Course Code	21EEO306T	Course Name	SUSTAINABLE DEVELOPMENT PRACTICES	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electrical and Electronics Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	gain a basic understanding on sustainable development
CLR-2:	understand the necessity of societal development towards sustainability
CLR-3:	familiarize the integrated strategies of sustainable development

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	familiarize the necessity of sustainable development by various stake holders	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO-2:	recognize the feasibility, approaches, techniques, and outcomes of sustainable development	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO-3:	interpret various policies and integrated approaches for adoption of sustainable environment	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-

Unit-1 - Introduction to Sustainable Development — 9 Hour

Definition, scope and elements. Stake holders of sustainable development: People, Government, investors, industry, judiciary, and international organizations working for sustainable development.

Unit-2 - Developmental Needs of Indian Society — 9 Hour

Poverty, unemployment, inadequate housing, unsafe drinking water, deficiency of energy sources and supply, sanitation, unscientific waste management, lack of transportation facilities, unskilled work force and apathy towards political activities.

Unit-3 - Social Interventions for Sustainable Development — 9 Hour

Education, skill development, people's participation in decision making, women empowerment, inclusive society, human rights, tolerance to diversity, reduction of health inequality, social safety net and Population control.

Unit-4 - Environment Protection Measures — 9 Hour

Environment protection policies, waste management, pollution control, reduce the use, reuse and recycle, sustainable energy, preservation of forest and water sources.

Unit-5 - Integrated Approaches — 9 Hour

Innovative models of sustainable development. Public private partnership, decentralization of power. Strategies to become a developed country. Future trends in integrated approaches, case study.

Learning Resources

1. Ghate, P., "Indian microfinance: The challenges of rapid growth", SAGE Publications, first edition, 2007.
2. Green, F.J., Chambers, B.W., "The Politics of Participation in Sustainable Development Governance", United Nations University Press, first edition, 2006.
3. Chopra, K., Gopal, K., "Operationalising Sustainable Development", Sage Publications, first edition, 1999.
4. Hans, C.B., Christina, V., "Sustainable Development in International and National Law", Groningen: Maimsbach Europa Law Publishing, first edition, 2008.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. M. Umasankar, Bharat Electronics Ltd, Andhrapradesh	1. Dr. S. S. Dash, GCE KJR	1. Dr. V. Pradeep, SRMIST
2. Dr. P. Kamaguvel, NIWE, Chennai	2. Dr. A. Vanlhaclesan, NIT Puducherry, Karaikal	2. Dr. R. Ramya, SRMIST

Course Code	21ECE223T	Course Name	Satellite Communication and Broadcasting	Course Category		Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	21ECC302T	Co-requisite Courses	NIL	Progressive Courses	NIL
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards	NIL		

Course Learning Rationale (CLR): The purpose of learning this course is to:	
CLR-1:	Study the background and orbital mechanics of satellite communication systems
CLR-2:	Investigate satellite links and identify areas to improve link performance
CLR-3:	Identify the various propagation effects and access techniques for satellite communication links
CLR-4:	Interpret the applications of satellite communication in VSAT systems, satellite TV, and radios
CLR-5:	Explore the concepts of satellite navigation and packet communication

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern tool usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	Interpret the concept and operation of satellite communication systems	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO-2:	Analyze satellite launching, link design, link availability, and interference	-	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO-3:	Examine the mechanism of multiple access techniques, propagation effects, and their impact on satellite communication	2	-	2	-	-	-	-	-	-	-	-	-	2	-	-
CO-4:	Illustrate the practical implementation of VSAT and DBS systems	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO-5:	Review the satellite communication navigation and global positioning system applications	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-

Unit-1: Overview of satellite communication: 9

Principle, historical developments, frequency allocations for satellite services
Orbital mechanics: Kepler's laws, orbital parameters, look angle determination, orbital perturbations, orbit control system, geostationary orbit, telemetry, tracking, command and monitoring, power systems, communication subsystems, transponders, satellite antennas, equipment reliability and space qualification

Unit-2: Satellite link design: 9

Basic transmission theory, system noise temperature and G/T ratio, design of downlinks, satellite systems using small earth stations uplink design, carrier to noise (C/N) ratio, design of satellite links for specified C/N (with and without frequency re-use), link budget, system design examples

Unit-3: Propagation effects and their impact on satellite-earth links: 9

Quantifying attenuation and depolarization, rain and ice effects, cloud attenuation, tropospheric and ionospheric scintillation, prediction of XPD, propagation impairment countermeasures
Multiple access techniques for satellite links: Multiple access, frequency division multiple access, time division multiple access, demand access multiple access, random access, code division multiple access

Unit-4: VSAT systems: 9

Network architectures, access control protocol, basic techniques, vat earth station engineering, calculation of link margins for VSAT star network, system design procedures
Direct broadcast satellite (DBS) TV and radio: C-band and Ku-band home satellite TV, DBS modulation, digital DBS-TV, DBS-TV system design, DBS-TV link budget, error control in digital DBS-TV, master control station and uplink, establishment of DBS–TV antennas, satellite radio broadcasting

Unit-5: Satellite navigation and global positioning system (GPS): 9

Radio and satellite navigation, GPS position location principles, GPS receivers and codes, satellite signal acquisition, GPS navigation message, GPS signal levels, timing accuracy, GPS receiver operation, case study – IRNSS/NAVIC, case study – GAGAN (GPS Aided GEO Augmented Navigation)
Satellite packet communication: Message transmission by FDMA, message transmission by TDMA, pure Aloha-satellite packet switching, slotted Aloha, packet reservation

Learning Resources	
	1. D. Roddy, "Satellite Communications", McGraw Hill Education, 4th Edition, 2017. 2. T. Pratt, C. Bostian and J. Allnutt, "Satellite Communications", Wiley, 2nd Edition, 2013. 3. W. L. Pritchart, H. G. Suyderhoud and R. A. Nelson, "Satellite Communication Systems Engineering", Pearson Education, 2nd Edition, 2012. 4. G. D. Gordon and W. L. Morgan, "Communications Satellite Handbook", Wiley, 2010. 5. L. J. Ippolito Jr, "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", John Wiley & Sons, 2nd Edition, 2017. 6. M. Richharia, "Satellite Communication Systems: Design Principles", Macmillan, 2nd Edition, 2003.

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 - (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	25%	-	25%	-	25%	-
Level 3	Apply	35%	-	35%	-	35%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1	1. Dr. Sachin Kumar, Research Assistant Professor, Dept. of ECE, SRM IST, Chennai
	2	2

Course Code	21ECE324T	Course Name	Advanced Mobile Communication systems	Course Category		Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	NIL	Co-requisite Courses	NIL	Progressive Courses	Nil
Course Offering Department	ECE	Data Book / Codes / Standards	NIL		

Course Learning Rationale (CLR)	The purpose of learning this course is to:
CLR-1:	ntroducing recent advancements and growing trends in mobile telecommunications
CLR-2:	Figure out the methods to improve the Data Rates in mobile communication
CLR-3:	nferring technical requirements for 5G, network architecture
CLR-4:	Acquire the knowledge of Network Planning and Deployment techniques.
CLR-5:	Analysing security techniques and Applications of Advanced Mobile communication system

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO) 1	2	3	4	5	6	7	8	9	10	11	12	Program Specific outcomes PSO-1	PSO-2	PSO-3
	Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project Management and Finance	Life Long Learning				
CO-1:	Examine the development ,challenges and requirements of mobile communications	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	Interpret the methods to improve the data rate	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	Connect the layers of communication systems	-	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO-4:	Analyze the techniques of Planning and deployment of communication network	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-
CO-5:	Summarize the security, services and applications of Next generation communication techniques.	-	2	-	-	-	-	-	-	-	-	3	-	-	-	-

Unit-1 : -Introduction — 9

Overview -What Is 5G? -Background -Research and Challenges for Electronics -Expected 5G in Practice - 5G and Security -Motivations -5G Standardization and Regulation -Global Standardization in 5G Era. 5G Requirements Based on ITU- The Technical Specifications of 3GPP-The 5 G Security, Case Study: Mobile Network Operators and Mobile Device Manufacturers in India

Unit-2 : Data Rates in Mobile Communication — 9

Fundamental Constraints in achieving High Data Rates Noise-limited scenarios Interference-limited scenarios Higher-order Modulation, Multi carrier modulation Wider bandwidth, Spectrum Composition Low frequency spectrum, capacity and coverage, spectrum for 5GNR, unlicensed mm waves bands, Terahertz spectrum, Spectrum requirements for 6G: SUB-6.

Unit-3: Radio Network — 9

Radio access technology-Orthogonal Frequency Division Multiplexing- Channel estimation and equalization- Multiple-Input Multiple-Output Techniques-Advanced MIMO-Radio network architecture and Interfaces. Case Study : The Role of 5G and beyond in the Cyber-World

Unit-4 : Network Planning and Deploymen — 9

Core and Transmission Network Dimensioning- Radio Network Planning- Core and Radio Network Deployment Scenarios- Standalone and Non-Standalone Deployment Scenarios- Network Interfaces and Elements-core deployment-Measurements. Case Study : Security Opportunities for Stakeholders

Unit-5: Security Services and Applications — 9

Security Threats and Challenges- Security Implications in 5G Environments and Use Cases - Security Layers- Device Security- Security between Network Entities , Vehicle Communications- Machine Learning and Artificial Intelligence .Case Study: The concept and vision of 6G Massive IoT

Learning Resources		
	5G explained: security and deployment of advanced mobile communications by Jyrki T.J. Penttinen. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2019.	Rappaport T.S., "Wireless Communications: Principles and Practice", 2nd Edition, Pearson, 2011
	6G wireless communications and mobile networking by xianzhong Xie, Bo Rong, Michel Kadoch-Bentham books	Chiller, "Mobile Communications", Pearson Education Asia Ltd., Reprint 2012

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) Formative CLA-1 Average of unit test (50%) Theory	Formative CLA-1 Average of unit test (50%) Practice	Life Long Learning CLA 2 - (10%) Theory	Life Long Learning CLA 2 - (10%) Practice	Summative Final Examination (40% weightage) Theory	Summative Final Examination (40% weightage) Practice
Level 1	Remember	15%	-	20%	-	20%	-
Level 2	Understand	30%	-	25%	-	40%	-
Level 3	Apply	40%	-	25%	-	20%	-
Level 4	Analyze	15%	-	20%	-	-	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1.	1. Dr.C.T.Manimegalai
	2.	2.

Course Code	21ECC302T	Course Name	ANALOG AND DIGITAL COMMUNICATION	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	21MAB203T	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	ECE	Data Book / Codes / Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	introduce to the learners the basic concepts involved in Communication system
CLR-2:	comprehend the functionalities of various radio transmitters and receivers
CLR-3:	realize the process involved in digital communication systems
CLR-4:	explore the pass band transmission system and analyze its performance in terms of probability of error
CLR-5:	get exposed to Information theory and channel coding concepts

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	explain the various analog modulation techniques	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO-2:	analyze the noise performance of radio transmitters and receivers	3	3	-	-	-	-	-	-	-	-	-	2	-	3	-
CO-3:	demonstrate the demodulation and detection of received digital data	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO-4:	apply the suitable passband techniques for real time applications	3	-	-	-	3	-	-	-	-	-	-	-	-	-	2
CO-5:	exposed to the concepts of information theory and channel capacity	3	-	3	-	-	-	-	-	-	-	-	-	3	-	-

Unit-1 - Analog Modulation Techniques — **9 Hour**

Need for Modulation - Types of Analog Modulation - Amplitude Modulation (AM) and its types - Generation of AM Waves - Linear Method (Collector Modulator) - Non Linear Method (Balanced Modulator) - Demodulation of AM waves (Envelop Detector) - Frequency Modulation (FM) – Types of FM –Narrow Band FM (NBFM) and Wide Band FM (WBFM) - Generation of NBFM (Varactor Diode Modulator) - Demodulation of NBFM waves (Foster Seely Method)- Phase Modulation (PM)- Generation of PM from FM and FM to PM

Unit-2 - Radio Transmitters and Receivers — **9 Hour**

AM Transmitter (Low Level and High Level) - FM Transmitter (Direct and Indirect Method) - Characteristics and functions of a receiver - AM Superheterodyne Receiver and FM Super Heterodyne Receiver - Noise in AM and FM (Elementary Treatment) - Need for Pre-emphasis and De-emphasis circuits

Unit-3 - Baseband and Digital Modulation Techniques — **9Hour**

Baseband Modulation Techniques (PAM, PWM and PPM) - Digital Modulation Techniques - Pulse Code Modulation (PCM) System) - Differential PCM (DPCM) System - Delta Modulation (DM) System - Matched Filter Receiver - Probability of error for Matched filter - Inter Symbol Interference (ISI) and Eye pattern

Unit-4 - Passband Transmission System — **9 Hour**

Passband Transmission System Model – Passband Modulation Techniques- Generation, Signal Space diagram, Detection, Probability of Error for BFSK - BPSK – QPSK – M-ary PSK and FSK (Elementary Treatment) – QAM System

Unit-5 - Information Theory and Channel Capacity — **9 Hour**

Entropy, Information rate, Source coding theorem, Shannon-Fano coding, Huffman coding, Mutual information – Shannon's channel capacity theorem

Learning Resources

1. Simon Haykin and Michael Moher, Communication Systems," 5th edition, John Wiley & Sons, 2013
2. Singh. R. P & Sapre. S. D, "Communication Systems: Analog & Digital," 3rd edition, Mc GrawHill Education, Seventh Reprint, 2016.
3. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2008
4. Bernard Sklar, "Digital Communication, Fundamentals and Application", Pearson Education Asia, 2nd Edition, 2001
5. Taub & Schilling, "Principle of Communication Systems", McGraw Hill Inc, 2nd Edition, 2003.
6. John G. Proakis, "Digital Communication", McGraw Hill Inc, 5th Edition, 2008.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	25%	-	15%	-	15%	-
Level 2	Understand	25%	-	20%	-	25%	-
Level 3	Apply	30%	-	25%	-	30%	-
Level 4	Analyze	20%	-	25%	-	30%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anil@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. M. Sangeetha, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	

Course Code	21ECC322L	Course Name	COMMUNICATION LAB	Course Category		Professional Core	L	T	P	C
							0	0	4	2

Pre-requisite Courses	21MAB203T	Co- requisite Courses		Progressive Courses	21ECC302T, 21ECC304T
Course Offering Department	ECE	Data Book / Codes / Standards		NIL	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Afford in depth awareness on various analog modulation and demodulation techniques
CLR-2:	Familiarize effective methods of digital modulation and demodulation techniques
CLR-3:	Examine detailed knowledge on microwave generation, transmission and measurement techniques
CLR-4:	Provide ample evidence on light transmission through optical fiber and their mechanisms.
CLR-5:	Practice acquired knowledge within the chosen area for project development

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	Recognize various analog modulation and demodulation techniques	2				-	-	-	-	-	3	-	-	3	-	-
CO-2:	Identify systematic methods of digital modulation and demodulation techniques			2		-	-	-	-	-	3	-	-	3	-	-
CO-3:	Discover microwave signal generation, transmission and different measurement techniques	2			3	-	-	-	-	-	-	-	-	3	-	-
CO-4:	Realize different characteristics and mechanisms of light transmission through fiber	2			3	-	-	-	-	-	-	-	-	3	-	-
CO-5:	Justify the technical aspects of the chosen project with a comprehensive and systematic approach	2				-	-	-	-	3	-	-	-		2	-

Unit-1 : Analog Modulation and Demodulation Techniques	3
Amplitude modulation and demodulation, DSB-SC modulation and demodulation, Frequency modulation and demodulation	
Unit-2 : Digital Modulation and Demodulation Techniques	3
Pulse Code Modulation and demodulation, DM and demodulation, PSK Modulation and demodulation, QPSK Modulation and Demodulation	
Unit-3: Microwave Communication	4
Characteristics of Reflex Klystron, power distribution in Directional coupler, E plane, H plane and Magic Tee, Impedance measurement by slotted line method, Gain and radiation pattern of Horn antenna, Characteristics of Strip Line	
Unit-4 : Optical Communication	4
Characteristics of LED and Laser diode, Characteristics of PIN and APD, Measurement of Numerical Aperture, Propagation and Bending losses, Analysis of Analog and Digital Optical Link	
Unit-5: Mini Project	

Learning Resources	1. Singh. R. P & Sapre S. D, "Communication Systems: Analog & Digital," 3rd edition, McGrawHill Education, Seventh Reprint, 2016. 2. Simon Haykin and Michael Moher, "Communication Systems," 5th edition, John Wiley & Sons, 2013 3. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Pearson Education, 2013. 4. Keiser G, "Optical Fiber Communication Systems", 5th Edition, 6th Reprint, McGraw Hill Education, India, 2015. 5. Laboratory Manual	

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 – (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	25%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. M. Neelaveni Ammal, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. S. Vasanthadev Suryakala, SRMIST

Course Code	21ECC304T	Course Name	MICROWAVE AND OPTICAL COMMUNICATION	Course Category		Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	21ECC302T	Co-requisite Courses		Progressive Courses	21ECE204T, 21ECE321T
Course Offering Department	ECE	Data Book / Codes / Standards		-	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Deliver in depth knowledge on microwave transmission and generation
CLR-2:	Propose efficient methods to analyze S-parameters of microwave devices
CLR-3:	Explore detailed awareness on measurement techniques and to provide complete knowledge on the techniques with associated equipment.
CLR-4:	Offer complete information on light transmission through optical fiber and their mechanism and characterization.
CLR-5:	Acquire detailed understanding on the methodologies and design considerations of link power budget in optical communication system and to grant mathematical formulation

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	Familiarize the concept of microwave transmission and generation	3	2			-	-	-	-	-	-	-	-	3	-	-
CO-2:	Realize systematic methods to design, analyze S-parameters of microwave devices	3	2			-	-	-	-	-	-	-	-	3	-	-
CO-3:	Identify different measurement techniques for determining various parameters and to gain knowledge on microwave measurements and the techniques with associated equipment	2			3	-	-	-	-	-	-	-	-	3	-	-
CO-4:	Discover complete information on the fundamentals of light transmission through fiber and their characterization and mechanism	3	2			-	-	-	-	-	-	-	-	3	-	-
CO-5:	Recognize the link power budget design considerations of optical communication system	3		2		-	-	-	-	-	-	-	-		2	-

Unit-1 : Introduction to microwaves and Sources	9
History of Microwave Engineering, Microwave transmission and Applications, Microwave Tubes, Klystron amplifier, Reflex Klystron oscillators, Magnetron oscillators, IMPATT, TRAPATT, Tunnel diode, Gunn diode.	
Unit-2 : S parameters analysis for N-port microwave devices	9
Scattering parameter, Directional coupler, E plane, H plane and Magic Tee Junctions, Microwave Circulators, Isolators, Phase shifters, Attenuators and Power dividers. Case study on Directional coupler	
Unit-3: Microwave Measurements and Equipments	9
VSWR, Impedance and Power measurement, Measurement of Frequency, Attenuation, Scattering parameters, Vector Network Analyzer, Signal Analyzer and Spectrum Analyzer, Case study on VSWR and Impedance measurement	
Unit-4 : Optical Fiber Communication Systems	9
Introduction to Optical fiber communication, Ray theory transmission, Optical fiber modes and configurations, Fiber attenuation and dispersion mechanisms, Optical sources-LED and LASER Diode, Optical detectors-PIN and Avalanche photo diode	
Unit-5: Optical Link Power Budget Analysis	9
Digital link-Point-to-Point link –System considerations, Link power budget and Risetime budget, Analog link and analysis, WDM and Passive devices, Case study on Point to Point link power budget analysis	

Learning Resources		
	1. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Pearson Education, 2013. 2.Robert. E. Collin, "Foundations for Microwave Engineering", 2nd edition, Wiley, Reprint 2014. 3. Annapurna Das, Sisir K. Das, "Microwave Engineering", 3rd Ed., McGraw Hill, 2015.	4. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley & Sons, 2012. 5. Keiser G, "Optical Fiber Communication Systems", 5th Edition, 6th Reprint, McGraw Hill Education (India), 2015. 6. John M. Senior, "Optical fiber Communications: Principles and Practice", Pearson Education, 3rd Edition, 2009. 7. Vivekanand Mishra, Sunita P. Ugale, "Fiber Optic Communication: Systems and Components", Wiley-India, 1st edition, 2013

Learning Assessment			
	Bloom's	Continuous Learning Assessment (CLA)	Summative

	Level of Thinking	Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 - (10%)		Final Examination (40% weightage)	
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	25%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.ani@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. Shanthi Prince, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. M. Neelaveni Ammal, SRMIST

Course Code	21ECC322L	Course Name	COMMUNICATION LABORATORY	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							0	0	4	2

Pre-requisite Courses	21MAB203T	Co- requisite Courses	Nil	Progressive Courses	21ECC302T, 21ECC304T
Course Offering Department	ECE	Data Book / Codes / Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	afford in depth awareness on various analog modulation and demodulation techniques
CLR-2:	familiarize effective methods of digital modulation and demodulation techniques
CLR-3:	examine detailed knowledge on microwave generation, transmission and measurement techniques
CLR-4:	provide ample evidence on light transmission through optical fiber and their mechanisms
CLR-5:	analyze the characteristics of specific Microwave and Optical devices and Components

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	recognize various analog modulation and demodulation techniques	2	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO-2:	identify systematic methods of digital modulation and demodulation techniques	-	-	2	-	-	-	-	-	-	3	-	-	3	-	-
CO-3:	discover microwave signal generation, transmission and different measurement techniques	2	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO-4:	realize different characteristics and mechanisms of light transmission through fiber	2	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO-5:	characterize and analyze Microwave and Optical devices and Components	2	-	3	-	-	-	-	-	-	-	-	-	-	2	-

Unit-1 - Analog Modulation and Demodulation Techniques — 12 Hour

Amplitude modulation and demodulation, DSB-SC modulation and demodulation, frequency modulation and demodulation

Unit-2 - Digital Modulation and Demodulation Techniques — 12 Hour

Pulse Code Modulation and demodulation, DM and demodulation, PSK Modulation and demodulation, QPSK Modulation and Demodulation

Unit-3 - Microwave Communication — 12 Hour

Characteristics of Reflex Klystron, power distribution in Directional coupler, E plane, H plane and Magic Tee, Impedance measurement by slotted line method

Unit-4 - Optical Communication — 12 Hour

Characteristics of LED and Laser diode, Characteristics of PIN and APD, Measurement of Numerical Aperture, Propagation and Bending losses.

Unit-5 - Microwave and Optical Communication — 12 Hour

Gain and radiation pattern of Horn antenna, Characteristics of Filters, Strip line and Parallel line Coupler, Analysis of Analog and Digital Optical Link, Simulation of Optical Communication System using Optilux

Learning Resources

1. Singh. R. P & Sapre S. D, "Communication Systems: Analog & Digital," 3rd edition, McGrawHill Education, Seventh Reprint, 2016.
2. Simon Haykin and Michael Moher, "Communication Systems," 5th edition, John Wiley & Sons, 2013.
3. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Pearson Education, 2013
4. Keiser G, "Optical Fiber Communication Systems", 5th Edition, 6th Reprint, McGraw Hill Education, India, 2015.
5. Laboratory Manual

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)						Final Examination (0% weightage)	
		CLA-1 Average of first cycle experiments (30%)		CLA-2 Average of second cycle experiments (30%)		Practical Examination (40% weightage			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	20%	-	20%	-	20%	-	-
Level 2	Understand	-	20%	-	20%	-	20%	-	-
Level 3	Apply	-	30%	-	30%	-	30%	-	-
Level 4	Analyze	-	30%	-	30%	-	30%	-	-
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100%		-	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anil@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. M. Neelaveni Ammal, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. S. Vasanthadev Suryakala, SRMIST

Course Code	21ECC304T	Course Name	MICROWAVE AND OPTICAL COMMUNICATION	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	21ECC302T	Progressive Courses	Nil
Course Offering Department	ECE	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	deliver in depth knowledge on microwave transmission and generation
CLR-2:	propose efficient methods to analyze S-parameters of microwave devices
CLR-3:	explore detailed awareness on measurement techniques and to provide complete knowledge on the techniques with associated equipment
CLR-4:	offer complete information on light transmission through optical fiber and their mechanism and characterization
CLR-5:	acquire detailed understanding on the methodologies and design considerations of link power budget in optical communication system and to grant mathematical formulation

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	familiarize the concept of microwave transmission and generation	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO-2:	realize systematic methods to design, analyze S-parameters of microwave devices	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO-3:	identify different measurement techniques for determining various parameters and to gain knowledge on microwave measurements and the techniques with associated equipment	2	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO-4:	discover complete information on the fundamentals of light transmission through fiber and their characterization and mechanism	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO-5:	recognize the link power budget design considerations of optical communication system	3	-	2	-	-	-	-	-	-	-	-	-	-	2	-

Unit-1 - Introduction to Microwaves and Sources — 9 Hour

History of Microwave Engineering, Microwave transmission and Applications, Microwave Tubes, Klystron amplifier, Reflex Klystron oscillators, Magnetron oscillators, IMPATT, TRAPATT, Tunnel diode, Gunn diode.

Unit-2 - S Parameters Analysis for N-port Microwave Devices — 9 Hour

Scattering parameter, Directional coupler, E plane, H plane and Magic Tee Junctions, Microwave Circulators, Isolators, Phase shifters, Attenuators and Power dividers. Case study on Directional coupler

Unit-3 - Microwave Measurements — 9 Hour

mpedance and Power measurement, Measurement of Frequency, Attenuation, Scattering parameters, Vector Network Analyzer, Signal Analyzer and Spectrum Analyzer Case study on VSWR and Impedance measurement

Unit-4 - Optical Fiber Communication Systems — 9 Hour

Introduction to Optical fiber communication, Ray theory transmission, Optical fiber modes and configurations, Fiber attenuation and dispersion mechanisms, Optical sources-LED and LASER Diode, Optical detectors-PIN and Avalanche photo diode

Unit-5 - Optical Link Power Budget Analysis — 9 Hour

Digital link-Point-to-Point link –System considerations, Link power budget and Risetime budget, Analog link and analysis, WDM and Passive devices, Case study on Point-to-Point link power budget analysis

Learning Resources

1. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Pearson Education, 2013.
2. Robert. E. Collin, "Foundations for Microwave Engineering", 2nd edition, Wiley, Reprint 2014.
3. Annapurna Das, Sisir K. Das, "Microwave Engineering", 3rd Ed., McGraw Hill, 2015.
4. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley & Sons, 2012
5. Keiser G, "Optical Fiber Communication Systems", 5th Edition, 6th Reprint, McGraw Hill Education (India), 2015.
6. John M. Senior, "Optical fiber Communications: Principles and Practice", Pearson Education, 3rd Edition, 2009.
7. Vivekanand Mishra, Sunita P. Ugale, "Fiber Optic Communication: Systems and Components", Wiley-India, 1st edition, 2013

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	25%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anil@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. Shanthi Prince, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. M. Neelaveni Ammal, SRMIST

Course Code	21ECC401T	Course Name	Wireless Communications and Antenna Systems	Course Category		Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18ECC205T, 18ECC105T	Co- requisite Courses	Nil	Progressive Courses	18ECE220T
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards		NIL	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Understand the elements of Wireless Communication and mobile communications
CLR-2:	Understand the elements of Wireless Communication and mobile communications
CLR-3:	Analyze how to apply Mobile Radio Wave Propagation - Small Scale Fading
CLR-4:	Study the Capacity and Diversity concepts in wireless communications
CLR-5:	Acquire the knowledge of Wireless System and Standards and Understand and design various wireless systems

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	Acquire the knowledge of Wireless communication and basic cellular concepts	H	-	-	-	-	-	-	-	-	-	M	M	-	-	L
CO-2:	Understand the essential Radio wave propagation and mobile channel models	H	H	H	H	-	-	-	-	-	-	M	M	-	-	H
CO-3:	Familiarize about Various performance analysis of mobile communication system.	H	H	H	-	-	-	-	-	-	-	-	-	-	-	H
CO-4:	Attain the knowledge of Diversity and capacity concepts	H	H	-	-	-	-	-	-	-	-	M	M	-	-	L
CO-5:	Be familiar with the various standards of Mobile Communication Systems and Explore the various concepts of wireless communication, its design with respect to fading and link performance	H	H	H	H	M	-	-	-	-	M	M	M	-	-	H

Unit-1 : Wireless communication: Mobile Communications: 9

Introduction to wireless communication and mobile radio communication- Classification of wireless communications -simplex, half duplex, dull duplex- Paging and Cordless systems- Cellular telephone systems- Timing diagram - landline to mobile Two- Timing diagram - mobile to mobile- Basic antenna parameters, Far field and near field- Frequency reuse, sectored and omnidirectional Antennas- Channel assignment strategies- Handoff and its types- Interference and system capacity- Trunking and Grade of Service-Cell splitting-Sectoring-Microcell Zone Concepts-Umbrella Cells- Solving Problem

Unit-2 : Large Scale Fading: 9

Introduction to Radio Wave Propagation-Large scale and small scale fading-Friss transmission equation-Free propagation model-pathloss model-Two ray model-Simplified pathloss model-Emperical model(Okumura)- Emperical model(Walfish and bertoni model) - Piecewise linear model-log normal model-Shadowing-Combined pathloss and shadowing-Outage Probability-Cell coverage area-Solving problems-VHF/UHF Antennas - Log periodic dipole array - Parabolic Reflector antennas

Unit-3: Small Scale Fading : 9

Introduction Small Scale multipath propagation-Impulse response model of multipath channel-Small Scale multipath measurements-Direct Pulse measurement-Slide -Small Scale multipath measurements-Sliding Correlator Measurements-Small Scale multipath measurents-Swept frequency measurement-Parameters of mobile multipath channel-Doppler spread and Coherent time-Type of fading: Flat and Frequency selective fading-Fast and slow fading-Ricean distribution-Rayleigh distribution-Solving problems(Doppler effect)- Design of Microstrip Patch Antenna

Unit-4 : Improvement of link performance: 9

Introduction to diversity, equalization and capacity-Space diversity-Scanning diversity-Maximal ratio combiner-Equal gain diversity-Rake receiver-Capacity in AWGN-Capacity of flat fading channels-Equalizer and its mode-Adaptive equalizer block diagram-Type of Equalizers-Introduction to MIMO antennas-Case Study: Recent Trends in Diversity and MIMO antennas

Unit-5: Wireless systems and standards : 9

AMPS Voice modulation Process- GSM system architecture and its interfaces-GSM frame structure-GSM speech operations input-output-Forward CDMA process- Reverse CDMA process-Multicarrier modulation-OFDM Transmitter Block diagram-OFDM Receiver Block diagram-Importance of Cyclic Prefix-Case study (Modern Antennas)

Learning Resources

1. Rappaport.T.S., "Wireless Communications: Principles and Practice", 2nd Edition, Pearson, 2011.
2. John D Kraus , Ronald J Marhefka, Ahmed S Khan "Antenna and Wave Propagation", 4th Edition, Tata McGraw Hill, 2010
3. Constantine Balanis. A, "Antenna Theory: Analysis and Design", 3rd Edition, John Wiley, 2012.
4. Andreas.F.Molisch., "Wireless Communications", Wiley, 2nd Edition-2005, Reprint-2014
5. Andrea Goldsmith, " Wireless Communications", Cambridge University Press, Aug 2005
6. Schiller, "Mobile Communications", Pearson Education Asia Ltd., Reprint 2012
7. Lee W.C.Y., " Mobile Communications Engineering: Theory and Applications", McGraw Hill, New York, 2nd Edition, 1998

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 - (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	20%	-	25%	-
Level 3	Apply	30%	-	25%	-	30%	-
Level 4	Analyze	30%	-	25%	-	30%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.ani@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. Sandeep Kumar P, SRMIST
Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. T. Ramarao, SRMIST

Theory Courses

Course Code	21ECC402P	Course Name	*Computer Communication and Network Security*	Course Category	P		L	T	P	C
							2	1	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Introduce the basic concepts in the field of computer networks.*
CLR-2:	*provide the functional aspects of OSI model architecture.*
CLR-3:	*Acquire knowledge of the Network Layer protocols*
CLR-4:	*Study the concepts in network security*
CLR-5:	*Identify the effect of various malwares and counter measures*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*
CO-1:	*provide the basic services and concepts related to internetworking.*
CO-2:	*Explain the basic OSI model architecture and its lower layer functions.*
CO-3:	*Give an insight of the various Network Layer concepts, mechanisms and protocols.*
CO-4:	*Gain knowledge in the various forms of network security*
CO-5:	*Analyse the effects of intrusion, viruses, firewalls and various levels of system security*
CO-6:	*Evaluate the various Networking concepts and Routing protocols.*

Program Outcomes (PO) (1- Low, 2 – Medium, or High-3)												Program Specific outcomes		
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	2	-	-	-	-	-	-	-	-	-	-	-	3
3	-	2	-	-	-	-	-	-	-	-	-	-	-	3
3		2	-	-	-	-	-	-	-	-	-	-	-	3

Unit-1: Data communication and networking **9**

Introduction to Data Communication and Networking, Data transfer modes-Serial and Parallel transmission, Protocols & Standards, Layered Architecture, Principles of Layering & Description, Brief description of concepts in OSI & TCP/IP model, Network topologies, switching- Circuit and Packet

Unit-2: Data link Layer

Network models, OSI layer architecture, Data Link Layer-Introduction, Link Layer Addressing, Error Detection, Error correction, Data link Control-LLC, Data link control-MAC

Unit-3: Networking layer

Introduction to Network Layer, Need for Internetworking, Addressing-Classful, Addressing-Classless, Routing protocols- Distance vector and link state, Internet protocol-IPV4 and IPV6

Unit-4: Network security

Email security, Overview of PGP and S/MIME, IP Security, Web Security, Secure Socket Layer, Transport Layer Security, Secure Electronic Transaction

Unit-5: Security attack

Intrusion Detection Techniques, Password Management, Malicious software, Viruses, Worms, and Zombies. Introduction to Firewall Types and Configurations, Trusted System, Port Scanning and Knocking.

	Bloom's Level of Thinking	**Continuous Learning Assessment (CLA) - By the Course Faculty**					
		Formative CLA-I Average of unit test (20%)		**Life Long* Learning** CLA-II- Project based Learning (60%)		**Report and viva voce** Examination (20% weightage)	
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	10 %	-	-	10 %	-	10 %
Level 2	Understand	15 %	-	-	15 %	-	15 %
Level 3	Apply	25 %	-	-	25 %	-	25 %
Level 4	Analyse	25 %	-	-	25 %	-	25 %
Level 5	Evaluate	25 %	-	-	25 %	-	25 %
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Learning Resources	1. William Stallings, Cryptography & Network Security,6th ed., Pearson, 2014 2. BehrouzA.Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, 2nd ed., Tata McGraw Hill, 2010	3. Bruce Schneier, Applied Cryptography, 2nd ed., 2015 4. Bernard Menezes, Network Security and Cryptography, Cengage Learning, 2010 5. Behrouz A Fehrouzan, "Data communication & Networking", Mc-Graw Hill, 5th Edition Reprint, 2014

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr.E.Elamaran, Assistant Professor of ECE, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr.V.Nithya, Associate Professor of ECE, SRMIST.

Course Code	21ECC401T	Course Name	WIRELESS COMMUNICATION AND ANTENNA SYSTEMS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	21ECC205T	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	ECE	Data Book / Codes / Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the elements of Wireless Communication and mobile communications
CLR-2:	understand the elements of Wireless Communication and mobile communications
CLR-3:	analyze how to apply Mobile Radio Wave Propagation - Small Scale Fading
CLR-4:	study the Capacity and Diversity concepts in wireless communications
CLR-5:	acquire the knowledge of Wireless System and Standards and Understand and design various wireless systems

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	acquire the knowledge of Wireless communication and basic cellular concepts	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO-2:	understand` the essential Radio wave propagation and mobile channel models	-	3	-	-	-	-	-	-	-	-	-	2	-	-	3
CO-3:	familiarize about Various performance analysis of mobile communication system	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO-4:	attain the knowledge of Diversity and capacity concepts	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO-5:	be familiar with the various standards of Mobile Communication Systems and Explore the various concepts of wireless communication, its design with respect to fading and link performance	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Unit-1 - Introduction to Wireless Communications and Antennas — **9 Hour**

Introduction to wireless communication and mobile radio communication- Classification of wireless communications -simplex, half duplex, dull duplex- Paging and Cordless systems- Cellular telephone systems- Timing diagram - landline to mobile Two- Timing diagram - mobile to mobile- Basic antenna parameters, Far field and near field- Frequency reuse, sectored and omnidirectional Antennas- Channel assignment strategies- Handoff and its types- Interference and system capacity- -Cell splitting-Sectoring- Microcell Zone Concepts-Umbrella Cells- Solving Problem on antenna parameters

Unit-2 - Large Scale Fading — **9 Hour**

Introduction to Radio Wave Propagation-Large scale and small scale fading-Friss transmission equation-Free propagation model-pathloss model-Two ray model-Simplified pathloss model-Empirical model (Okumara)- Empirical model(Walfish and Bertoni model)-Piecewise linear model-log normal model-Shadowing-Combined pathless and shadowing-Outage Probability-Cell coverage area-Solving problems-VHF/UHF Antennas - Log periodic dipole array - Parabolic Reflector antennas

Unit-3 - Small Scale Fading — **9 Hour**

Introduction Small Scale multipath propagation-Impulse response model of multipath channel-Small Scale multipath measurements-Direct Pulse measurement-Slide -Small Scale multipath measurements-Sliding Correlator Measurements-Small Scale multipath measurements-Swept frequency measurement-Parameters of mobile multipath channel-Doppler spread and Coherent time-Type of fading: Flat and Frequency selective fading-Fast and slow fading-Ricean distribution-Rayleigh distribution-Solving problems(Doppler effect)- Design of Microstrip Patch Antenna

Unit-4 - Improvement of link Performance — **9 Hour**

Introduction to diversity, equalization, and capacity-Space Diversity-Scanning Diversity-Maximal ratio combiner-Equal gain diversity-Rake Receiver-Capacity in AWGN-Capacity of flat fading channels-Equalizer and its mode-Adaptive equalizer block diagram-Type of Equalizers-Introduction to MIMO antennas-Case Study: Recent Trends in Diversity and MIMO antennas

Unit-5 - Wireless Systems and Standards — **9 Hour**

AMPS Voice modulation Process- GSM system architecture and its interfaces-GSM frame structure-GSM speech operations input-output-Forward CDMA process- Reverse CDMA process-Multicarrier modulation-OFDM Transmitter Block diagram-OFDM Receiver Block Diagram-Importance of Cyclic Prefix-Case study (Modern Antennas)

Learning Resources

1 Rappaport.T.S." Wireless Communications: Principles and Practice", 2nd Edition, Pearson, 2011.
2 John D Kraus, Ronald J Marhefka, Ahmed S Khan "Antenna and Wave Propagation", 4th Edition, Tata McGraw Hill, 2010
3 Constantine Balanis. A, "Antenna Theory: Analysis and Design", 3rd Edition, John Wiley, 2012.
4 Andreas.F. Molisch., "Wireless Communications", Wiley, 2nd Edition- 2005, Reprint-2014
5 Andrea Goldsmith, "Wireless Communications", Cambridge University Press, Aug 2005
6 Schiller, "Mobile Communications", Pearson Education Asia Ltd., Reprint 2012
7 Lee W.C.Y.," Mobile Communications Engineering: Theory and Applications", McGraw Hill, New York,2nd Edition ,1998

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	20%	-	25%	-
Level 3	Apply	30%	-	25%	-	30%	-
Level 4	Analyze	30%	-	25%	-	30%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anil@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr. Sandeep Kumar P, SRMIST
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr. T. Ramarao, SRMIST

Course Code	21ECC402P	Course Name	COMPUTER COMMUNICATION AND NETWORK SECURITY	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	ECE	Data Book / Codes / Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	introduce the basic concepts in the field of computer networks
CLR-2:	provide the functional aspects of OSI model architecture
CLR-3:	acquire knowledge of the Network Layer protocols
CLR-4:	study the concepts in network security
CLR-5:	identify the effect of various malwares and counter measures

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	provide the basic services and concepts related to internetworking	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	explain the basic OSI model architecture and its lower layer functions	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO-3:	give an insight of the various Network Layer concepts, mechanisms and protocols	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	gain knowledge in the various forms of network security	3	-	2	-	-	-	-	-	-	-	-	-	-	-	3
CO-5:	analyse the effects of intrusion, viruses, firewalls and various levels of system security	3	-	2	-	-	-	-	-	-	-	-	-	-	-	3

Unit-1 - Data Communication and Networking — **9 Hour**

Introduction to Data Communication and Networking, Data transfer modes-Serial and Parallel transmission, Protocols & Standards, Layered Architecture, Principles of Layering & Description, Brief description of concepts in OSI & TCP/IP model, Network topologies, switching- Circuit and Packet

Case Studies on Network topologies

Unit-2 - Data Link Layer — **9 Hour**

Network models, OSI layer architecture, Data Link Layer-Introduction, Link Layer Addressing, Error Detection, Error correction, Data link Control-LLC, Data link control-MA, flow control and error control, HDLC

Case Studies on Hamming code

Unit-3 - Networking Layer — **9 Hour**

Introduction to Network Layer, Need for Internetworking, Addressing-Classful, Addressing-Classless, Routing protocols- Distance vector and link state, Internet protocol-IPV4 and IPV6, border gateway protocol

Case Studies on Routing protocol-DVR

Unit-4 - Network Security — **9 Hour**

Email security, Overview of PGP and S/MIME, IP Security, Web Security, Secure Socket Layer, Transport Layer Security, Secure Electronic Transaction

Case Studies on Secure electronic Transaction

Unit-5 - Security Attack — **9 Hour**

Intrusion Detection Techniques, Password Management, Malicious software, Viruses, Worms, and Zombies. Introduction to Firewall Types and Configurations, Trusted System, Port Scanning and Knocking.

Case Studies on firewall

Learning Resources	
	1. Behrouz A. Forouzan, "Data communication & Networking", Mc-Graw Hill, 5th Edition Reprint, 2014.
	2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education India, 5th Edition, 2013
	3. William Stallings, "Cryptography & Network Security", Pearson Education India, 6th edition 2014
	4. Bruce Schneier, "Applied Cryptography", Pearson Education India, 2nd edition., 2015
	5. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2010

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)						Final Examination (0% weightage)	
		Formative CLA-1 Average of unit test (20%)		Project Based Learning CLA-2 (60%)		Report and Viva Voce (20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	-	10%	-	-	-	-
Level 2	Understand	25%	-	-	20%	-	-	-	-
Level 3	Apply	30%	-	-	25%	-	-	-	-
Level 4	Analyze	25%	-	-	25%	-	-	-	-
Level 5	Evaluate	-	-	-	10%	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100%		-	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anil@gmail.com	1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu	1. Dr.E. Elamaran, SRMIST
2. Mr. Hariharasudhan, Johnson Controls,Pune, hariharasudhan.v@jci.com	2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in	2. Dr.V. Nithya, SRMIST

Course Code	21CSS303T	Course Name	DATA SCIENCE	Course Category	S	ENGINEERING SCIENCES	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Data Science and Business Systems	Data Book / Codes / Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the basics of data
CLR-2:	learn the Pandas library to analyze data frames
CLR-3:	utilize different methods of data acquisition and data cleaning
CLR-4:	explore the visualization tools for different kinds of input data formats
CLR-5:	apply supervised and unsupervised learning to learn the hidden patterns from the data and predict the output

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	understand the relationship between data	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2:	identify the different data structures to represent data	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-3:	identify data manipulation and cleaning techniques using pandas	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-4:	constructs the Graphs and plots to represent the data using python packages	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-5:	apply the principles of the data science techniques to predict and forecast the outcome of real-world problem	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

Unit-1 - Introduction to Data Science, Numpy and Pandas — **10 Hour**

Introduction to Data science: Facets of data, Data Science Process Introduction to Numpy: Numpy, creating array, attributes, Numpy Arrays objects: Creating Arrays, basic operations (Array Join, split, search, sort), Indexing, Slicing and iterating, copying arrays, Arrays shape manipulation, Identity array, eye function Pandas: Exploring Data using Series, Exploring Data using DataFrames, Index objects, Re index, Drop Entry, Selecting Entries, Data Alignment, Rank and Sort, Summary Statistics, Index Hierarchy Data Acquisition: Gather information from different sources, Web APIs, Open Data Sources, Web Scrapping.

Unit-2 - Data Wrangling, Data Cleaning and Preparation — **10 Hour**

Data Handling: Problem faced when handling large data-General techniques for handling large volume of data- General programming tips for dealing large data sets Data Wrangling: Clean, Transform, Merge, Reshape: Combining and Merging Datasets, Merging on Index, Concatenate, Combining with overlap, Reshaping, Pivoting Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation, summarizing, Binning, classing and Standardization, outlier/Noise& Anomalies.

Unit-3 - Visualization — **10 Hour**

Customizing Plots: Introduction to Matplotlib, Plots, making subplots, controlling axes, Ticks, Labels and legends, annotations and drawing on subplots, saving plots to files, matplotlib configuration using different plot styles, Seaborn library. Making sense of data through advanced visualization: Controlling line properties of chart, creating multiple plots, Scatter plot, Line plot, bar plot, Histogram, Box plot, Pair plot, playing with text, styling your plot, 3d plot of surface

Learning Resources

1. Grus, J. (2019). Data Science from Scratch, 2nd Edition. O'Reilly Media, Inc.
2. Jiawei Han, Micheline Kamber and Jian Pei (2012), Data Mining Concepts and Techniques, Third Edition, Elsevier.
3. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali (2016), Introducing Data Science: Big data, machine learning, and more, using Python tools, Manning Publications.
4. McKinney, W. (2018). Python for data analysis: Data wrangling with pandas, NumPy, and IPython. O'Reilly Media, Inc.
5. Vanderplas, J. T. (2017). Python data science handbook: Essential tools for working with data. O'Reilly Media, Inc.
6. Jeffrey S. Saltz and Jeffrey M. Stanton (2018), An Introduction to Data Science, Sage Publication.
7. Shai Vaingast (2014), "Beginning Python Visualization Crafting Visual Transformation Scripts", Second Edition, Apress.
8. Wes Mc Kinney (2012). "Python for Data Analysis", O'Reilly Media.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	20%	-	40%	-
Level 2	Understand	40%	-	20%	-	40%	-
Level 3	Apply	10%	-	20%	-	10%	-
Level 4	Analyze	10%	-	20%	-	10%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	10%	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Veeramanickam. M.R.M. Associate Professor Chitkara University Institute of Engineering and Technology	1. Mr. Snehith Attam Raju Senior Manager Advanced Analytics & Architecture Envista Holdings Corporation, Hyderabad.	1. Dr.V.Kalpana, SRMIST
		2. Dr.G.Vadivu, SRMIST