 2022
2.	Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perespective‖, Elsevier Publication Elsevier India Pvt.ltd, 3rd Edition, 2010
3.	P.E.Green, Optical Networks‖, Prentice Hall, 1994.
4.	Biswanath Mukherjee, ―Optical Communication Networks‖, McGraw-Hill, 1997.
5.	Le Nguyen Binh, ―Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink‖, CRC Press, 2010
6.	Harry G. Parros, Communication Oriented Networks, Wiley
7.	G. Agarwal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Edition, New York, 2014.

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

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.

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

Optical Fiber Communication Lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tutorial	Total
26ETPCL72	Optical Fiber Communication Lab	--	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*					
26ETPCL72	Optical Fiber Communication Lab	--	--	--	--	25	25	50

Prerequisite:	Electronic Devices and circuits ,Communication Engineering,Electromagnetics and Transmission
Lab Objectives:	
1	To make students understand and familiarize with different types of optical fibers.
2	To enable the students to measure the fundamental parameters such as numerical aperture, losses, dispersion for single mode and multimode fibers.
3	Expose the students to characterize various sources and detectors.
4	To enable the students to analyze point-to-point optical fiber link.
5	To understand the basic concepts of multiplexing in optical systems.

Lab Outcomes: Students should able to	
1.	To identify the different types of fibers and understand their properties.
2.	To measure the losses, dispersion and compensation techniques in all optical networks.
3.	To design all optical network with amplifiers and modern lasers for error free transmission
4.	To implement a point-to-point optical fiber network, WDM or DWDM Network.
5.	To develop power budget and rise time budget for a given optical fiber link.

Sr. No	**Name of the Experiment** Suggested Experiments: Students are required to complete at least 8 experiments and present one case study.
1.	Measurement of Numerical Aperture of Optical Fiber.
2.	Measurement of attenuation characteristics of Fiber for different lengths.
3.	Measurement of coupling losses in optical fibers.
4.	Measurement of bending losses in optical fibers.
5.	Simulation and study of DWDM without Dispersion Compensated Fiber using Optisystem.
6.	Simulation and study of DWDM with Dispersion Compensated Fiber using Optisystem.
7.	Simulation and Investigation of the L-I curves and spectrum of a FP Laser using Optisystem.
8.	Simulation and Investigation of the characteristics of PIN Photodiode using Optisystem.
9.	Determination of power budget (link loss) for a given optical link.
10.	Determination of rise time budget (data rate) for a given optical link.
11.	Case studies on recent trends in optical communication.
Term work	
1.	Term work should be graded based on at least 8 experiments and one case study.
2.	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3.	TW marks: 25 Experiments: 20 marks Case study: 05-marks

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: Network Management in Telecommunication

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE741	Network Management in Telecommunication	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

Network Management in Telecommunication(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/ PR	Tut	Total
26ETPE741	Network Management in Telecommunication	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPE741	Network Management in Telecommunication	20	20	60	---	---	100

Course Prerequisite: Basic knowledge of computer networks, including OSI and TCP/IP models, network protocols, IP addressing, and fundamental concepts of data communication.	
Course Objectives:	
1	To provide a basic understanding of telecommunication network design principles and network management concepts.
2	To introduce the OSI Network Management model, including its layers, functions, and management protocols.
3	To provide an understanding of Internet network management using SNMP, including its models, versions (SNMPv1, SNMPv2, and SNMPv3), security mechanisms, and remote network monitoring concepts.
4	To provide a clear understanding of Telecommunication Management Networks (TMN), including their framework, models, and management services.
5	To provide knowledge of network management systems, tools, and applications for effective monitoring and control of networks.
6	To understand broadband networks, ATM technology, and ATM network management principles.

Course Outcomes: After successful completion of the course students will be able to:	
1	Explain fundamental concepts of telecommunication network management, including network management goals, architectures, and standards.
2	Describe the OSI network management architecture, including organizational, information, communication, and functional models.
3	Explain Internet network management using SNMP by detailing its architecture, operations, versions (SNMPv1, SNMPv2, and SNMPv3), security mechanisms, and RMON concepts.
4	Describe Telecommunication Management Network (TMN) architecture, including its functional and conceptual models and service management concepts.
5	Analyse network management systems by applying FCAPS functions and key techniques for monitoring, reporting, event correlation, and policy-based management.
6	Apply concepts of broadband and ATM network management, including ATM architecture, management models, and standard management interfaces (M1–M4), to analyze telecommunication network operations.

Network Management in Telecommunication

Module	Content	Hrs
1	**Introduction to Telecommunication Network Management**	**04**
	1.1 Introduction to Network Management; Case Histories on Network Management; System and Service Management; Challenges of an IT Manager; Need for NMS; **1.2** Goal of Network Management. Network Management architecture and Organization; Network Management perspectives; Network Management Standards.	
2	**OSI Network Management**	**07**
	2.1 OSI Network Management Model. **2.2** OSI Organizational Model, Information Model **2.3** OSI Communication Model and Functional Model.	

	2.4 OSI Management protocol and services (CMIP, CMISE) **2.5** Introduction to ASN.1and BER (TLV format).	
3	**Internet Management**	**10**
	3.1 Introduction to Internet Management: Simple Network Management Protocol (SNMP); Structure of Management Information (SMI); Management Information Base (MIB); SNMP message encoding using ASN.1 and BER (TLV format). **3.2** SNMP v1: SNMP v1 architecture; SNMP Communication Model; Administrative model; SNMP Protocol Specifications and Operations. **3.3** SNMPv2: Major changes in SNMPv2; SNMPv2 Architecture; SNMPv2 management information base; SNMPv2 protocol; Compatibility with SNMPv1. **3.4** SNMPv3: Key Features and SNMPv3 architecture, SNMPv3 message format, SNMPv3 security; User-based Security Model, Access control (VACM); SNMPv3 applications **3.5** Remote Monitoring: Introduction to RMON, and comparison of RMON 1 and RMON 2.	
4	**Telecommunication Management Networks (TMN)**	**05**
	4.1 Definition and need for Telecommunication Management Network (TMN); TMN framework; TMN functional model. **4.2** TMN conceptual model; mapping of OSI network management functionality within TMN. **4.3** TMN management services architecture; TMN implementation concepts; overview of eTOM as a business process framework for telecom service management.	
5	**Network Management Tools and Applications**	**09**

	5.1 Network Management System (NMS): Functional requirements; NMS client–server architecture; centralized and distributed management approaches. **5.2** Network Operations Center (NOC): Role and functions of a NOC; basic NOC architecture and workflow; fault detection, alarms, escalation; key performance indicators (KPIs). **5.3** FCAPS Management: Application of fault, configuration, accounting, performance, and security management in practical network environments; proactive vs reactive management. **5.4** Event Correlation Techniques: Rule-based reasoning, Model-based reasoning, Case-based reasoning, Codebook, State Transition Graph model and Finite State Machine model **5.5** Policy-based Management and Service Level Management	
6	**Broadband Network Management**	**04**
	6.1 Broadband networks and services; ATM technology – virtual path (VP), virtual channel (VC), ATM cells/packets, integrated services, ATM LAN emulation. **6.2** ATM network management – ATM network reference model; integrated local management interface. **6.3** ATM management information base (MIB); management interfaces M1, M2, M3, and M4.	
	Total	**39**

Textbooks:	
1	Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw-Hill Education.

2	Andrew S. Tanenbaum, David J. Wetherall, *Computer Networks*, 5th Edition, Pearson Education
3	Benoit Claise, Ralf Wolter, Network Management: Accounting and Performance Strategies, Cisco Press.
4	J. Richard Burke, Network Management: Concepts and Practice – A Hands-On Approach, Pearson Education.
5	Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media.
6	David Medhi, Karthik Ramasamy, Network Routing: Algorithms, Protocols, and Architectures, 2nd Edition, Morgan Kaufmann.
7	A. D. Green, Network Management: Principles and Practice, Addison-Wesley, 1993.
Access to software and virtual labs:	
1	https://www.ibm.com/think/topics/network-operations-center
2	https://www.techtarget.com/searchnetworking/definition/network-operations-center
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 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.

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

Network Management in Telecommunication Lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
26ETPEL741	Network Management in Telecommunication	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
26ETPEL741	Network Management in Telecommunication	--	--	--	--	25	25	50

Lab Objectives:	
1	To introduce packet capture and traffic monitoring techniques using command-line and graphical tools
2	To measure and analyze network performance parameters such as throughput, delay, packet loss, and bandwidth utilization.
3	To perform network discovery, auditing, and service identification using scanning tools
4	To implement fault, availability, and centralized monitoring using industry-standard network management systems.

5	To implement fault, availability, and centralized monitoring using industry-standard network management systems.
6	To compare and evaluate multiple networks monitoring tools based on performance, usability, and reporting features.
Laboratory Outcomes:	
1	Capture and analyze network traffic to identify protocols and basic traffic characteristics.
2	Compute network performance metrics including delay, packet loss, throughput, and bandwidth utilization.
3	Discover network devices and services and perform basic network audits.
4	Collect, store, and visualize SNMP-based network statistics using monitoring and graphing tools.
5	Monitor network availability, faults, and events using centralized network management platforms.
6	Compare network monitoring tools and assess their effectiveness for real-world network management tasks.

List of Suggested Experiments:

Sr. No	List of Experiments	Hrs
01	Packet Capture & Simple Traffic Monitoring using Wireshark • Capture packets on a LAN • Analyse TCP/UDP, identify protocols, extract basic stats Tools: **Wireshark** (opens many monitoring possibilities)	02

02	Traffic Monitoring with tcpdump& Baseline Traffic Metrics
	• Capture traffic via command line
	• Calculate:
	  • Packets per second
	  • Byte counts over time
	  • Throughput (kbps/Mbps)
	Tools: tcpdump, Linux CLI
		02

03	Network Performance Calculation (Delay & Packet Loss)
	• Active ping tests
	• Compute:
	  • Average Delay
	  • Loss % from packet capture
	Concepts: RTT, latency measurement
		02

04	Bandwidth Utilization Monitoring using iftop, nload • Real-time bandwidth usage display • Graph/interpret traffic patterns Tools: iftop, nload	02
05	LAN Scanner & Network Audit with Nmap • Discover hosts & open ports • Identify services running Tools**:** Nmap / Zenmap (graphical)	02
06	Monitoring with SNMP – Basics • Configure SNMP agent on a Linux host • Use SNMP queries to poll basic metrics • Record interface counters, CPU utilization Tools: SNMP utilities (snmpwalk, snmpget)	02
07	Plotting Network Statistics using MRTG / RRD • Collect SNMP stats periodically • Visualize interface traffic trends Tools: MRTG**,** RRDTool	02

08	Graphical Monitoring using Cacti • Discover devices using SNMP • Generate traffic graphs • Extract average/peak throughput values Tools: Cacti	02
09	. Real-Time Fault & Availability Monitoring with Nagios/Icinga • Monitor host availability • Configure alerts for status changes Tools: Nagios Core / Icinga	02
10	Network Device Discovery & Map using Netdisco • Discover network devices (switches/routers) • Show connectivity maps Tool: Netdisco .	02
11	. Centralised Monitoring using Zabbix • Add host(s) • Monitor: • SNMP metrics • Network uptime • Traffic history Tool: Zabbix	02
12	Flow-Based Traffic Measurement (NetFlow / sFlow) • Collect flow records (e.g., with sample tools) • Analyse traffic distribution Concepts: NetFlow/sFlow traffic analysis	02
13	Syslog Based Monitoring & Analysis • Configure remote syslog • Filter/interpret significant events Tools: rsyslog / syslog-ng	02
14	Combined Dashboard with OpenNMS / LibreNMS • Import SNMP & syslog sources • Visualise metrics on a central dashboard Tools: Open NMS/LibreNMS	02

15	. Comparative Performance Evaluation Across Tools • Select any *3 monitoring tools* (e.g., Cacti, Zabbix, Nagios) • Compare: • Accuracy of traffic metrics • Ease of use • Graphing capabilities	02

The laboratory experiments shall be performed using the above-mentioned open-source tools; however, any other suitable software or tools may also be used to carry out the specified experiments.

Term Work:	
1	Term work should consist of 9 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: 5 marks, Micro Project/Case study/Assignment/Tutorial: 5 marks)

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: Wireless Networks

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE742	Wireless Networks	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

Wireless Networks

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26NETPE 742	Wireless Networks	03	--	---	03	--	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPE742	Wireless Networks	20	20	60	-	-	100

Course Prerequisite: Basics of Communication Engineering	
Course Objectives:	
1	To analyze the fundamental architecture, design issues, standards and classification of wireless networks.
2	To compare Personal Area Network (PAN) technologies such as ZigBee, Bluetooth, UWB, NFC and 6LoWPAN.
3	To classify different LAN topologies and technologies and ad hoc networks.
4	To classify network protocols, ad hoc vehicle networks and Wireless MANs.
5	To apply Wireless sensor networks concepts to develop IoT applications.

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 Outcomes: After successful completion of the course students will be able to:	
1	Explain fundamental architecture, design issues and standards of wireless networks.
2	Compare different types of Personal Area Network (PAN) technologies such as ZigBee, Bluetooth, UWB, NFC and 6LoWPAN.
3	Analyse different LAN topologies and technologies.
4	Compare various types of wireless adhoc networks, vehicular networks and MANET and their MAC protocols.
5	Understand the basic network architecture of Wireless sensor networks concepts to develop IOT applications.

Wireless Networks

Module		**Content**	**Hrs**
1		**Overview of wireless communication and networks**	05
	1.1	**Wireless Networks:** Architecture, Classifications, Communication Problems, Networking issues and Wireless Communication and Networking Standards: Role of IEEE, ITU, and 3GPP; Overview of IEEE 802.11, 802.15.4, Cellular Standards (2G–5G), and the need for standardization.	
	1.2	**Wireless Body Area Networks:** Properties, Network Architecture, Network components and Applications	
2		**Wireless Personal Area Networks**	10
	2.1	**Bluetooth (802.15.1):** Radio Specifications, Protocol Stack, Link Types, Security, Topologies, Applications.	
	2.2	**ZigBee(802.15.4):** Radio Specifications, Components, Topologies, Protocol Stack, Applications.	
	2.3	**RFID:** Radio Specifications, Architecture, Types and applications.	
	2.4	**Near Field Communication & UWB** (802.15.3 a): Introduction and working.	

	2.5	**6LoWPAN:** Features, Architecture, protocol stack and applications	
3		**Wireless Local Area and Wireless Metropolitan Network**	06
	3.1	Wireless Local Area Network: Equipment, Topologies, Technologies, Applications, Main features of IEEE802.11a,b,e, i and n	
	3.2	WMAN(IEEE802.16): Introduction, WMAN Network Architecture	
4		**Wireless Adhoc Networks**	06
	4.1	Wireless Adhoc Networks: Features, advantages & Applications, Mobile Adhoc Networks: Network Architecture, MAC Protocol.	
	4.2	Vehicular Adhoc Networks (VANETs): Characteristics, Protocols & Applications	
5		**Wireless Sensor Networks**	06
	5.1	Wireless Sensor Networks: Network Architecture, Design Considerations, Network Protocol Stack, and Applications	
	5.2	Wireless Mesh Network: Network architecture, Protocols, technologies & Applications	
6		**Internet of Things and Internet of everything**	06
	6.1	IOT Conceptual Frame work, Architecture, Technology & Examples. M2M Communication	
	6.2	Research issues in wireless networks	
		Total	**39**

Textbooks:	
1	Vijay K. Garg, Wireless Communications & Networking, *Wireless Communications & Networking*, 1st Edition, Morgan Kaufmann Series in Networking, Elsevier, 2007,
2	Sunilkumar S. Manvi and Mahabaleshwar S. Kakkasageri, *Wireless and Mobile Networks: Concepts and Protocols*, 2nd Edition, Wiley India Pvt. Ltd., 2016
3	Raj Kamal, *Internet of Things: Architecture and Design Principles*, 1st Edition, McGraw Hill Education, 2017.
4	Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, Pearson Education.
Reference Books:	
1	Upena Dalal "Wireless and Mobile Communicationsǁ", Oxford university Press
2	Upena Dalal, *Wireless and Mobile Communications*, 1st Edition, Oxford University Press, 2009.
3	Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley Student Edition, 2007.
4	Cordeiro, C. de M., & Agrawal, D. P., *Ad Hoc and Sensor Networks: Theory and Applications*, 2nd Edition, World Scientific Publishing, 2011.
5	Stallings, W., *Wireless Communications and Networks*, 2nd Edition, Pearson / Prentice Hall, 2005

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	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/a MOOC	10
2.	Wins in the event/competition/hackathon	10
3.	Content beyond syllabus presentation	10
4.	Creating Proof of concept	10
5.	Mini Project / Extra Experiments/ Virtual Lab	10
6.	GATE Based Assignment test/Tutorials etc	10
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5
8.	Multiple Choice Questions (Quiz)	5

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.

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

Wireless Networks Lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
26ETPEL742	Wireless Networks Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Practical				Term Work	Pract & Oral	Total
		Internal Assessment		End Exam	Exam Duration (Hrs)			
		MidTest	CA*					
26ETPEL742	Wireless Networks Lab	--	--	--	--	25	25	50

Prerequisite:	1.Communication Networks 2. Communication Engineering
Lab Objectives:	
1	Explain the fundamental architecture, design issues, classifications, and standards of wireless networks.
2	Compare different Personal Area Network (PAN) technologies such as ZigBee, Bluetooth, UWB, NFC, and 6LoWPAN.
3	Analyze various Wireless LAN (WLAN) topologies, technologies, and performance parameters.
4	Compare and evaluate different wireless ad hoc networks, vehicular networks (VANETs), MANETs, and their MAC protocols.
5	Understand the architecture and operation of Wireless Sensor Networks (WSNs) and apply WSN concepts to IoT-based applications.

Lab Outcomes: Students should able to	
1	Analyze the architecture, classifications, standards, and communication issues of wireless networks.
2	Compare the characteristics and performance of PAN technologies including Bluetooth, ZigBee, NFC, UWB, and 6LoWPAN.
3	Evaluate the performance of WLANs using relevant wireless networking standards, protocols, and topologies.
4	Analyze the behaviour and performance of MANETs, VANETs, and other ad hoc wireless networks under different network conditions.
5	Design and simulate WSN/WBAN-based systems and apply them to IoT applications using appropriate software tools.

Suggested Experiments: Students are required to complete at least 8 experiments and present one case study.

Sr. No	**Name of the Experiment**
1	Overview of IEEE, ITU, and 3GPP Standards and Their Roles in Wireless Networking.
2	Simulation of a Wireless Body Area Network (WBAN) Architecture using NS-3 software.
3	Simulation of Physiological Sensor Data Transmission in WBAN using NS-3 software.
4	To analyze the performance of a Wireless LAN (WLAN) using IEEE 802.11 and evaluate throughput, delay, and packet delivery using NETSIM.
5	To evaluate the Bit Error Rate (loss) and data of Wireless LAN (IEEE 802.11b) network varies as the distance between the Access Point and the wireless nodes is varied using NETSIM.
6	To simulate Bluetooth communication and study piconet operation using NETSIM
7	To compare Star, Tree, and Mesh ZigBee topologies using NETSIM.
8	Analyze the working of Zigbee and Compare the theoretical throughput based on IEEE 802.15.4 standard with the simulation result obtained using NETSIM.
9	Simulation and evaluation IPv6 communication over low-power wireless networks using NETSIM.
10	To analyze the working of Personal Area Network and Comparing the Utilization and Queuing Delay with respect to distance and number of nodes in the network using NETSIM.
11	Analysis of SuperFrame Structure and analyse the effect of SuperFrame order on Energy consumption and throughput using NETSIM.
12	Analysis of the Impact of Node Mobility on MANET Performance using NETSIM.
13	Analysis of Communication in Vehicular Ad Hoc Networks (VANETs) using NETSIM.

14	Analysis of Energy Consumption and Network Lifetime in Wireless Sensor Networks (WSNs) using NETSIM.
15	Performance Evaluation of Wireless Mesh Networks using NETSIM.
16	Case Studies on Applications of WBAN, WPAN, WLAN, WSN, MANET, VANET, and IoT in Healthcare, Smart Cities, Industrial Automation, and Transportation Systems.
Term work	
1	Term work should be graded based on at least 8 experiments and one case study.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work
3	TW marks: 25 Experiments: 20 marks Case study: 05-marks

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

Cloud Computing and Security

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE743	Cloud Computing and Security	**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

Cloud Computing and Security(Theory)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
26ETPE743	Cloud Computing and Security	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 Test (MT)	Continuous Assessment (CA)					
26ETPE743	Cloud Computing and Security	20	20	60	2	--	--	100

Prerequisite: Computer Communication Network, Data Compression & Cryptography, Database Management System

Course Objectives:

1	Understand the fundamentals of cloud computing.
2	Appreciate the importance of virtualization in cloud computing
3	Understand various cloud computing services and platforms
4	Understand application design concepts in cloud
5	Understand the security aspects of cloud computing
6	Understand the advances in cloud computing

Course Outcomes: After successful completion of course student will be able to;	
1	Explain the fundamentals of cloud computing.
2	Interpret the significance of virtualization in the context of cloud computing and understanding the significance of docker
3	Describe cloud computing services working on AWS, Azure and Google cloud platforms
4	Explain application design aspects of cloud computing.
5	Interpret security aspects to cloud computing.
6	Explain advances in cloud computing in terms of multimedia cloud, fog, edge computing and real applications of cloud.

Module		**Content**	**Hrs**
1		**Introduction to Cloud**	**04**
	1.1	Introduction to Cloud Computing, Cloud Characteristics, Cloud Computing Components, Comparing of Cloud Computing with Peer to Peer architecture, Client Server , Distributed, Grid, Cloud Deployment model (Cloud types- Public, Private, Community, Hybrid), Service Models-(IaaS,PaaS,SaaS,)	
2		**Virtualization**	**07**
	2.1	Introduction and need of Virtualization, Implementation levels of Virtualization-design requirements and providers	
	2.2	Virtualization structure -Hosted & Bare metal structure, KVM, Xen Hypervisor	
	2.3	Types of virtualization- Full Virtualization & Paravirtualization, Virtualization of CPU, Memory and I/O Devices	
	2.4	Docker- Introduction to docker, Docker & Containers, Containers vs Hypervisors, Listing of docker image	
3		**Cloud Computing Services**	

	3.1	Compute Services - Amazon Elastic Compute Cloud, Google Compute Engine, Windows Azure Virtual Machines Storage Services - Amazon Simple Storage Service, Google Cloud Storage, Windows Azure Storage Database Services - Amazon Relational Data Store, Amazon DynamoDB, Google Cloud SQL, Google Cloud Datastore, Windows Azure SQL Database, Windows Azure Table Service Application Services - Application Runtimes & Frameworks, Queuing Services, Email Services, Notification Services, Media Services Anything as a service or Everything as a service (XaaS)	**10**
	3.2	Content Delivery Services - Amazon CloudFront, Windows Azure Content Delivery Network Analytics Services - Amazon Elastic MapReduce, Google MapReduce Service, Google BigQuery, Windows Azure HDInsight Deployment & Management Services - Amazon Elastic Beanstalk, Amazon CloudFormation	
4		**Cloud Application Design**	**06**
	4.1	Design Considerations for Cloud Applications - Scalability, Reliability & Availability, Security, Maintenance & Upgradation, Performance	
	4.2	Cloud Application Design Methodologies - Service Oriented Architecture, Cloud Component Model, IaaS, PaaS and SaaS services for cloud applications, Model View Controller, RESTful Web Services, Data Storage Approaches - Relational (SQL) Approach, Non-Relational (No-SQL) Approach	
5		**Cloud Security**	**06**
	5.1	Security for Virtualization Platform – Host security for SaaS, PaaS and IaaS – Data Security – Data Security Concerns – Data Confidentiality and Encryption – Data Availability –Data Integrity – Cloud Storage Gateways – Cloud Firewall	
	5.2	AAA Administration for Clouds -AAA model – SSO for Clouds – Authentication management and Authorization management in clouds – Accounting for Clouds Resource utilization.	
6		**Cloud Computing Applications**	**06**
	6.1	Cloud Computing for Health care, Education, Transportation, Manufacturing Industry, Energy System, Mobile Computing	

	6.2	Multimedia Cloud - Introduction, Streaming Protocols - RTMP Streaming, HTTP Live Streaming, HTTP Dynamic Streaming	
	6.3	Case Studies - Live Video Streaming App , Video Transcoding App, Edge Computing, FOG Computing	
Total			**39**

Textbooks:	
1	Arshdeep Bahga and Vijay K. Madisetti, "Cloud Computing - A Hands-on Approach"
2	Rajkumar Buyya , Christian Vecchiola , S.Thamarai Selvi, "Mastering Cloud Computing: Foundations and Applications Programming" , Publisher: Morgan Kaufmann
3	Bernard Golden, "Amazon Web Services For Dummies (For Dummies Series)", Paperback, Publisher: John Wiley & Sons
4	Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained".
5	Judith Hurwitz Daniel Kirsch, "Cloud Computing for Dummies".
6	James Turnbull, "The Docker Book"
Reference Books:	
1	Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing Black Book", Kogent Learning Solutions , Publisher : Dreamtech Press
2	Cloud Computing Concepts Technology and Architecture - Erl second hand book online from UsedBooksFactory
3	Chris Dotson, "Practical Cloud Security", Publisher(s): O'Reilly Media, Inc. ISBN: 9781492037514
4	AWS Whitepapers & Guides https://aws.amazon.com/whitepapers/
5	Azure whitepapers https://azure.microsoft.com/en-in/resources/whitepapers/
6	Google Cloud whitepapers https://cloud.google.com/whitepapers
7	Adrian Mouat, "Using Docker-Developing & Deploying Software with Containers"

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

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 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.

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

Cloud Computing and Security(Lab)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
26ETPEL743	Cloud Computing and Security 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)					
26ETPEL743	Cloud Computing and Security Laboratory	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
26ETPEL713	Cloud Computing and Security Lab	1

Prerequisite:

Lab Objectives: The Cloud Computing and Security Laboratory aims to enable students

1	To understand the fundamentals of cloud computing including cloud architecture, service models (IaaS, PaaS, SaaS) and deployment models (Public, Private, Hybrid and Community Cloud).
2	To develop practical skills in configuring and managing cloud resources such as virtual machines, storage services, networking and cloud based applications.
3	To Implement cloud security mechanisms including identity and access management (IAM), encryption techniques, firewall configuration and secure data storage.

4	To gain hands on experience with cloud platforms and tools for deploying, monitoring and maintaining scalable cloud infrastructure and services.
5	To analyze and apply best practices for cloud security and management to ensure confidentiality, integrity, availability and secure access to cloud resources.
Lab Outcomes: Upon successful completion of the Cloud Computing and Security Laboratory, students will be able to	
1	Identify and explain various cloud computing service models, deployment models and virtualization concepts.
2	Create, configure and manage cloud resources including virtual machines, storage buckets and virtual private networks using standard cloud platforms.
3	Implement and evaluate cloud security solutions such as IAM policies, encryption methods and firewall/security group configurations.
4	Deploy and monitor cloud-based applications using cloud infrastructure services and monitoring tools while following security best practices.
5	Demonstrate the ability to design and manage secure cloud environments by integrating networking, storage, access control and monitoring techniques to meet real world application requirements.

Suggested Experiments: Students are required to complete 8 experiments.	
Sr. No.	**Name of the Experiment**
1	To study and explore cloud service models (IaaS, PaaS, SaaS) using a cloud platform
2	To create, configure and monitor Azure Virtual Machines and Computing Services
3	To implement Cloud-Based Object Storage Using Azure Blob Storage
4	Deployment of Web Applications Using Azure App Service Platform
5	To configure a Virtual Private Cloud (VPC)
6	To implement encryption techniques in cloud (AES, RSA)
7	To create secure virtual networks, subnets, routing configurations and access control policies
8	To launch, configure, access, monitor, start, stop, reboot, and terminate cloud-based virtual machines using Amazon EC2
9	To create and manage Amazon S3 buckets for object storage, file sharing, versioning, and access control
10	To design and deploy a static web application using HTML/CSS/JavaScript and host it through Amazon S3 static website hosting
11	To create IAM users, groups, roles, and policies to implement role-based access control in AWS.
12	To configure monitoring dashboards, alarms, logs, and metrics to track cloud resource utilization and performance.
13	Comparative Study and Performance Analysis of AWS S3 and Azure Blob Storage Services
14	To build Docker images, run containers, manage container lifecycle
15	Virtualization Type-I/Type-II

Term Work:	
1	Term work should consist of 9 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: 10-marks, Attendance: 5 marks, Micro Project/Case study/Assignment/Tutorial: 10 marks)

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: Radar & Satellite Communication

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE751	Radar & Satellite Communication (Theory)	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

Radar & Satellite Communication(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE751	Radar & Satellite Communication (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				
26ETPE751	Radar & Satellite Communication (Theory)	20	20	60	---	---	100

Course Prerequisite: Analog and Digital Communication, Antennas, Microwave Engineering	
Course Objectives:	
1	To understand and analyze the fundamentals of radar systems, radar equations, frequencies, and signal detection in noise.
2	To develop understanding of advanced radar techniques such as MTI, Doppler radar, and tracking methods.
3	To provide knowledge of radar transmitters, receivers, and real-world applications like altimeters and navigation systems.
4	To understand the basics of satellite communications and different satellite orbits
5	To provide an in-depth understanding of satellite communication system operation, launching techniques, and earth station technology
6	To analyze and evaluate satellite link design

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 Outcomes: After successful completion of the course students will be able to:	
1	To analyze and apply basic radar principles, including radar equation, SNR, and detection concepts.
2	To understand and evaluate the working of **MTI, Doppler, and tracking radars**, including their limitations and performance.
3	To understand radar hardware components (transmitters, receivers, displays) and assess their applications in navigation and surveillance systems.
4	To understand the basic concepts of satellite communication systems and orbital parameters.
5	To understand the various satellite sub-systems, earth station technologies and launching mechanisms.
6	To analyze and evaluate link budget and various performance parameters of satellite signal for proper communication.

Radar & Satellite Communication(Theory)

Module		Content	Hrs
1		**Introduction to Radar**	**06**
	1.1	Basics Radar, Radar equation, Block Diagram, Radar Frequencies, Applications of Radar	
	1.2	Detection of signal in noise, Receiver Noise and Signal - to - noise Ratio, Probability of detection and false alarm: Simple , complex Targets, Pulse Repetition Frequency, Numerical Problems.	
2		**MTI, Pulse Doppler Radar and Tracking Radar**	**08**
	2.1	Introduction to Doppler and MTI radar, Doppler frequency shift	
	2.2	Simple CW Doppler radar, MTI radar block diagram, Delay line canceler, Moving - target - detection, Pulse Doppler radar, Numerical Problems.	
	2.3	Monopulse tracking, Conical scan and sequential lobbing, Limitation of tracking accuracy, Low angle tracking, Numerical Problems.	
3		**Radar Displays and Applications**	**05**
	3.1	Radar Display: Types of displays	

	3.2	Radar Applications- Radar Altimeter, Instrument Landing System (ILS), Long Range Navigation (LORAN)	
4		**Overview of Satellite Systems, Orbits and Launching**	**07**
	4.1	An overview of space and classification of satellite, orbital elements: apogee and perigee heights, semi-major axis, eccentricity, and mean anomaly, argument of perigee, inclination and right ascension of the ascending node, polar orbiting satellites, Kepler's first, second and third law, Orbital perturbations, effects of a non-spherical earth, atmospheric drag, Numerical Problems.	
	4.2	Sub-satellite point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage, Numerical Problems..	
	4.3	Selection of launching site, launch window, zero and non-zero degree latitude launching, sea launch, Launchers: Polar Satellite Launch Vehicle (PSLV), Geostationary Satellite Launch Vehicle (GSLV), Reusable launch vehicles (RLV), Sounding rockets, Fuels used for launch Vehicles.	
5		**Space Segment and Earth Station**	**07**
	5.1	**Space Segment :** Satellite configuration, transponder sub-system, antenna sub-system, AOC sub-system, TT&C sub-system, power sub-system, thermal sub-system.	
	5.2	**Earth Station :** General configuration: block diagram, receive only type earth, transmit-receive type earth station, antenna system, feed system, tracking system, LNA and HPA.	
6		**Link budget calculations**	**06**
	6.1	Introduction, General Link Design Equations, System Noise Temperature C/N and G/T Ratio, Atmospheric and Ionospheric effects on link design, Uplink design, Complete link design, Interference effects on complete link design, Earth station parameters, Numerical Problems.	
		Total	**39**

Textbooks:	
1	M. I. Skolnik, Introduction to Radar Systems, 3rd ed. New York, USA: McGraw-Hill, 2001.
2	A. K. Sen and A. B. Bhattacharya, Radar Systems and Radio Aids to Navigation. New Delhi, India: Khanna Publishers, 2007.
3	G. S. N. Raju, Radar Engineering and Fundamentals of Navigational Aids. New Delhi, India: IK International Publishing, 2008.
4	Dennis Roddy, —Satellite Communications‖, 4th Ed., Mc. Graw-Hill International Ed. 2009.
5	M. Richharia, —Satellite Communication Systems Design Principles‖, Macmillan Press Ltd. Second Edition 2003.
6	R. N. Mutangi, — Satellite Communication‖, Oxford university press, 2016. 4. Gerard Maral and Michel Bousquet, —Satellite Communication Systems‖, 4th Edition Wiley Publication
Reference Books:	
1	M. A. Richards, J. A. Scheer, and W. A. Holm, Principles of Modern Radar: Basic Principles. Raleigh, NC, USA: SciTech Publishing, 2010.
2	H. Meikle, Modern Radar Systems. Boston, MA, USA: Artech House, 2008.
3	M. I. Skolnik, Ed., Radar Handbook, 3rd ed. New York, NY, USA: McGraw-Hill, 2008.
4	Gerard Maral, —VSAT Networks‖, John Willy & Sons 39
5	Space technology Veterans, Quintessence of Nano satellite technology (small is big), Planet aerospace India,2020.
6	Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, —Satellite Communication systems Engineering‖, Pearson Publication
Suggested reference material:	
1.	https://onlinecourses.nptel.ac.in/noc19_ee58/preview
2.	Self Learning Topics: 1. Synthetic Aperture Radar 2. Ground Penetrating Radar 3. GPR Measurements and Microwave Tomography

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:

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

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.

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

Radar & Satellite Communication(Lab)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPEL751	Radar & Satellite Communication Lab	–	02	---	—	01	---	01

Course Code	Course Name	Examination Scheme					
		Practical			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPEL751	Radar & Satellite Communication Lab	--	--	--	25	25	50

Pre-requisite: 1. Analog and Digital Communication Systems 2. Antenna Wave Propagation 3. Microwave Engg	
Lab Objectives:	
1	To provide practical exposure to the principles and operation of radar and satellite communication systems.
2	To develop the ability to perform measurements, analysis, and characterization of radar and communication signals using modern instrumentation.
3	To enhance understanding of signal propagation, target detection, tracking, and satellite link performance through experimentation and simulation.
4	To develop skills in configuring, testing, and evaluating radar and satellite communication

	subsystems for real-world applications.

Lab Outcomes: Students should able to	
1	Demonstrate the operation of radar and satellite communication systems and interpret their performance characteristics.
2	Analyze radar and communication signals by measuring relevant parameters such as frequency, velocity, signal quality, and link performance metrics.
3	Evaluate the effects of channel impairments, antenna characteristics, and system parameters on radar and satellite communication performance.
4	Apply experimental and simulation techniques to investigate, troubleshoot, and validate radar and satellite communication system concepts.

Suggested List of Experiments

Sr. No.	**Title**
1	Measure the speed of a fan using Radar setup
2	Simulate Radar range equation in Matlab
3	Find the time period and frequency of a moving pendulum with different lengths using Radar setup
4	Find the frequency of tuning fork using Radar setup
5	Emulate the variable speed of moving objects using target emulator and radar absorber
6	Set up satellite communication link for audio and video signal
7	Measurement of the baseband analog signal parameters in a satellite link
8	Transmission of Tele-command and reception of the telemetry data
9	Measurement of the C/N ratio of the received signal
10	Measurement of the S/N ratio of the received signal

11	Simulation on link budget
12	Simulation on system Noise, C/N, G/T
13	Study effect of fading and propagation delay in satellite communication
14	Study PC-PC communication via satellite link
15	Study the effect of various types of antennas subsystem

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**

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:Advanced Digital Signal Processing

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE752	Advanced Digital Signal Processing	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

Advanced Digital Signal Processing Theory

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
26ETPE752	Advanced Digital Signal Processing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks			Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment		End Sem. Exam.				
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPE752	Advanced Digital Signal Processing	20	20	60	02	--	--	100

Course Code:	Course Title	Credit
26ETPE722	Advanced Digital Signal Processing	4
Prerequisite: Digital Signal Processing		
Course Objectives:		
1	To develop a thorough understanding of power spectrum estimation and different models for the same.	
2	To apply optimum linear filters, linear prediction, and adaptive filtering techniques for signal processing applications.	
3	To process multi-rate data.	
4	To develop multi-resolution analysis using wavelets.	

Course Outcomes:	
1.	Illustrate parametric and non-parametric techniques of power spectrum estimation.
2.	Explain optimum linear filters and their different forms.
3.	Perform linear estimation and prediction of discrete time signals.
4.	Implement various types of adaptive filters for the given applications.
5.	Design interpolator, decimator and sampling rate convertors for multi-rate signal processing.
6.	Apply concepts of wavelets and filter banks for signal processing applications.

Module No.	Unit No.	Topics	Hrs.
1.0		**Power Spectrum Estimation**	**09**
	1.1	Principle of Power Spectrum Estimation	
	1.2	Non Parametric Method of Power Spectrum Estimation: Modified Periodogram, Bartlett's Method, Welch's Method, Blackman-Tukey Method	
	1.3	Parametric Methods for Power Spectrum Estimation: Relationships between the Autocorrelation and the Model Parameters, Autoregressive (AR), Moving Average (MA), and Autoregressive Moving Average (ARMR) Models.	
	1.4	Introduction to Least-Squares Method for the AR Model Parameters and Yule-Walker Method for the AR Model Parameters	
2.0		**Optimum Linear Filters**	**03**
	2.1	Wiener Filters	
	2.2	Finite Impulse Response (FIR) Wiener Filter (Wiener-Hopf filter)	
	2.3	Infinite Impulse Response (IIR) Wiener filter (Non-Causal and Causal IIR Wiener Filter)	
	2.4	Orthogonality Principle in Linear Mean-Square Estimation	
3.0		**Linear Prediction**	**05**
	3.1	Forward and Backward Linear Prediction	
	3.2	Solution of Normal Equation (Levinson-Durbin and Schur Algorithm)	
	3.3	Autoregressive (AR) Lattice and Autoregressive Moving Average (ARMA) Lattice Ladder Filters	
	3.4	MMSE Estimation	
	3.5	Introduction to Kalman Filter, Matched Filter	

4.0		**Adaptive Filters**	**07**
	4.1	Adaptive Algorithms: Least Mean Squares (LMS) Algorithm, Normalized Least Mean Squares (NLMS) Algorithm, Recursive Least Squares (RLS) Algorithm, Lattice Ladder Algorithm	
	4.2	Applications of Adaptive Filters: System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation	
5.0		**Multi-rate Signal Processing**	**08**
	5.1	Introduction to Multi-rate Signal Processing	
	5.2	Interpolation and Decimation, Sampling Rate Conversion by Non-integer Factor	
	5.3	Multistage Interpolation and Decimation	
	5.4	Polyphase Decomposition	
	5.5	Filter Banks: Quadrature Mirror Filter Banks	
6.0		**Introduction to Wavelets**	**07**
	6.1	Limitations of Fourier Transform and Short Time Fourier Transform, Introduction to Time-Frequency Tiling	
	6.2	Multi-resolution analysis using Discrete Time Wavelet Transform: Haar, Multi-resolution Analysis of two band dyadic filter banks, Frequency response of the Haar Filter Bank	
	6.3	Introduction to Daubechies Wavelets	
	6.4	Application of Wavelet theory to Signal Denoising (Soft and Hard Thresholding)	
		Total	**39**

Note: No questions will be asked in the end semester exam from self-study topics. However, students are encouraged to explore these topics for better understanding of the subject.

Textbooks:	
1	John G. Proakis, Dimitris K. Manolakis, "Digital Signal Processing Principles, Algorithms, and Applications", Prentice-Hall, 4th Edition, 2012.
2	Simon Haykin, "Adaptive Filter Theory", Pearson Education, Fourth Edition, 2002
3	Martin Vetterli, Jelena Kovacevic, "Wavelets and Subband Coding", Prentice-Hall, 1995.
4	Burrus, C. Sidney, Ramesh A. Gopinath, and Haitao Guo, "Introduction to wavelets and wavelet transforms", Prentice Hall Inc. 1997"
Reference Books:	
1	Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Pearson Education, 2008.
2	E. Chandrasekhar, V. P. Dimri, V. M. Gadre (Eds.), "Wavelets and Fractals in Earth System Sciences", CRC Press, 2013.
3	Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2014.
4	K. Deergha Rao, M.N.S. Swamy, "Digital Signal Processing: Theory and Practice", Springer, 2018.
5	K. P. Soman, K.I. Ramchandran and N. G. Reshmi, "Insight into Wavelets: From Theory to Practice", Third Edition PHI, 2010.
6	P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice-Hall, 1993.
7	Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", McGraw Hill, 2011.
NPTEL/Swayam Courses:	
1	"Estimation of Signals and Systems" by Prof. S. Mukhopadhyay, IIT Kharagpur. https://nptel.ac.in/courses/108/105/108105059/
2.	"Adv. Digital Signal Processing - Multirate and wavelets" by Prof. V. M. Gadre, IIT Bombay. https://nptel.ac.in/courses/117/101/117101001/

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.

Advanced Digital Signal Processing (Laboratory)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
26ETPEL752	Advanced Digital Signal Processing Lab	-	02	--	–	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks			Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment		End Sem Exam.				
		Mid Test (MT)	Continuous Assessment (CA)					
26ETPEL752	Advanced Digital Signal Processing Lab	–	–	–	–	25	25	50

Prerequisite: ECC502 Digital Signal Processing	
Lab Objectives:	
1	To provide hands-on experience in implementing power spectrum estimation techniques for discrete-time signals.
2	To design and analyze optimum linear filters, linear predictors, and adaptive filtering algorithms for practical signal processing applications.
3	To implement multi-rate signal processing techniques such as interpolation, decimation, and sampling rate conversion.
4	To perform multi-resolution analysis of signals using wavelet transforms and filter banks for denoising and compression applications.
Lab Outcomes: Upon successful completion of the laboratory, students will be able to:	
1	Implement and compare parametric and non-parametric power spectrum estimation techniques using MATLAB.
2	Design and evaluate FIR and IIR Wiener filters for noise reduction applications.
3	Perform linear prediction of discrete-time signals and compute prediction coefficients using standard algorithms.
4	Implement adaptive filtering algorithms such as LMS, NLMS, and RLS for noise cancellation and system identification.
5	Design and implement interpolation, decimation, and sampling rate conversion systems for multi-rate signal processing.
6	Apply wavelet transform techniques for multi-resolution analysis, signal denoising, and compression applications.

Suggested Experiments: Students are required to complete at least 08 experiments.

Sr. No.	Name of the Experiment
1.	Estimation and comparison of Power Spectral Density (PSD) using Periodogram, Bartlett, and Welch methods.
2.	Estimation of PSD using Parametric Methods (AR Model) and comparison with Non-Parametric Methods using Yule-Walker estimation.
3.	Design and implementation of FIR Wiener Filter for noise reduction in a corrupted signal.
4.	Design and implementation of IIR Wiener Filter and comparison with FIR Wiener Filter performance.

5.	Implementation of Forward Linear Prediction and estimation of prediction error.
6.	Estimation of Linear Prediction Coefficients using Levinson-Durbin Algorithm and analysis of prediction performance.
7.	Adaptive Noise Cancellation using LMS Algorithm.
8.	Comparative analysis of LMS, NLMS, and RLS Algorithms in terms of convergence speed and Mean Square Error.
9.	Implementation of Interpolation and Decimation for sampling rate conversion.
10.	Decimation of Discrete-Time Signals and analysis of aliasing effects.
11.	Interpolation of Discrete-Time Signals and signal reconstruction.
12.	Multi-resolution Signal Analysis using Haar Wavelet Transform.
13.	Signal Decomposition and Reconstruction using Discrete Wavelet Transform (DWT).
14.	Signal Compression and Denoising using Wavelet Transform Techniques.

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: Quantum Communication

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE753	Quantum Communication	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

Quantum Communication Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPE753	Quantum Communication	03	--	---	03	--	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ETPE753	Quantum Communication	20	20	60	--	--	100

Course Prerequisite: Matrices and operations, Digital Circuits

Course Objectives:

1	To Understand the fundamental principles of quantum computing and how they differ from classical computing.
2	To develop necessary mathematical background including linear algebra and tensor product for quantum computing
3	To Learn about quantum bits (qubits), transformation and their representation using quantum states.
4	To analyze and implement various quantum gates and quantum circuits.
5	To develop an understanding of quantum algorithms and their applications.
6	Apply the principles of quantum mechanics to build and interpret quantum circuits and understand its hardware implementation.

Course Outcomes:

After successful completion of the course students will be able to:	
1	Differentiate Quantum and Classical Computing Paradigms in terms of computation models, information representation, and processing mechanisms.
2	Apply Mathematical Foundations in analyzing quantum systems and multi-qubit states.
3	Represent and Manipulate Quantum States using Dirac notation and linear operators.
4	Design and Analyze Quantum Circuits through matrix operations and circuit analysis.
5	Implement and Evaluate Quantum Algorithms such as Deutsch-Jozsa, Grover's search, and Shor's factoring algorithm, identifying their computational advantages over classical counterparts.
6	Understand application of Quantum Principles in hardware architectures such as superconducting qubits and trapped ions.

Quantum Communication (Theory)

Module		**Content**	**Hrs**
1		**Introduction to Quantum Computing:**	**5**
	1.1	• Motivation for studying Quantum computing • Origin of Quantum Computing • Classical vs Quantum Computing	
	1.2	• Bits vs Qubits • Overview of major concepts in quantum mechanics: Superposition, Entanglement, Decoherence, Interference • Introduction to Bloch Sphere and Qubit Representation	
	1.3	• Quantum Evolution & Key Milestones • Industrial applications in Finance, Cryptography, Optimization, Drug discovery etc.	
2		**Mathematics foundations for Quantum computing:**	**6**
	2.1	• Matrix Algebra: Vectors, Complex numbers and Vector spaces, Superposition of vectors, Inner product & Hilbert space, Dirac notation, Ket-Bra vectors, Eigen Values, Eigen Vectors Orthogonality, Orthonormality, Outer product & Tensor product.	
	2.2	• Spectral Decomposition Theorem • Linear Operators: Identity, Unitary, Hermition, Projector, Normal, Diagonalizable and Density operator, Significance and applications of these operators in Quantum circuits	
3		**Quantum Logic Gates and Circuits:**	**8**

	3.1	**Single-Qubit Operations** • Pauli Gates and Matrices (X, Y, Z) • Hadamard gate (H), Phase gate (S, T), and π/8 gates • Rotation gates and their significance • Transformation, Measurement and Bloch sphere representation	
	3.2	**Multi-Qubit Systems and Entanglement:** • CNOT, Toffoli and Fredkin gates • Controlled-U operations and reversible computing • SWAP gate and its role in quantum circuits • No cloning Theorem • Bell states and quantum entanglement • Super Dense coding and Quantum Teleportation protocols	
4		**Quantum Algorithms:**	**8**
	4.1	• Algorithm for constant and Balanced Functions: **Deutsch algorithm, Deutsch Josza algorithm**	
	4.2	• Simon's periodicity algorithm	
	4.2	• **Shor's algorithm** for integer factorization	
	4.3	• **Grover's algorithm** for for Search	
5		**Quantum Error Correction:**	**6**
	5.1	• Difference between classical and quantum error correction	
	5.2	• Quantum error correction using repetition 3 qubit codes (Bit flip & Phase flip)	
	5.3	• Shor's 9 qubit error correction	
6		**Quantum Cryptography and quantum Hardware**	**6**
	6.1	• Why QKD, QKD Protocols: BB84, B92, E91 etc.	
	6.2	• The DiVincenzo Criteria , Physical realization of Qubits using Superconducting, Ion Traps and Optical implementations	
		Total	**39**

Textbooks:	
1	Introduction to Classical and Quantum Computing, Thomas G. Wong,
2	Quantum Computing Explained By DAVID McMAHON, Wiley-Interscience , IEEE Computer Society (2008)
3	Quantum Computation and Quantum Information – Nielsen and Chuang, Cambridge University Press. Cambridge, 2010
4	An Introduction to Quantum Computing, P Kaye, R Laflamme and M Mosca
5	Learn Quantum Computing with Python and IBM Quantum Experience, A hands-on introduction to quantum computing and writing your own quantum programs with Python
Reference Books:	
1	Quantum Computing and Techniques, Rajiv Chopra, Khanna Publishing House, 2024
2	Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools an d Special Topics, World Scientific.
3	An Introduction to Quantum Computing, Pittenger,
4	Quantum error Correction - Frank Gaitan
E Resources	
	Learn Quantum Computation Using Qiskit" https://qiskit.org/learn/ 20235.
	https://onlinecourses.nptel.ac.in/noc21_cs103/preview
	https://archive.nptel.ac.in/courses/115/101/115101092/
Any other (Access to software)	

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	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	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.

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

Quantum Communication Laboratory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ETPEL753	**Quantum Communication**	**–**	**2**	**-**	**–**	**1**	**-**	**1**

Course Code	**Course Name**	**Examination Scheme**					
		Theory			**Term Work**	**Oral**	**Total**
		Internal Assessment		**End Sem Exam**			
		Mid-Term Test	**CA**				
26ETPEL753	**Quantum Communication**	**-**	**-**	**-**	**25**	**25**	**50**

Learning Objectives:	
1	Develop proficiency in quantum programming environments such as Qiskit/Cirq and use visualization tools to represent and analyze qubit states and quantum circuits.
2	Design, implement, and test quantum circuits using single-qubit, multi-qubit, and controlled quantum gates to perform quantum computations and generate entangled states.
3	Implement and analyze fundamental and advanced quantum algorithms including Deutsch–Jozsa, Simon's, Grover's, and Shor's algorithms using quantum programming frameworks.
4	Explore practical quantum computing applications through implementation of quantum communication protocols, quantum error correction techniques, and case studies in real-world domains.
Learning Outcomes: After successful completion of the laboratory course, students will be able to:	
1	Use Qiskit/Cirq tools to create, simulate, and visualize quantum states, quantum gates, and quantum circuits on quantum simulators.
2	Construct and verify quantum circuits involving single-qubit gates, multi-qubit gates, Bell states, GHZ states, quantum teleportation, and quantum key distribution protocols.

3	Develop and execute programs for major quantum algorithms such as Deutsch–Jozsa, Simon's, Grover's, and Shor's algorithms, and evaluate their advantages over classical approaches.
4	Apply quantum computing concepts to communication, security, error correction, and domain-specific applications by implementing quantum protocols and analyzing real-world quantum computing use cases.

Suggested list of experiments

1	**Installation of Qiskit and study of Quantum Composer, Bloch sphere Visualizer**
2	**Qiskit/Cirq for quantum programming: Design of quantum circuits using following Gates** : Single-Qubit Gates:Implementation of Pauli Gates (X, Y, Z) and their effects on qubits. Hadamard Gate (H): Creating superposition. Phase Gates (S, T): Understanding phase shifts. Identity Gate (I): Checking qubit stability.
3	**Multi-Qubit Gates:** CNOT (Controlled-NOT) Gate: Testing quantum entanglement. Toffoli Gate: Implementation of classical AND in quantum systems. Swap Gate: Exchanging two qubit states. Fredkin Gate: Quantum-controlled swap.
4	**Entanglement and Measurement Experiments:** Bell State Generation (Using Hadamard + CNOT). GHZ State (Three-qubit entanglement). Measurement in different bases (Computational and Hadamard basis).
6	Write a program to implement Deutsch's-Jozsa algorithm : Identifying constant vs. balanced functions.
7	Write a program to implement Shor factorization technique to factor large numbers exponentially faster.
8	Write a program to implement Simon's Algorithm to detect periodic patterns faster than classical methods.
9	Write a program to implement Grover search technique for quadratic speed-up in searching an unsorted database.
10	Quantum Teleportation Circuit: Build a basic teleportation circuit using 3 qubits. Verify teleportation success rate
11	6 BB84 Quantum Key Distribution Protocol: Simulate the BB84 protocol for secure key sharing between Alice and Bob
12	Bit Flip Error and Correction: Introduce a bit flip error manually and correct it using simple 3-qubit error correction
13	Prepare case study for any suitable application on quantum encryption methods for Cyber security/ financial modeling/ traffic optimization/weather forecasting and climate change etc. (Mini project)

Term Work	
1	Lab work: Total 8 experiments out of 11 are to be submitted as a part of TW submission and Mini project.
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, Project Assessment: 10-marks)

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

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: Major Project-II

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
26ETCP71	Major Project-II	--	04	--	4	--	2

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		MidTest (MT)	Continuous Assessment (CA)					
26ETCP71	Major Project -II	--	--	--	--	50	100	150

Course Code:	Course Title	Credit
26ETCP71	Major Project - II	2

Prerequisite:
Knowledge of subjects studied during semester I-VI

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:

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 problems/ issues.
3	To develop and test a working prototype or simulation that demonstrates the real-world application of the selected problem or issue, and effectively present the operational hardware/software model through poster presentations and demonstrations in a forum or community setting.
4	To demonstrate the knowledge, skills and attitudes of a professional engineer.

Guidelines	
1	**Project Topic:** i. To proceed with the project work it is very important to implement the idea presented in Sem VI. ii. The completed project is to be demonstrated with results, conclusion and future work. iii. Students have to submit a weekly progress report of the project to the internal guide whereas the internal guide has to keep track of the progress of the project and also has to maintain attendance reports. This progress report can be used for awarding term work marks. This progress report will be used for awarding term work marks. iv. There will be two reviews of progress of the project in the semester by the review panel assigned by Head of department, Deputy Head and department project in charge. The evaluation by review panel will be used for awarding term work marks. v. Students are to be encouraged to participate in various project competitions, national and international conferences and present their work in reputed journals. Innovative/ unique work/idea is to be encouraged to file patents to protect the innovations.

2	**Project Report Format:** At the end of semester, a project report should be submitted by the group as per given format (In LATEX only). It should preferably contain at least following details, **i. Abstract** **ii. Introduction** **iii. Literature Survey** a) Survey of Existing system b) Limitations of Existing system or research gap c) Problem Statement and Objective d) Scope **iv. Proposed System** a) Analysis/Framework/ Algorithm b) Details of Hardware & Software c) Design details d) Methodology (your approach to solve the problem) **v. Implementation steps** **vi. Conclusion** **vii. Future scope** **viii. References in standard format** **Minimum number of pages should be 50.** Along with the project report a pen drive consisting of folders of project documentation, all literature survey papers, implemented code, required software, utilities, used component details, user manual etc, is to be submitted. Number of copies of the project report to be submitted: 2+ No. of students in the group

Term Work:

Distribution of marks for term work shall be as follows:

- Weekly Attendance/discussion/Assessment
- Project work contribution
- Project Review I & II
- Project Report (Hard Bound)
- Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project-II should be conducted by Internal and External examiners approved by Academic council/ Exam cell. Students have to give presentations and demonstrations on Project-II.

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 Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ETRM71	Research Methodology (Theory)	04	---	---	04	---	---	04

Course Code	Course Name	Examination Scheme				
		Theory		Term Work	Practical & Oral	Total
		Internal Assessment	End Sem Assessment			
		Continuous Assessment				
26ETRM71	Research Methodology (Theory)	50	–	50	---	100

Prerequisite: Basic knowledge of engineering fundamentals, mathematics and statistics, and computer tools, along with the ability to read technical literature, perform basic data analysis, and demonstrate analytical and communication skills.

Course Objectives:

1	**Identify and formulate** clear, relevant, and well-defined research problems.
2	**Conduct a systematic literature review** using credible and reliable scholarly sources.
3	**Design appropriate experiments, tests, and prototypes** to investigate research problems and develop functional solutions.
4	**Analyze, interpret, and validate research data and results** using appropriate methods and tools.

5	**Communicate research outcomes effectively** through well-structured technical reports, presentations, and publications.
6	**Apply ethical research practices** related to academic integrity, plagiarism, copyright, intellectual property, and scholarly publication.
Course Outcomes:	
CO1	Students will be able to identify gaps in knowledge and state research problems.
CO2	Students will be able to perform a deep literature review using reliable sources.
CO3	Students will be analyse experiments or systems.
CO4	Students will be able to interpret data and validate results.
CO5	Students will be able to report research findings effectively.
CO6	Students will be able to follow research ethics in the IPR /Publication/Copyright.

Module	Module / Topic	Experiential Activity	**Hours**
1	**Introduction to Research**: Definitions and objectives of research, types of research, research approaches, significance of research, main components of research process	**Group Discussion** on Research	**8**

2	**Defining a research problem**: Reviewing the literature, technical writing, framing the research problem, hypotheses; Data collection,	**Literature Survey** for the research and Identification of the topic	**10**
3	**Research Design and Methodology** Design system, methodology, sampling and validation, statistical analysis, TRL levels	Design of methodology for the research problem, **Case study TRL levels**	**7**
4	**Analysis and Interpretation:** Designing of experiments, data types, methods of data collection, repeatability, reproducibility and reliability, sampling methods, displaying of data	**Literature review presentation** and group discussion	**9**
5	**Scientific Report Writing** types of scientific report, structure and components of conference and journal articles and theses, arts of writing, pitching of the research, research proposal for funding	Discussion and **pitching of research outcome** **Report writing** and Research paper Writing	**12**
6	**Research Ethics, IPR and Scholarly Publishing:** ethics and scientific conduct, ethics in life science studies, plagiarism, copyright, intellectual property rights, commercialization, royalty, scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability	Case study -**How to file Patent** and copyright	**6**

Total Hours	**52**

RECOMMENDED BOOKS

1. C. R. Kothari, Research methodology: Methods and Techniques, 3rd Edn., New age International 2014.

2. R. Kumar, Research methodology a step-by-step guide for beginners, Sage Publications, London, 2011.

3. C.G. Thomas, Research methodology and scientific writing, Ane books, Delhi, 2015.

4. P. Laake, H. B. Benestad and B. R. Olsen, Research methodology in the medical and biological sciences, Academic Press, 2007.

5. H. J. Ader and G. J. Mellenbergh, Research Methodology in the Social, Behavioural and Life Sciences Designs, Models and Methods, 3rd Edn., Sage Publications, London, 2000.

6 Donald Cooper and PS Schindler (2009) Business Research Methods, 9th edition, Tata McGraw Hill.

7 Uma Sekaran (2010) Research Methods for Business, 4th edition, Wiley.

8 Naresh Malhotra and S Dash (2009) Marketing Research, 5th edition, Pearson Prentice Hall.

9 Michael V. P Research Methodology.

10 Fred N. Kerlinger : Foundations of Behavioural Research

Online Reference NPTEL- https://nptel.ac.in/courses/121106007

Execution of the course

Theory -18 Hours

Experiential Activity - 34 Hours

Internal Continuous Assessment

Continuous Assessment is of **50 marks**. The rubrics can be

Sr. No	Rubrics	Marks (50)
1	Literature Review Report	10 marks
2	Problem Definition and Methodology	10 marks
3	Case Study	10 marks
4	Technical Paper Writing	10 marks
5	Presentation and Group discussion	10 marks
Sr. No	**Term Work**	**Marks (50)**
1	Research Study Report	20 marks
2	Oral	15 marks
3	Case Study	10 marks
4	Final Presentation	15 marks

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