Jabalpur Engineering College, Jabalpur
(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)
(AICTE Model Curriculum Based Scheme)
Bachelor of Technology (B.Tech.) VII Semester (Electronics & Tele Communication Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	EC71	PEC	Professional Elective Course-III	70	20	10	-	-	100	3	1	-	4
2	EC72	OEC	Open Elective Course-II	70	20	10	-	-	100	3	1	-	4
3	EC73	PCC	T.V & Digital Display Devices	70	20	10	30	20	150	3	-	2	4
4	EC74	PCC	Optical Communication	70	20	10	30	20	150	3	-	2	4
5	EC75	PCC	Antenna & Wave Propagation	70	20	10	30	20	150	3	-	2	4
6	EC76	MC	Industrial Training Evaluation	-	-	-	60	40	100	-	-	4	2
			Total	**350**	**100**	**50**	**150**	**100**	**750**	**15**	2	**10**	**22**
7	EC77	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	EC78	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code EC77 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four elective subjects for each PEC and OEC.
02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator
03. Industrial training presentation & viva shall take place in VII Sem. which students have already done in VI Sem.

Professional Elective Course-III		
S.No	Subject Code	Subject Name
1	EC71A	Advanced Communication
2	EC71B	Mixed Signal Design
3	EC71C	Fuzzy Logic & Neural Network

Open Elective Course-II		
S.No.	Subject Code	Subject Name
1	EC72A	Digital Image Processing
2	EC72B	Internet of Things
3	EC72C	Cyber Security

1 hour lecture (L) = 1 credit | 1 hour Tutorial (T) = 1 credit | 2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, OEC: Open Elective Course, PCC: Professional Core Course, DLC: Distance Learning Course, MC: Mandatory Course

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
EC71A	Advanced Communication	End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work	100	L	T	P	4
		70	20	10	-	-		3	1	-	

MODULE-I

Carrier and Symbol Synchronization: Signal parameter estimation. The likelihood function, Carrier recovery and symbol synchronization in signal demodulation, Carrier phase estimation, Maximum likelihood carrier phase estimation, The phase locked loop, Effect of additive noise in phase estimation, Decision directed loops, Symbol timing estimation, Maximum likelihood timing estimation, Non-decision directed timing estimation, Joint estimation of carrier phase and symbol timing.

MODULE-II

Multicarrier Modulation: Data transmission using multiple carriers, Multicarrier modulation with overlapping sub channels, Mitigation of subcarrier fading, Coding with interleaving overtime and frequency, Frequency equalization, Adaptive loading. Discrete Implementation of multicarrier. The cyclic prefix, Challenges in multicarrier systems, Peak to average Power ratio, Frequency and timing offset.

MODULE-III

Multiuser Communications: Introduction to multiple access techniques, Capacity of multiple access methods, Code division multiple access, CDMA signal and channel models, The optimum receiver, Suboptimum receivers, Performance characteristics of Detectors, Random access methods, ALOHA systems and protocols, Carrier sense systems and protocols.

MODULE-IV

WSN: Introduction to wireless sensor networks, Sensor network architecture, Routing Protocols, Classifications, Design issues and Applications.

MODULE-V

Cognitive Networks: Definition, Requirements, Cognitive radio, Cross-layer design, Cognitive process, Cognitive network design.

References:

1. J. G. Proakis: Digital Communications, McGraw Hills.
2. A. Goldsmith: Wireless Communications, Cambridge University Press.
3. U. Madhow: Fundamentals of Digital Communication, Cambridge University Press.
4. H. Arslan: Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer

Course Outcomes:
Upon successful completion of course students will be able to:

CO1	Basic study of carrier and symbol synchronization
CO2	Knowledge of multicarrier modulation
CO3	Analyze various access methods
CO4	Discuss various OFDM techniques
CO5	Illustrate cognitive radio

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
EC71B	Mixed Signal Design	End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work	100	L	T	P	4
		70	20	10	-	-		3	1	-	

Module I:
Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

Module II:
Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

Module III:
Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Module IV:
Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

Module V:
Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

Text /References:

1. R.Jacob Baker, "CMOS Mixed Signal Circuit Design", Wiley India, IEEE Press, reprint 2008.
2. R.Jacob Baker,"CMOS Circuit Design, Layout and Simulation", Wiley India, IEEE Press, Second Edition, reprint 2009.
3. Behzad Razavi,"Design of Analog CMOS Integrated Circuits" McGraw Hill, 33rd Reprint, 2016.

Course Outcome:

At the end of this course students will demonstrate the ability to

CO1. Understand the concepts for mixed signal circuits.
CO2. Analyze the characteristics of IC based CMOS filters.
CO3. Design of various data converter architecture circuits.
CO4. Analyze the signal to noise ratio and modeling of mixed signals.
CO5. Analyze various analog and digital PLL circuits and systems.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC71C	Fuzzy Logic & Neural Network	70	20	10	-	-	100	3	1	-	4

MODULE-I: Classical & Fuzzy Sets

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

MODULE-II: Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

MODULE-III: Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron. Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

MODULE-IV: Single and Multi Layer Feed Forward Neural Networks

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications, Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training. Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

MODULE-V: Applications Neural network applications:

Process identification, control, fault diagnosis and load fore casting Fuzzy logic applications; Fuzzy logic control and Fuzzy classification.

Reference Books:

1. Neural Networks, Fuzzy logic. Genetic algorithms: synthesis and applications by Rajasekharan and Rai - PHI Publication
2. Neural Networks - James A Freeman and Davis Skapura, Pearson Education, 2002.
3. Neural Networks - Simon Hakins, Pearson Education
4. Neural by C.Eliasmith and CH.Anderson, PHI Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications

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Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Introduction to Neural Network
CO2	Differentiate between single and multilayer feed forward neural network
CO3	Discuss classical and fuzzy sets
CO4	Knowledge of fuzzy logic system components
CO5	Illustrate various Neural network application

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC72A	Digital Image Processing	70	20	10	-	-	100	3	1	-	4

MODULE-I

DIGITAL IMAGE PROCESSING: Elements of digital image processing system, Image acquisition using sensors, Image formation and contrast sensitivity, Sampling and quantization, Neighbors of a pixel, Distance measures, Pixel connectivity, Image geometry.

MODULE-II

IMAGE ENHANCEMENT: Definition, Spatial domain methods, Contrast stretching, Slicing, Averaging, Frequency domain methods Histogram modify techniques, Neighborhood averaging, Segmentation techniques, Media and filtering, Edge detection, Image sharpening by differentiation, Low and high pass filtering.

MODULE-III

IMAGE TRANSFORMS: Introduction to Fourier transform-DFT, Properties of two dimensional DFT, Average value, FFT algorithm, Walsh transforms, Hadamard transform, Haar transform, K-L transform, Discrete cosine transform, Wavelet transform and comparison of all transforms.

MODULE-IV

IMAGE RESTORATION: Definition, Degradation model, Discrete formulation, Circulant matrices, Block circulant matrices, Unconstrained and Constrained restorations, Inverse filtering, Wiener filter, Restoration in spatial domain.

MODULE-V

IMAGE ENCODING: Objective and subjective fidelity criteria, Basic encoding process, Variable length coding, Run-length coding, LZW, Bit-plane coding, Lossy and lossless compressions, Transform coding, Wavelet coding, Image compression. Introduction to all image compression techniques and standards, CCITT, JPEG, JPEG 2000, Video compression standards, Basics of pattern recognition and applications.

Reference Books:

1. "Digital Image Processing" by Rafael, C. Gonzlez and Paul, Wintz, Addision-Wesley Publishing Company.
2. "Fundamentals of Digital Image Processing" by Anil K. Jain Prentice Hall.
3. "Digital Image Processing" by Sosenfeld, and Kak. A.C., Academic Press.
4. The Image Processing Handbook,(5/e), CRC, 2006 by J.C. Russ.
5. Digital Image Processing with MATLAB by R.C. Gonzalez & R.E. Woods, Prentice Hall 2003.

Course Outcomes:

Upon successful completion of course students will demonstrate the ability to:

CO1	Knowledge of elements of digital image processing system.
CO2	Understand image enhancement techniques.
CO3	Apply different transforms over images.
CO4	Implement restoration techniques in Digital Images.
CO5	Develop various image compression techniques.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC72B	Internet of Things	70	20	10	-	-	100	3	1	-	4

MODULE-I:

IoT Introduction and Fundamentals: Deciphering the term IoT. Applications where IoT can be deployed, Benefits/challenges of deploying an IoT, IoT components: Sensors, front-end electronics (amplifiers, filtering, digitization), digital signal processing, data transmission, choice of channel (wired/wireless), back-end data analysis. Understanding packaging and power constraints for IoT implementation

MODULE-II:

Signals, Sensors, Actuators, Interfaces: Sensors: types, signal types, shape and strength, Sensor non-idealities: Sensitivity and offset drift, noise, minimum detectable signal. nonlinearity, Read-out circuits: Instrumentation-amplifier, SNR definition, noise-bandwidth- power trade off, Circuit component mismatch and mitigation techniques (calibration, chopping. auto zeroing etc.), Power/energy considerations, Basic signal processing (filtering, quantization, computation, storage),

MODULE-III:

Networking in IoT: Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth, Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control (MAC) Protocols for M2M Communications, Standards for the IoT, Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area Networks (LPWAN), Wireless communication for IoT: channel models, power budgets, data rates, IoT Security and Privacy, MQTT Protocol, Publisher and Subscriber Model

MODULE-IV:

Cloud Computing in IoT Cloud computing platform (open source) and local setup of such environment, embedded software relevant to microcontroller and IoT platforms (enterprise or consumer), user interfaces

MODULE-V:

Data Analysis for IoT applications, Statistics relevant to large data, linear regression, Basics of clustering, classification

Reference Books:

1. S. Vitturi, C. Zunino and T. Sauter, "Industrial Communication Systems and Their Future Challenges: Next-Generation Ethernet, IIoT, and 5G," in Proceedings of the IEEE, vol. 107, no. 6, pp. 944-961, June 2019, doi: 10.1109/JPROC.2019.2913443.

2. F. John Dian, R. Vahidnia and A. Rahmati, "Wearables and the Internet of Things (IoT), Applications, Opportunities, and Challenges: A Survey," in IEEE Access, vol. 8, pp. 69200-69211, 2020, doi: 10.1109/ACCESS.2020.2986329.

3. O. Liberg, M. Sundberg, E. Wang, J. Bergman, J.Sachs, "Cellular Internet of Things: Technologies, Standards, and Performance", Academic Press, ISBN: 978-0-12-812458-1, Oct. 2017.

4. S. Vitturi, C. Zunino and T. Sauter, "Industrial Communication Systems and Their Future Challenges: Next-Generation Ethernet, IIoT, and 5G," in Proceedings of the IEEE, vol. 107, no. 6, pp. 944-961, June 2019, doi: 10.1109/JPROC.2019.2913443.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand the fundamentals of Internet of things
CO2	Knowledge of interfacing of signal, sensors and actuators in Internet of Things
CO3	Interpret networking in Internet of things
CO4	Implement on Cloud computing in Internet of things
CO5	Analyze the data for various Internet of things applications

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC72C	Cyber Security	70	20	10	-	-	100	3	1	-	4

Module I:

Cyber Security Concepts: Cyber Risks, Breaches, attacks, Exploits, Social Engineering, Foot Printing, Scanning, etc. Cryptography and Cryptanalysis: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security.

Module II:

Infrastructure and Network Security: Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Introduction to Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management,

Module III:

Cyber Security Vulnerabilities & Safe Guards: Internet Security, Cloud Computing & Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness.

Module IV:

Malware: Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis. Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, Anti Phishing.

Module V:

Security in Evolving Technology: Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP, REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Text /References Books:

1. Jeeva Jose & Vijo Mathew, Introduction to Security of Cyber-Physical Systems, Khanna Book Publishing Company, 2023.
2. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.
3. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House.
4. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi.
5. Atul Kahate, "Cryptography and Network Security", McGraw Hill.
6. V.K. Pachghare, "Cryptography and Information Security", PHI Learning.

Course Outcome: At the end of this course students will demonstrate the ability to

CO1. Understand the basic concept of cyber security and its importance.
CO2. Analyze and distinguish various security threats and attacks that are prevalent now.
CO3. Find different ways for safety of assets and systems by increasing the strength of security parameters.
CO4. Perform simple simulations of cyber security attacks and ways to mitigate those.
CO5. Have knowledge of basic security for web services.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC73	T.V. & Digital Display Devices	70	20	10	30	20	150	3	-	2	4

Module-I

Fundamentals of television Engineering, Scanning mechanism frequency interleaving aspect ratio kell factor plumbicon, vidicon Image acquisition by CCD, CMOS Camera devices, B/W Picture Tube, Color picture tube principle, Various T. V. Standard.(NTSC CCIRB PAL)

Module-II

Composite Video Signal, Horizontal and Vertical blanking pulses, Calculation of BW in T. V., Vestigial side band transmission, Sound signal transmission, B/W T. V. Transmitter block diagram ad its working ,Color T.V. transmission.

Module-III

B/W T. V. Receiver block diagram and its working. Color T.V. Receivers block Diagram and its working. RF section, IF section in receivers, Video detector, FM sound section. PAL-D system

Module-IV

Basics of color formations in color TV. Luminance signal, Chrominance signal, Negative modulation, Quadrature amplitude modulation. Various kinds of antennas used in T.V. transmission and reception satellite T.V. principle.

Module-V

Digital display method, TFT monitor, LCD, LED, PLASMA display system, High definition TV Flat panel T. V. OLED display, quantum dot display, Holography and 3D TV

Books

1. TV Engineering by R R Gulati
2. A.M. Dhake Television & Video Engineering.
3. For LCD, LED PLASMA "Service manuals of various companies"

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understanding of basics of T.V. and scanning.
CO2	Knowledge of design aspect of video signal BW calculation
CO3	Understand of TV receiver and transmitter
CO4	Comprehensive knowledge of basics of T.V. modulation and Antenna
CO5	Comprehensive study of model Display devices.

LIST OF EXPERIMENTS

1. To Study Picture Tube.
2. To Study RF Section.
3. To Study VIF Section.
4. To Study Vertical Deflection Section.
5. To. Study Horizontal Deflection Section and EHT Section.
6. To study chroma Section.
7. To Study Video Amplifier.
8. To Study Control System.
9. To Study Sound Section.
10. To Study Switch Mode Power Supply.
11. To Study TV pattern Generator.
12. To Study of flat panel TV receiver.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC74	Optical Communication	70	20	10	30	20	150	3	-	2	4

MODULE-I

Overview of Optical Fiber Communications (OFC): Motivation, optical spectral bands, key elements of optical fiber systems. Optical fibers: basic optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single mode fibers, graded- index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, fiber optic cables.

MODULE-II

Optical sources: emitting diodes (LEDs): structures, materials, quantum efficiency, LED power, modulation of an LED. Laser diodes: modes, threshold conditions, laser diode rate equations, external quantum efficiency, resonant frequencies, structure and radiation patterns, single mode lasers, modulation of laser diodes. Power launching and coupling: source to fiber power launching, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors. Multimode fibers.

MODULE-III

Photo detectors: pin photo detector, avalanche photodiodes, photo detector noise, detector response time, avalanche multiplication noise. Signal degradation in optical fibers: Attenuation: units, absorption, scattering losses, bending losses, core and cladding losses. Signal distortion in fibers: overview of distortion origins, modal delay, factors contributing to delay, group delay, material dispersion, waveguide dispersion, polarization-mode dispersion. Characteristics of single mode fibers: refractive index profiles, cutoff wavelength, dispersion calculations, mode field diameter, bending loss calculation. Specialty fibers.

MODULE-IV

Optical receivers: fundamental receiver operation, digital receiver performance, eye diagrams, coherent detection: homodyne and heterodyne, burst mode receiver, analog receivers.

Digital links: point to point links, link power budget, rise time budget, power penalties. Analog links: overview of analog links, carrier to noise ratio, multichannel transmission techniques.

MODULE-V

Optical technologies Wavelength division multiplexing (WDM) concepts: operational principles of WDM, passive optical star coupler, isolators, circulators, Active optical components: MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, polarization controller, chromatic dispersion compensators. Optical amplifiers: basic applications and types of optical amplifiers, Erbium Doped Fiber Amplifiers (EDFA): amplification mechanism, architecture, power conversion efficiency and gain. Amplifier noise, optical SNR, system applications. CWDM & DWDM.

Performance Measurement and monitoring: measurement standards, basic test equipment, optical power measurements, optical fiber characterization, eye diagram tests, optical time- domain reflectometer, optical performance monitoring.

References:

1. G. Keiser: Optical Fiber Communications, 4th Edition, TMH New Delhi.
2. J. M. Senior: Optical Fiber Communication- Principles and Practices, 2nd Edition, Pearson.
3. G. P. Agarwal: Fiber Optic Communication Systems, 3rd Edition, Wiley India Pvt. Ltd.Education.

4. J. C. Palais: Fiber Optics Communications, 5th Edition, Pearson Education.

5. R.P. Khare: Fiber Optics and Optoelectronics, Oxford University Press.

6. A. Ghatak and K. Thyagrajan: Fiber Optics and Lasers, Macmillan India Ltd.

7. S. C. Gupta: Optoelectronic Devices and Systems, PHI Learning.

8. Sterling: Introduction to Fiber Optics, Cengage Learning.

List of Experiments:

1. Launching of light into the optical fiber

2. Observing Holograms and their study.and calculate the numerical aperture and V-number.

3. Optic version Mach-Zehnder interferometer.

4. Measurement of attenuation loss in an optical fiber.

5. Diffraction using gratings.

6. Construction of Michelson interferometer.

7. Setting up a fiber optic analog link and study of PAM.

8. Setting up a fiber optic digital link and study of TDM and Manchester coding.

9. Measurement of various misalignment losses in an optical fiber.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand basics of optical fibers
CO2	Knowledge of various light sources
CO3	Describe various detectors and other theoretical aspects of fibers
CO4	Illustrate various optical receivers
CO5	Elaborate optical technologies

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC75	Antenna & Wave Propagation	70	20	10	30	20	150	3	-	2	4

MODULE-I

Introduction to antenna: antenna terminology, radiation, retarded potential, radiation field from current element, radiation resistance of short dipole and half wave dipole antenna, network theorems applied to antenna, self and mutual impedance of antenna, effect of earth on vertical pattern and image antenna,

MODULE-II

Antenna arrays: of point sources, two element array, end fire and broad side arrays, uniform linear arrays of n-elements, linear arrays with non-uniform amplitude distribution (binomial distribution and Chebyshev optimum distribution), arrays of two-driven half wavelength elements (broad side and end fire case), principle of pattern multiplication.

MODULE-III

Types of antennas: Babinet's principles and complementary antenna, hornantenna, parabolic reflector antenna, slot antenna, log periodic antenna, loop antenna, helical antenna, biconical antenna, folded dipole antenna, Yagi-Uda antenna, lens antenna, turnstile antenna. Long wire antenna: resonant and travelling wave antennas for different wave lengths, V-antenna, rhombic antenna, beverage antenna, microstrip antenna.

MODULE-IV

Antenna array synthesis: introduction, continuous sources, methods-Schelknoff polynomial method, Fourier transform method, Woodward- Lawson method, Taylor's method, Laplace transform method, Dolph- Chebychev method, triangular, cosine and cosine squared amplitude distribution, line source, phase distribution, continuous aperture sources. Beam forming.

MODULE-V

Propagation of radio wave: structure of troposphere, stratosphere and ionosphere, modes of ground wave propagation, duct propagation. Sky wave propagation: Mechanism of Radio Wave Bending by Ionosphere, critical angle and critical frequency, virtual height, skip distance and LUF, MUF. Single hop and multiple hop transmission, influence of earths magnetic field on radio wave propagation, Fading Space Wave Propagation: LOS, effective earth's radius, field strength of space or tropospheric propagation.

Reference Books:

1. J. D. Krauss: Antennas; for all applications, TMH.
2. R. E. Collin, Antennas and Wave Propagation, Wiley India Pvt. Ltd.
3. C. A. Balanis: Antenna Theory Analysis and Design, Wiley India Pvt. Ltd.
4. Jordan and Balmain: Electromagnetic Fields and Radiating System, PHI.
5. A. R. Harish and M. Sachidananda: Antennas and wave propagation, Oxford University Press.
6. K. D. Antennas and Wave Propagation, SatyaPrakashan.
7. B. L. Smith: MordernAnteenas, 2nd Edition, Springer, Macmillan India Ltd.

Course Outcomes: Upon successful completion of course students will be able to:

CO1	Understand various antenna terminologies
CO2	Designing of antenna arrays
CO3	Knowledge of working of various types of antenna
CO4	Synthesize various antenna arrays
CO5	Differentiate between various mechanism of propagation of radio waves

LIST OF EXPERIMENTS

1. To study the variation of field strength of radiated wave, distance from transmitting
2. To plot radiation pattern of an omni directional antenna.
3. To plot the radiation pattern of a directional antenna. (Yagi-Uda 3- elements)antenna.
4. To study the phenomenon of linear & circular polarization of antennas. hence
5. To demonstrate that the transmitting and receiving pattern of an antenna are equal &conform the reciprocity of the antennas
6. Study of dipole antenna/ folded dipole antenna & its radiation pattern.
7. Study of Yagi (3ele/4ele) antenna & its radiation pattern
8. Study of Log-periodic antenna & its radiation pattern.
9. Study of Parabolic reflector & its construction & its radiation pattern.
10. Study of Loop antennas, (Quad & Square loop) construction & its radiation pattern.
11. Study of Biconical antenna, construction & its radiation pattern
12 Study of Horn antenna
13. Study of Rhombic antenna

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