FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS

FOR

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS)

(SEMESTER: I – IV)

(Credit Based Evaluation and Grading System)

SESSION: 2019-20

GURU NANAK DEV UNIVERSITY AMRITSAR

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER SYSYEM)
(Credit Based Evaluation and Grading System)

Semester – I:

		CREDITS		
Course Code	**Course Name**	**L**	**T**	**P**
ECL 511	Fiber Optic Communications	4	0	1
ECL 512	Analysis of Digital Communication Systems	4	0	0
ECL 514	Microwave Circuits	4	0	0
ECL 517	Data Communication and Networking	4	0	0
ECP 516	Term Paper – I	0	0	1
Sub Total:		**16**	**0**	**2**
Total Credits:		**18**		

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Semester – II:

CREDITS

Course Code	**Course Name**	**L**	**T**	**P**
ECL 522	Information Theory and Coding	4	0	0
ECL 523	Wireless & Mobile Communication System	4	0	0
ECL 524	Photonic Network and Switching	4	0	0
	Interdisciplinary Course	4	0	0
ECP 526	Communication Systems Simulation Lab using Matlab	0	0	1
ECP 527	Term Paper – II	0	0	1
Sub Total:		**15**	**0**	**2**
Total Credits:			**18**	

Note:-
PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. in any semester except Semester 1st. This ID Paper is one of the total ID Papers of this course.

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Semester – III

Course Code	Course Name	L	T	P
	Elective I	4	0	0
ECL–614	Digital Signal Processing	4	0	0
ECL–615	Microwave Communication Systems	4	0	0
	Interdisciplinary Course–II	4	0	0
ECP–618	Term Paper III	0	0	1
	Sub Total:	**16**	**0**	**1**
	Total:		**17**	

***Credit for Term Paper**

Elective Courses:

ECL–601 Image Processing	4	0	0
ECL–602 Integrated Optics	4	0	0
ECL–603 Radiating Systems	4	0	0
ECL–604 Detection & Estimation Theory	4	0	0
ECL–605 Telematics	4	0	0
ECL–606 Microwave Materials	4	0	0
ECL–607 Advance Computer Architecture	4	0	0
ECL–608 Neural Networks	4	0	0
ECL–609 Fuzzy Logic Processing	4	0	0
ECL–610 Communication Networks	4	0	0
ECL–611 Operational Research	4	0	0
ECL–612 Nano Technology Applications in Engineering	4	0	0
ECL–613 Bio Informatics	4	0	0
ECL–617 Quantum Transport & Nano Electronics	4	0	0
ECL–619 Biomedical Signal Processing	4	0	0

Note:

- **PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. this paper in any odd semester. This ID Paper is one of the total ID Papers of this course.**

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Semester–IV

Course Code Course Name	**L**	**T**	**P**
ECD–621 Dissertation	0	0	15

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–I)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Fiber Optic Communications**
Course Code	**:**	**ECL-511**
Credits (L-T-P)	**:**	**5 (4-0-1)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

1. To make students aware of optical communication systems using optical fibers and to provide basic understanding regarding the signal degradation in optical fiber.
2. Making students capable of understanding the basic principle of working of transmitters and receivers used in optical fiber communication.
3. To provide the students capability to analyse a point to point optical link.
4. To provide knowledge about WDM based fiber optic systems.
5. To provide basic information regarding the latest developments in optical communications.
6. To provide practical exposure regarding the basic optical communication systems and components required for the same.

Total No. of Lectures – 44

	Lecture wise Breakup	**Number of Lectures**
	SECTION - A	
1	1. Introduction: Evolution of optical communication systems, elements of optical fiber transmission link. Comparison of optical communication systems with other contemporary communication systems. 2. Optical Fibers & Signal Degradation: Basics of optical fibers. Attenuation and dispersion effects in single mode and multimode optical fibers. Control of dispersion in single mode & multimode fibers. Non linear effects in single mode fibers and their control.	11
	SECTION - B	
2	3. Transmitter Receivers & Modulators: Light emitting diodes, laser diodes, their structures, efficiency of laser diodes, functional block diagram & typical circuits of transmitter. P.i.n & A P D photodiodes noise sources in photo detectors, SNR and noise equivalent power, sensitivity & quantum limit of receivers. Functional block diagram and typical circuits of a receiver, decision circuit design, Electro- optic, electroabsorption & acousto-optic external modulators.OPTICAL DETECTORS: p–i–n photo detector, avalanche photo detector, photo detector noise.	11

SECTION - C		
3	4. Digital Transmission Systems: Point to Point link, system considerations, link power, budget & rise time budget analysis. Line coding techniques, NRZ, RZ, Manchester etc. eye pattern analysis. 5. Introduction to Wavelength Division Multiplexed system, Components of WDM systems: Couplers and Splitters, FBT Couplers, WDM Multiplexers and Demultiplexers, Fixed and tunable filters, Isolators, Circulators and attenuators.& ODE's .	11
SECTION - D		
4	6. Latest developments in optical communications: Basic Concepts of Li-fi and Free space optical communications. Basic study of degradation of optical signals due to various environmental factors in free space communication.	11

Practical:	
1	The students will perform the experiments on optical fiber characterization, Link power budget and Risetime budget evaluation, BER analysis from eye diagrams. Study of WDM optical communication systems, Crosstalk in WDM components. Study of non-linear effects in optical communication systems.

Course Outcomes:	
1	Section 1 of the syllabus covers the first objective.
2	Section 2 covers the second objective.
3	Section 3 covers the third, fourth and fifth objectives.
4	The practical sessions of this course have been designed to provide a good exposure of practical fiber optic communication system.
Suggested / Reference Books:	
1	G. Keiser, "Optical Fiber Communications", McGraw Hill, 2009.
2	D.K. Myanbaev & Lowell L. Scheiner, "Fiber Optic Communication Technology", Pearson Education
3	G.P. Agrawal, "Nonlinear Fiber Optics", Academic Press, 2009.
4	J.M. Senior, "Optical Fiber Communications", Prentice Hall, India, 2008.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION
(COMMUNICATION SYSTEMS) (SEMESTER – I)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Analysis of Digital Communication Systems**
Course Code	**:**	**ECL-512**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

At the end of this course, the student should be able to understand the

- mathematical background of communication signal analysis
- analysis of different noise components present in communication systems
- performance analysis of a digital communication system in presence of noise
- optimal detection of received signal with different modulation techniques

Total No. of Lectures –60

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Review of Fourier Transforms, Random Processes Probability, Probability density function, Gaussian, density function, Rayleigh probability density, Correlation between random variables, Autocorrelation, Power spectral density of random sequences.	14
	SECTION - B	
2	Noise, spectral components of noise, Linear filtering of Noise, Noise Factor, Noise Temperature, Noise bandwidth, Narrowband Noise, Quadrature components of noise, Properties of Narrowband Noise components, Sampling Theorem, Natural and Flat-Top Sampling, Pulse modulations, Digital Transmission of Analog signal, Quantization, Pulse Code Modulation, Delta Modulation.	16
	SECTION - C	
3	Digital Modulation Schemes, PSK, QPSK, MPSK, QAM, FSK, MSK, OFDM, Performance analysis of Digital Modulation schemes.	14

SECTION - D		
4	Optimal Reception of Digital Signal, Probability of error, Probability of error of the digital modulation schemes, Comparison of digital modulations. Performance analysis of Noise in Pulse Code Modulation and Delta Modulation.	16

Course Outcomes: After the completion of course, the student will be able to	
1	Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise
2	Analyze the different noise components present in PCM and Delta modulation
3	Analyze the performance of digital communication system in terms of bit error rate and probability of error for different modulation schemes

Suggested / Reference Books:	
1	Communication System −Taub Scuilling, McGraw-Hill Education.
2	Digital Communication System−Simon & Haykin, John Wiley & Sons.
3	Communication Systems−RP Singh & Sapre, Tata McGraw-Hill Education.
4	Principals of Communication System− J. Das, Wiley Eastern Limited.
5	Digital Communications: Fundamentals and Applications − Sklar and Ray, Pearson Publications.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER – I)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Microwave Circuits**
Course Code	**:**	**ECL-514**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

At the end of this course, the student should be able to understand and gain complete knowledge about microwave measurements, components, devices such as amplifiers, oscillators and mixers.The student learns how to design amplifiers, understand the concept of stability, analyze various other Solid State Devices and to gain complete knowledge about RF basic concepts, RF filter design

Total No. of Lectures – 40

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Circuit Theory for Waveguide System: Impendence description of waveguide elements and circuits, one port circuit, N port circuit. Normalized impendence and admittance matrix, Two port junction, scattering matrix formulation, properties of scattering matrix, Scattering matrix for two port junction, Magic T, E plain & H plain T, directional couples, rat race, Smith chart, Circulators, Isolators, Attenuators.	10
	SECTION - B	
2	Periodic Structure and Filters: Introduction, maximally flat filter, Characteristics, Chebyshev filter, low pass filter design, low pass to Band pass transformation, low pass to high pass transformation, Microstrip parallel coupled filter examples.	10
	SECTION – C	
3	Solid State Amplifiers: Bipolar transistors at microwave frequency, FET microwave transistors, microwave amplifiers design using Scattering Matrix parameters, Amplifiers gain derivation, Amplifier stability circle, conditionally stable devices, constant power gain circles, unstable devices, Stable Device, Unstable Devices, Constant noise figure circles, constant mismatch circles, output impendence mismatch circle, Single stage amplifier design, two stage amplifier design, Low noise amplifiers design.	12

SECTION - D		
4	Oscillators and Mixers: Gunn diode Oscillator, IMPATT diode oscillator, Transistor oscillator, oscillator circuit, linear mixer operation, non-linear mixer, balanced mixer.	8

Course Outcomes:	
1	To discuss the basic operation, characteristic and working of various microwave components like E&H plane Tee, Magic tee, directional couplers, isolators and circulators etc.
2	Become proficient with microwave measurement of power, frequency and VSWR, impedance forthe analysis and design of circuits.
3	Design and analysis of various RF filters and their transformations.
4	Able to find various applications of microwave engineering in specific area.
5	Design and implement the microwave amplifier, oscillator, and mixer circuits

Suggested / Reference Books:	
1	Robert. E Collin, Foundation of Microwave Engineering, McGraw Hill, 2006
2	SY Liao, Microwave Circuit Analysis and Amplifier Design, Prentice Hall, 2006
3	GD Vendelin, A.M.Pavio, U.L. Rahde, Microwave Circuit Design, Using Linear and Non LinearTechniques, John Wiley, 1990
4	Y.Konishi, Microwave Integrated Circuits, Marcel Dekker, 1991
5	David M.Pozar, Microwave Engineering, John Wiley & Sons, 4th Edition.
6	G.S. Raghuvanshi, Microwave Engineering, Cengage learning India, 2012.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER – I)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Data Communication and Networking**
Course Code	**:**	**ECL-517**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

- At the end of this course, the student should be able to understand concept of network architecture, network standards and network models.
- Demonstrate the ability to unambiguously explain networking as it relates to the connection of computers, media, and devices (routing).
- Understand the concept of congestion and congestion control strategies in Data networks
- Concept of Data Security and Encryption algorithms for Electronic Transactions

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Chapter 1: Overview of Data Communications & Networking:** Data Communication, Computer Network, Types, Network Standards, Networking Models, Data Transmission Modes, Multiplexing & Switching, Network Architecture, Layered Architecture, OSI Reference Model, TCP/IP Model. **Chapter 2: Network Hardware Components:** Connectors, Transceivers, Media Converters, repeaters, Network Interface Card (NIC), Bridges, Switches, Routers, Gateways, Virtual Private Network (VPNs)	12
	SECTION - B	
2	**Chapter 3: High Speed Network:** X.25, Frame Relay, Asynchronous Transfer Mode (ATM) High Speed LAN – Ethernet, FastEthernet, Gigabit Ethernet, Fiber Channel, Wireless LANs, Wimax, SONET, FDDI, ISDN. **Chapter 4: Internet Routing:** Routing Protocols, Interior Routing Protocols, Exterior Routing Protocols	12

	SECTION - C	
3	**Chapter 5: Congestion & Traffic Management:** Congestion control in Data Networks & Internets, Flow & Error Control, TCP Traffic Control, Traffic and Congestion Control in ATM Networks **Chapter 6: Emerging Trends in Computer Networks** Mobile Computing, Mobile Ad-hoc Networks, Wireless Sensor Networks, Wireless Mesh Networks, Computational Grids, P2P Networks	12
	SECTION - D	
4	**Chapter 7: Network Security:** Issues, Threat Assessment, Network Attacks, Firewalls, Encryption Methods, Block Ciphers, Stream Ciphers, Symmetric and Asymmetric Ciphers, Digital Certificates, Network Access Control and Cloud Security,IP security	12

Course Outcomes:	
1	Understand the concept of reliable and unreliable transfer protocol of data and how TCP and UDP implement these concepts, to understand the client/server model and socket API with their implications,
2	Demonstrate an understanding of the significance and purpose of protocols and standards and their key elements and use in data communications and networking
3	Understand the purpose of network layered models, network communication using the layered concept, and able to compare and contrast Open System Interconnect (OSI) and the Internet Model.

Suggested / Reference Books:	
1	Michael A. Gallo & William M. Hancock; Computer Communications & Network Technologies: Thomson Publications, 2017
2	William Stallings; High Speed Networks & Internets: PEARSON Publications, 2015
3	William Stallings; Computer Networking with Internet Protocols & Technology:
4.	ATUL KAHATE; Cryptography & Network Security: Tata McGraw Hill, 2017
5.	William Stallings; Cryptography and Network Security, Pearson India 2018

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–II)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Information Theory and Coding**
Course Code	**:**	**ECL-522**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

- To make students awared about information theory and coding.
- Concept of noiseless and noisy techniques channel and techniques for information transmission.
- Concept of channel capacity and application of various codes.

Total No. of Lectures – 40

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Information Theory, Information Rate and Coding to increase average information per bit.	10
	SECTION - B	
2	Mutual information, entropy for discrete ensembles, Shannon's noiseless coding theorem; Encoding of discrete sources.	10
	SECTION - C	
3	Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.	10
	SECTION – D	
4	Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolution arithmetic codes.	10

Course Outcomes:	
1	• Students understand the concept of various coding and decoding techniques. • Students are able to differentiate between the noisy and noiseless channel coding concepts.

Suggested / ReferenceBooks:	
1	R.B. Ash, Information Theory, Prentice Hall India, 2006.
2	Modern Analog & Digital Communication System by BP Lathi, 4th Edition, Oxford
3	Communication Systems by Singh and Sapre PHI, 2007.
4	Digital Communication Systems by Simen Hakins TMH, 2006.
5	Principles of Digital Communication by J Das, SK Mullick and PK Chatterjee, PHI, 2006.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–II)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Wireless & Mobile Communication System**
Course Code	**:**	**ECL-523**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

- Challenges for wireless communication.
- Propagation related various models.
- Concept of Digital Modulation in context of error and probability.
- Various Fading Mitigation techniques.
- Concept of Multicarrier techniques.

Total No. of Lectures – 40

	Lecture wise breakup	Number of Lectures
	SECTION – A	
1	**Overview of wireless Communications:** History, Current Wireless Systems and Standards, Technical Challenges of Wireless Communications. Wireless Propagation Channels: Path Loss and Shadowing, Free-Space and Empirical Path Loss Models, Shadow Fading, Time-Varying Channel Impulse Response,	10
	SECTION – B	
2	**Digital Modulation and its Performance**: Error Probability of Digital modulations in AWGN Channels, Outage Probability and Average Probability of Error in Flat-Fading Channels, Error Probability in Delay-and Frequency-Dispersive Fading Channels.	10

	SECTION – C	
3	**Fading Mitigation Techniques:** Diversity, Realization of Independent Fading Paths, Receiver Diversity, Selection Combining, Threshold Combining, Maximal Ratio Combining, Equal-Gain Combining, Transmitter Diversity, Adaptive Transmission System, Adaptive Techniques. Multiantenna Systems: Smart Antennas and its Receiver Structures, MIMO Model, Channel State Information, MIMO Capacity in Flat-Fading Channels, MIMO Diversity gain and Spatial Multiplexing Gain.	10
	SECTION – D	
4	**Multicarrier Techniques:** Multicarrier Modulation with Overlapping Subchannels, Mitigation of Subcarrier Fading, Discrete Implementation of Multicarrier Multicarrier Modulations, Multicarrier Code Division Multiple Access.	10

Course Outcomes:	
1	• Students understand wireless communication fundamentals. • Students can apply the suitable fading mitigation technique depending upon the application. • Students know how to apply multicarrier modulation techniques in different scenarios.

Suggested / Reference Books:	
1	Andrea Goldsmith, 'Wireless Communications', Cambridge University Press, 2005.
2	Andreas F. Molisch, 'Wireless Communications', Second Edition, John Wiley, 2011.
3	I.P. Mohana Shankar, 'Fading and Shadowing in Wireless Systems,' Springer, 2012.
4	Theodore S. Rappaport, 'Wireless Communications Principles & Practice', PHI, 2002.
5	J.W. Mark & W. Jhuang, 'Wireless Communications & Networking,' PHI, 2006.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–II)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Photonic Network & Switching**
Course Code	**:**	**ECL-524**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

- To make students aware of various multiplexing techniques in optical communication networks.
- To make students aware of optical networks, design issues of WDM based optical networks and PONs.
- To make students capable of understanding the optical switching technologies being used in the networks.

Total No. of Lectures – 40

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Introduction: Introduction to basic optical communication & devices, WDM optical Network evolution. Optical Multiplexing Techniques: Wavelength Division multiplexing, Optical time division multiplexing & optical code division multiplexing.	10
	SECTION - B	
2	Optical Networks: Why optical networks? Conventional optical networks, SONET/SDH, FDDI and DQDB,	10
	SECTION – C	
3	WDM optical networks architectures and issues in wavelength routed networks. All Optical Networks: Amplification in all optical networks. Design issues of WDM based optical Networks. Passive Optical Networking and some common PON architectures.	10

SECTION - D		
4	Optical Switching & Routing: Optical switching, example of an optical switch using 2 x 2 coupler, evolution of switching technologies, switching architectures, Micro Electro Mechanical Systems (MEMS), free space optical switching, thermoptic & bubble switches, optical routers. Protection of optical switched path. Wavelength converters, Implementation of wavelength converters using optoelectronics approach, Optical Gating, Interferometric techniques & Wave mixing.	10

Course Outcomes:	
1	Students will be capable of understanding the functioning of optical networks, passive optical networks and will also be able to understand various design issues of the wavelength routed optical networks. The course work also provides the knowledge regarding the passive & active components of fiber optic networks

Suggested / Reference Books:	
1	Uyless Black, 'Optical Networks', Pearson Education, 2008.
2	D.K. Mynbaeu & L. Scheiner, 'Fiber Optic Communication Technology', Pearson Edu.Asia, 2008.Asia,
3	C. Siva Ram Murthy & M. Gurusamy, 'WDM Optical Networks' Pearson Education, 2009.
4	RG Gallager & D Bertsekas, 'Data Networks', PHI, 2006.
5	R. Ramaswami & Kumar N. Sivarajan, "Optical Networks – A Practical Perspective" Second Edition, Morgan, Kaufonan Publishers and Imprint of Elsevier.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Image Processing**
Course Code	**:**	**ECL-601**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The students will get the understanding of the digitized colour layers of an image. Understanding about the image properties like hue, saturation, brightness, contrast etc. Various algorithms for image transformation and colour enhancement.

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Image Representation and Modeling:** Fourier transform, z– transform, optical and modulationtransfer functions, Matrix theory results, block matrices, Random signals, Discrete randomfields, spectral density functions, results from estimation theory.	12
	SECTION – B	
2	**Image Perception:** Light, luminance, brightness and contrast, MTF of Visual system, Visibility function, Monochrome vision methods, Image fidelity criteria, color matching and reproduction, color coordinate systems, color difference measures, color vision model, Temporal properties of vision. **Image Sampling & Quantization:** Introduction, two dimensional sampling theory, Extensions of sampling theory, Practical limitations in sampling and reconstruction, Image Quantization,Optimum mean square or lloyd Max quantizer, A compandor design.	12

SECTION – C		
3	**Image Transform:** Two dimensional orthogonal and unitary transforms, properties of unitarytransforms, Two dimensional DFT, Cosine transform, KL–transform. Image Representation by Stochastic Models: Introduction, One dimensional causal models, One dimensional Spectral Factorization, AR Models, linear prediction in two dimension, Image decomposition, Fast KL transforms. Image Enhancement: Point Operations, Spatial Operations, Transform Operations, Multispectral.	12
SECTION – D		
4	Image Enhancement, False Color and pseudocolor, color image enhancement. Image Filtering and Restoration: Introduction, Image observation models, Inverse and Wiener filtering, FIR Wiener filters, Fourier domain filters, filtering using image transforms, Smoothing splines and Interpolation, least square filters, Generalized inverse, SVD and Iterative methods, Recursive filtering for state variable system, causal models, Semi–causal models, Digital processing of speckle images, Maximum entropy restoration, Bayesian methods.	12

Course Outcomes:	
1	Ability to understand the dimensions of an image file with bit wise color depth.
2	Students will be able to enhance and manipulate the image and do research related activities.

Suggested / Reference Books:	
1	Digital Image Processing by Keenneth R Castleman, Pearson Education Society.
2	Digital Image Processing by Rafact Gonzalez and Richard E. Woods, Pearson Edu.Society.
3	Related IEEE/IEE Publications.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Integrated Optics**
Course Code	**:**	**ECL-602**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. The advancements in optical fiber domain.
2. Introduction to the passive optical devices and various other devices used in the optical networks.
3. Methods to improvise the throughput of an optical network.

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Optical Wave Guide Analysis:** Single mode waveguide analysis, loss mechanisms, Material attenuation, waveguide attenuation, Dispersion in single mode waveguide, standard waveguide profiles & bandwidth considerations.	12
	SECTION – B	
2	**Planar Waveguide Integrated Optics:** Overview of planar waveguide components, phase matching at a single interface, the FTIR beam splitter, prism coupler, phase matching for guided modes, respective optical components gratings, gratings in guided wave optics. **Channel Waveguide Integrated Optics:** Channel waveguide types, input & output couplings, sources of propagation loss, polarizer, mirrors, tapes & Y–Junctions, phase modulators, Frequency shifting &high speed operation, Interferometers.	12
	SECTION – C	
3	**Optical Device Fabrication:** Overview, planar processing, substrate growth & preparation, Deposition & growth of materials, material modification, Etching lithography & Optical Fiber fabrication.	12

SECTION – D		
4	**Integrated Optics & Network Components:** Fiber optic switches & active couplers, fixed couplers, wavelength multiplexing & demultiplexing fiber optic modulators, VLSI Techniques applied to integrated optics.	12

Course Outcomes:	
1	Understanding of various optical network components.
2	Ability to design and conduct a research upon a network utilizing passive optical components.

Suggested / Reference Books:	
1	Richard Syms& John Cozens 'Optical Guided Waves & Devices, McGraw Hill International Ed.
2	Donald G. Baker, 'Monomode Fiber Optic Design with Local Area &Long Haul Network Applications" Van Nostrand Rainhold Company, New York.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Radiating Systems**
Course Code	**:**	**ECL-603**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. Understanding of various types of antennas, and their radiation patterns.
2. Latest trends in the antenna systems and communication systems.

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**1. Basic Concepts of Radiation:** Radiation mechanism, Current distribution on antennas, Fundamental Antenna parameters, Types of Antennas. **2. Analysis and Synthesis of Antennas:** Vector potential for electric and magnetic source, Antenna theorems, types of linear arrays, linear wire antennas– Infinitesimal, Small and Finite Length Dipole, Antenna synthesis– Schelkunoff Polynomial Method, Fourier Transform Method, Woodward–Lawson Method and Taylor Line–Source.	12
	SECTION – B	
2	**3. Antennas/ Antenna Measurement**: Different antennas–Dipole, loop, reflector, slot antennas, Microstrip Antennas– Feeding structure, Methods of Analysis. Antenna Measurement– Gain, Directivity, Impedance, Polarization and radiation pattern.	12
	SECTION – C	
3	**4. MIMO Communication Systems:** Introduction, Basic Principle, Types: SIMO, MIMO, Space time block codes, SISO & MIMO Characteristics, Space time transmit diversity, MIMO Capacity gain, MIMO radio Channel model.	12

SECTION – D		
4	**5. Smart Antennas**: Spatial Radio Channel, Spatial processing for wireless systems: introduction, Vector channel impulse response & the Spatial signature, Spatial processing receivers, fixed beam forming networks, switched beam system, Adaptive antenna systems, Wide band smart antennas, Digital radio receiver & software radio smart antennas.	12

Course Outcomes:	
1	Understanding of different types of antenna systems and their implementation.
2	Conduct a research on wireless communication system involving different antenna systems.

Suggested / Reference Books:	
1	Joseph C. Liberti, Theodore S. Rappaport–"Smart Antennas for Wireless Communications IS95 and Third Generation CDMA Applications", Prentice Hall, Communications Engineering and Emerging Technologies Series, 2007
2	Kraus J.D., "Antennas for all Applications", III Edition, TMH, 2005.
3	Collin R.E. and Zucker F.– "Antenna Theory" Part I, Tata McGraw Hill, 2005.
4	Balanis A., "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 2002.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Detection & Estimation Theory**
Course Code	**:**	**ECL-604**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:
To enable the students to acquire the knowledge about the basic concepts of signal detection and estimation. To formulate and solve problems for parameter estimation from noisy signals.Derive and apply linear filtering methods for parameter estimation and signal smoothing.

Total No. of Lectures – 48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**Signals and Systems:** System theory, Stochastic process, Gauss Markov models, Representation of Stochastic Process, Likelihood and Sufficiency. **Review of Random Processes:** Review of Probability Theory, Random variable, Two randomvariables, Moments and conditional statistics, Sequence of random variables, Random Process definition and classification, Stationary and non stationary process, correlation functions, Stochastic Integrals, Fourier transform of random process. Ergodicity and power spectral density, transformation of random process by linear systems. Representation of random processes via sampling, K–L sampling and narrow band representations, Special random processes (White	12
	SECTION – B	
2	**Hypothesis Testing:** Simple binary hypothesis tests, Decision Criteria, Neymanpearson tests, Bayes Criteria, Receiver operating characteristics, Multiple Hypothesis testing, Composite hypothesis testing, Asymptotic Error rate of LRT for simple hypothesis testing. **Detection Theory**: CFAR Detection, Sequential detection, Walds test, Detection of knownsignals in white noise: the correlation receiver, Detection of known signals in coloured noise, Maximum SNR Criteria. Detection of signals with unknown	12

	SECTION – C	
3	**Estimation Theory:** Bayes estimation, Real parameter estimation, Maximum likelihoodestimation, Cramer Rao inequality, lower bound on the minimum mean square error inestimating a random parameter, Multiple parameter estimation bound on estimation errors of non random variables, General gaussian problem.	12
	SECTION – D	
4	**Estimation of Waveforms:** Linear MMSE of waveforms, Estimation of stationary process: The Wiener Filter, Estimation of non–stationary process: The Kalman Filter, Relation between Kalman and Wiener filters, Non linear estimation. **Applications to Communication & Radar Systems:** Digital communication, Spread SpectrumCommunication, Radar Systems, Radar Target Models, Target detection, Parameter estimation in radar systems, Dynamic Target tracking.antenna systems, Wide band smart antennas, Digital radio receiver & software radio smart antennas.	12

Course Outcomes:	
1	Conduct in-depth analysis of estimation problems and apply suitable estimation and detection techniques that meet the constraints of the problem such as performance, bandwidth and power overheads and computational complexity.
2	Students will be able to carry out the research in the signal detection and estimation in communication.

Suggested / Reference Books:	
1	Detection Estimation and Modulation Theory – by HL Van Trees Wiley New York.
2	Introduction to Statistical Signal Processing with Application – by MD Srinath, PK.
3	Signal detection theory – by Hancock and Wintz.
4	Detection of signals and noise – by AD Whalen.
5	Related IEEE/IEE Publications.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Telematics**
Course Code	**:**	**ECL-605**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. How the communication system works and what different technologies are involved.
2. Technologies and protocols involved in the public communication networks.

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION – A	
1	**Introduction:** Evolution of telecommunication, simple telephone communication, Basic Switching system, Manual–switching system. **Cross–Bar Switching:** Principal of common control, touch–tone dial telephone, principles of cross bar switching, cross bar switching configuration, cross point technology, cross bar exchange organization.	12
	SECTION – B	
2	**Electronics Space Division Switching:** SPC, centralized SPC, distributed SPC, software architecture, application software, enhanced services, two, three and n–stage networks. Speech digitization and Transmission: Sampling, vocodors, TDM. **Time Division Switching:** Basic time division space and time switching, time multiplexed space and time switching, combination switching, three stages and N–stages combination switching.	12
	SECTION – C	
3	**Traffic Engineering:** Network traffic load parameters, grade of service, and blocking probability, modeling a switching systems, incoming traffic and service characterization, blocking models and loss estimates, delay systems. **Telephone Networks:** Subscriber loop system, switching hierarchy, and routing, transmission plan, transmission system, numbering plan, charging plan, signaling techniques, in–channel and common channel signaling techniques.	12

SECTION – D		
4	**ISDN:** Motivation, new services, network and protocol architecture, transmission channel, user networks interface, signaling, numbering and addressing, service characterization, internetworking ISDN standards.	12

Course Outcomes:	
1	Ability to understand various communication systems and communication protocols.
2	Work on the research related activities based on various protocols and public communication networks.

Suggested / Reference Books:	
1	Thiagarajan Viswanathan, "Telecommunication Switching System and Networks", 1st
2	John Bellamy, "Digital Bellamy", 3rd Edition, John Willey, 2000.
3	J.E Flood, "Telecommunications Switching, Traffic and Networks", Pearson Education,

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Microwave Materials**
Course Code	**:**	**ECL-606**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. The understanding of various microwave components, materials and their properties.
2. Understanding of various types of ceramic microwave materials.
3. The lattice structure of the microwave materials.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**1. Electronics of Materials: –** Crystal structure: Lattice type, Defects, reciprocal lattice, Miller indices. Band theory, band structure of Si and III–V semiconductors. Carrier Transport Boltzmann transport theory, relaxation time approximation, high field transport and hot carrier effects, Hall Effect	12
	SECTION – B	
2	**2. Introduction to materials:** types–semiconductor, conductor, dielectric and magnetic materials. **3. Ceramic materials–** introduction, types of ceramics, properties and its applications.	12
	SECTION – C	
	4. Magnetic materials– different types, properties and applications.	12
	SECTION – D	
4	**5. Glasses and glass ceramics–** Introduction, composition and structure, properties and applications.	12

Course Outcomes:	
1	The understanding and ability to differentiate various microwave materials based on lattice structure and their properties.
2	Ability of implementation of the microwave properties in research related activities.
Suggested / Reference Books:	
1	Microwave electronics by L.F. Chen, C.K. Ong and CP Neo, John Wiley & Sons Ltd.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Advance Computer Architecture**
Course Code	**:**	**ECL-607**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:
The objective of the course is to provide in-depth exposure of evolving trends in computer architecture, focusing on performance of a computer. The course emphasis is on studying essential topics in architecture design like pipelining and parallel processing and their impact on application performance.

Total No. of Lectures – 48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**1. Introduction:** Elements of modern computers, Evolution of computer architecture, system attributes to performance, Multiprocessors & Multi computers– Shared memory, Distributed memory, Multivector and SIMD computers– Vector & SIMD super computer.	12
	SECTION - B	
2	**2. Bus Cache & Shared Memory:** Backplane bus systems– specification, addressing & timing protocols, arbitration, transaction & interrupt. Cache Memory Organization: Cache addressing Models, Direct Mapping & Associative Cache, Cache performance issues. Shared Memory Organization: Interleaved Memory Organization, Bandwidth & Fault tolerance, Memory Allocation schemes. **3. Pipelining & Superscalar Techniques:** Linear pipeline processors, nonlinear pipeline processors, Instruction pipeline design, Arithmetic pipeline design, superscalar & super pipeline design.	12
	SECTION – C	
3	**4. Parallel & Scalable Architecture:** Multiprocessor system interconnects cache coherence & Synchronization mechanisms, message passing mechanism, Vector processing principles, compound vector processing, SIMD Computer organization, Latency–Hiding techniques– Shared virtual memory, Perfecting techniques, Distributed coherent caches, Principles of Multithreading: Issues & Solution, Dataflow computer architectures, control flow vs data flow, advantage & potential problems, Static & dynamic data flow computers, data flow design alternatives.	12

SECTION – D		
4	**5. Multiprocessing Control & Algorithms**: Interprocessor communication Mechanisms, system deadlock & protection, Multiprocessor scheduling strategies, parallel algorithm formultiprocessors:	12

Course Outcomes:
A student who has successfully completed this course should be able to: 1. Examine various performance parameters of a computer system. 2. Understand advanced issues in design of computer processors, caches, and memory. 3. Analyze performance trade-offs in a computer design. 4. Apply knowledge of processor design to improve performance in algorithms.

Suggested / Reference Books:	
1	Computer Architecture by Nicholas Carter, McGraw Hill–Schaum Series.
2	Computer Architecture & parallel processing by Kai Hwang & Faye A Briggs McGraw Hill.
3	Advance Computer Architecture by Kai Hawang, TMH.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Neural Networks**
Course Code	**:**	**ECL-608**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. Basic to advance understanding of the neural networks.
2. Various architectures involved in the neural networks.
3. Application of the neural networks in various research related activities.

Total No. of Lectures –48

	Lecture wise breakup	Number of Lectures
	SECTION – A	
1	1. Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, supervised, Unsupervised, Re–enforcement learning, Knowledge representation and acquisition.	12
	SECTION – B	
2	2. Basic Hop field model, Basic learning laws, unsupervised learning, Competitive learning, K–means clustering algorithm, Kohonen's feature maps.	12
	SECTION – C	
3	3. Architecture of Back propagation network, single perceptron and multilayer perceptron, Back propagation learning, BP algorithm.	12
	SECTION – D	
4	4. Applications of neural nets such as pattern recognition, Associative memories, speech and decision making.	12

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Outcomes:	
1	Understanding of various architectures involved in neural networks.
2	Carry out research in the field of neural networks.

Suggested / Reference Books:	
1	Artificial Neural Networks by B. Yegnatoarayana.
2	Neural Networks & Fuzzy Logic by Bart Kosko.
3	Neural Computing Theory & Practice by P.D. Wasserman (ANZA PUB)
4	Introduction to Artificial Neural Systems– by J.M. Zurada (Jaico Pub)
5	Architecture of Back Propagation Network, Single Perception and Multilayer Perceptron

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Fuzzy Logic Processing**
Course Code	**:**	**ECL-609**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

Fuzzy logic allows the problems to be defined in the basic terms instead of the exact numeric terms, this course will enable the students to understand the basicity of the problem and methods to solve the same by use of various fuzzy logics.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**Introduction to Fuzzy sets and Fuzzy logic:** The uncertain and inexact nature of the real world, ideas and examples, fuzzy membership function, fuzzy numbers and fuzzy arithmetic, basic concept and properties of fuzzy logic versus classical two valued logic.	12
	SECTION – B	
2	**Fuzzy Information Processing:** Basic concept and techniques for fuzzy information processing.	12
	SECTION – C	
3	**Fuzzy Interface:** Fuzzy inference principles, fuzzy decision making, approximate reasoning. **Fuzzy rule base:** If–Then rules, general format of fuzzy rules base, establishment of fuzzy rule base.	12
	SECTION – D	
4	**Fuzzy modeling:** Static fuzzy modeling, dynamic fuzzy modeling. **Application:** Industrial Application.	12

Course Outcomes:	
1	Understanding principles of neural networks and fuzzylogic fundamentals
2	Design the required and related systems
Suggested / Reference Books:	
1	Introduction to fuzzy systems, by Guanrong Chen and Trung Tat Pham, Chapman & Hall, 2007.
2	Fuzzy Logic and Neuro Fuzzy Applications explained by C Van Altrock, Printice Hall, 2007.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Communciation Networks**
Course Code	**:**	**ECL-610**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

To get the understanding of the trends in the communication networks and get the working knowledge of the basic networking and internetworking technologies. To get the knowledge about the recent trends in networking and communication networks.

Total No. of Lectures – 48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Introduction:** Historic overview of wireless communications & Challenges in wireless communication networking, wireless communication standards.	12
	SECTION – B	
2	**Wireless LAN:** Infrared Vs radio transmission, infrastructure &adhoc networks, IEEE 802.11,HIPERLAN, Bluetooth, their system & protocol architecture, Physical & MAC layersecurity & link management.	12
	SECTION – C	
3	**Wireless ATM:** Motivation for WATM, reference model, radio access layer, handover, location management & access point control protocol. Mobility Management in wireless networks call admission control, Handoff management, local management for cellular, PCS network.	12
	SECTION – D	
4	**Wireless/Wire line Networking**: Mobile IP, IPV6 Vs IPV4, Mobile IPV6, TCP, Network Performance, WAP & Mobile ADHOC Networks.	12

Course Outcomes:	
1	The ability to understand the working of various wireless networks.
2	The ability to start a research on the cellular platforms as well as wireless computer networks
3	Understanding about the communication between the machines (layer 2 and layer 3 devices)

Suggested / Reference Books:	
1	J.W. Marks & W. Jhuang, 'Wireless Communications & Networking', PHI.
2	J. Schiller, 'Mobile Communication', Pearson Education.
3	T.S. Rappaport, 'Wireless Communication', Prentice Hall.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Operational Research**
Course Code	**:**	**ECL-611**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. The understanding of the methods involved while working on a research topic.
2. Various data optimization techniques their pros and cons.
3. Various simulation and data manipulation techniques.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**Linear Programming:** The theory of simplex solution, alternative optimal solution, unbounded solutions, infeasible solution, formulation of LP models for production scheduling, network planning, inventory maintenance and capital budgeting and similar industrial problems. Two phase methods, revised simpler method and dual simplex method sensitivity analysis.	12
	SECTION – B	
2	**Dynamic Optimisation Models:** Formulation of dynamic optimization models for commonindustrial problems. Optimisation of non linear objective function by dynamic programming.	12
	SECTION – C	
3	**Non–Linear Optimisation Models:** Non linear objective queuing function of unconstrainedvariables, quadratic programming. **Queues Models:** Queing with single and parallel channels with limited and unlimited service. Bulk services, priority queue discipline.	12
	SECTION – D	
4	**Simulation Models:** Generation of Random number, Use of Coeff random numbers for system simulation. Use of computers for system simulation.	12

Course Outcomes:	
1	Students can work on the research topics that involve data analysis, optimization and simulations.
2	Understanding of various optimization and simulation techniques.

Suggested / Reference Books:	
1	Fundamental of Operation Research by Ackoff&Sasieni: Wiley Eastern.
2	Principles of OR with Applications to Managerial Decision by Wagner, Prentice Hall.
3	Introduction to OR by Hillier & Lieberman Holder Day.
4	Operation Research by PK Gupta & DS Hira.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Nano Technology Applications in Engineering**
Course Code	**:**	**ECL-612**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. The understanding of nano-electronics and behavior of various materials at nano scale.
2. Applications of the nano devices in day to day basis.
3. How the nano components can be constructed.

Total No. of Lectures – 48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Introduction:**Introduction to nanoscale systems, length energy and time scales, top down approach to nanolithography, spatial resolution of optical, deep ultraviolet, x–ray, electron beam and icon beam lithography	12
	SECTION – B	
2	Single electron transistor, coulomb blockade effects in ultra small metallic tunnel junctions.	12
	SECTION – C	
3	**Quantum Mechanics:**Quantum confinement of electron in semiconductor nano structures, two dimensional confinement (Quantum wells) Band gap engineering, epitaxy Landaeur–Puttiker formation for conduction in confined geometrical, one dimensional confinement, quantum point contacts, quantum dots and Bottom up approach; Introduction to quantum methods for information processing.	12

SECTION – D		
4	**Molecular Techniques:**Molecular Electronics, Chemical self assembly, carbon nano tubes, self assemblednano layers, Electromechanical techniques, applications in biological and chemical detection, Atomic scale characterization techniques, scanning tunneling microscopy, atomic force microscopy.	12

Course Outcomes:	
1	Ability to carry out research related activities in the field of nano technology.
2	Understanding the difference between the behavior of component at normal scale and nano scale.

Suggested / Reference Books:	
1	Beenaker and Van Houten, "Quantum Transport in Semiconductor Nanostructures in Solid State Physics" Ehemreich and Turnbell, A Cademic Press, 1991.
2	David Ferry "Transport in Nao Structures" Cambridge University Press 2000.
3	Y. Imry "Introduction to Meroscopic Physics", Oxford University Press 1997.
4	S. Dutta "Electron Transport in Mesoscopic System" Cambridge University Press 1995.
5	H. Grabert and M Devoret "Single Charge Tunneling" Plenum Press 1992.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Bio Informatics**
Course Code	**:**	**ECL-613**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. A broad education in bioinformatics with strong basics in computer science, biology, and statistics.
2. A significant experience in a specific area of bioinformatics.
3. Ability to conduct independent research in bioinformatics.

Total No. of Lectures – 48

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Molecular Biology and Biological Chemistry:** The genetic material, Gene structure and information content, protein structure and function, the nature of chemical bonds, molecularbiology tools, genomic information content. Data Searches and Pairwise Alignments: Dot plots, Simple alignments, scoring, Gaps, Scoring matrices, The Needleman and Wunsch algorithm, local and global alignments, Database searches, multiple sequences alignments.	12
	SECTION - B	
2	**Substitution Patterns:** Patterns of substitutions within genes, Estimating substitution numbers, variations in substitution rates between genes, Molecular clocks, Evolution in organelles. Character–Based Approaches to Phylogenetics: Parsimony, Inferred ancestral sequences, strategies for faster searches, consensus trees, Tree confidence, comparison of phylogenetics methods, Molecular phylogenies.	12
	SECTION – C	
3	**Genomics and Goene Recognition:** Prokaryotic genomes, Prokaryotic gene structure, prokaryotic gene density, Eukaryotic genomes, Eukaryotic gene structure, Open reading frames, Gene expression, Transposition, Repetitive elements, Eukaryotic gene density. Protein Folding: Polypeptide composition, Secondary structure, Tertiary and quaternarystructure, Protein folding structure prediction.	12

SECTION – D		
4	**Proteomics:** Protein classification, Experimental techniques, Inhibitors and drug design, Ligand screening, X–ray crystal structure, Empirical methods and prediction techniques, Post translational modification prediction.	12

Course Outcomes:	
1	Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
2	Understand the structural and functional relationships, and molecular evolution.

Suggested / Reference Books:	
1	Fundamental Concepts of Bioinformatics by Dan Krane, Michel Raymor& Bryan Bergeson Publisher Addison Wesley.
2	Introduction to Bioinformatics: A Theoretical & Practical Approach by DawdD.Womble & Stephen A Krawetz Publisher: Humnana Press.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Digital Signal Processing**
Course Code	**:**	**ECL–614**
Credits (L-T-P)	**:**	**4 (3-1-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

At the end of this course, the student should be able to understand the key theoretical aspects of discrete-time processing, finite impulse response and infinite impulse response filters and modern multirate signal processing as well.

Total No. of Lectures –40

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	**Review of Discrete Time Signals and Systems:** Review of Signals & Systems, Z and Inverse, Z Transformation and their properties, Discrete and Fast Fourier Transforms.	12
	SECTION - B	
2	**Digital Filter Structures:** Structure of Digital Filter realizations, Basic FIR, IIR Structures (Direct form I & II) Cascade and parallel forms. **Design of FIR Filter Digital Filters:** Introduction, Advantages over IIR, Design Techniques for FIR Filters, Magnitude / Phase Response of Digital Filters, Design Techniques for FIR Filters.	12
	SECTION - C	
3	**Design from Analog Filter**, impulse invariant & Bilinear Transformation Techniques, Frequency Transformation.	08
	SECTION - D	
4	**Multirate Signal Processing**: Introduction Sampling Rate Conversion, Decimation and interpolation. Filter structures. **Application of DSP**: Radar, Communication, Image and Speech processing.	08

Course Outcomes: Students who successfully complete the course will be able to:	
1	Understand the basic concepts of discrete time signals and systems.
2	Determine the frequency response, the z-transform of discrete-time systems and the discrete Fourier transform of discrete-time signals.
3	Design and realization of finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters.
4	Understand the basic concepts of multirate signal processing. Also covered various applications of DSP.

Suggested / Reference Books:	
1	Digital Signal Processing by Proakis&Manolaki, Pearson Education Society, 2007.
2	Speech and Audio Processing for Multimedia PC's by Iain Murray.
3	Digital Image Processing by Keenneth R Castleman, Pearson Education Society, 2007.Prentice Hall.
4	Digital Image Processing by Rafact Gonzalez and Richard E Woods, Pearson Education Society, 2007.
5	Digital Signal Processing-A Computer Based Approach, S. K. Mitra 1st 2006 Tata McGraw Hill.
6	Related IEEE publications.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Microwave Communication Systems**
Course Code	**:**	**ECL–615**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:
At the end of this course, the student should be able to understand the concepts of Microwave and millimeter-wave communications.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Characteristics of Radio Wave Propagation: Attenuation and absorption, interference and noise, ground wave propagation, line of sight space wave propagation and effective earth radius, ionosphere propagation, virtual height, skip distance, maximum usable and critical frequency, troposphere scatter propagation.	12
	SECTION - B	
2	Line of Sight Microwave Relay Systems: Microwave transmitter, receiver and repeaters. Mobile radio propagation, free-space path loss, fading and its types, multi–path fading, diversity techniques - frequency diversity, space diversity, system link calculation, system gain, fade margin, outage probability.	12
	SECTION - C	
3	Satellite Microwave Systems: Satellite orbits and dynamics, Geo stationary orbits, Low Earth and Medium orbits, Frequency allocation and satellite footprints, Earth stations and satellite transponders, Noise considerations. Satellite uplink-down link budget calculations, C/No, G/T, Noise temperature, System noise. Multiple access methods, Mobile satellite systems, their uses and illustrative systems.	12

SECTION - D		
4	Modern Trends in Microwave Communication – Introduction to Millimeter Wave propagation, Characteristics, Transmitter, Receiver and Transceiver Technologies. Millimeter Wave link budget analysis.	12

Course Outcomes:	
1	At the end of this course, students will be able to visualize and analyze the microwave and millimeter-wave communication systems.
2	State various aspects related to radio wave propagation and satellite systems.
3	Solve numerical problems related to design of link budget for the given parameters and conditions.

Suggested / Reference Books:	
1	John D. Kraus, “Antenna and Wave Propagation”, TMH, 4th Edition, 2012
2	Wayne Tomasi, "Advanced Electronic Communications Systems”, PHI, 6th Edition, 2012
3	Huang, K.-C. and Wang, Z., “Millimeter wave Communication Systems”, John Wiley & Sons.
4	T.Pratt and CW Bostian, “Satellite Communication”, John Wiley & Sons, 2nd Edition, 2006.
5.	DC Aggarwal, “Satellite Communication”, 2nd Edition, PHI, 2nd Edition, Khanna Publishing, 2006

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Quantum Transport & Nano Electronics**
Course Code	**:**	**ECL-617**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

The objectives of this course are to provide students with:

1. Behavioral analysis of various quantum particles and nano materials.
2. Various quantum structures and their fabrication techniques.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**1. INTRODUCTION TO NANOELECTRONICS** The "Top Down" Approach, The "Bottom–up" Approach, Why Nanoelectronics, Nanotechnology Potential **2. CLASSICAL PARTICLES, CLASSICAL WAVES AND QUANTUM PARTICLES** Comparison of classical and Quantum Systems, Origins of Quantum Mechanics, Light as a Wave, Light as a Particle, Electrons as particles, Electrons as Waves, Wavepackets and Uncertainty	12
	SECTION – B	
2	**3. QUANTUM MECHANICS OF ELECTRONS** General Postulates of Quantum Mechanics, Time Independent Schrodinger's Equation, Free Electrons, The Free Electron Gas Theory of Metals, Fermi level and Chemical Potential, Semiconductors, crystal lattices, electron energy bands, organic semiconductors, Quantum Dots, Wires and Wells **4. TUNNEL JUNCTIONS AND APPLICATIONS OF TUNNELING** Tunneling through a Potential Barrier, Potential Energy Profiles for Material Interfaces, applications of Tunneling, Coulomb Blockade, The Single Electron–Transistor, Field effect transistors	12

	SECTION – C	
3	**5. QUANTUM STRUCTURES AND FABRICATION TECHNIQUES** Semiconductor Heterostructures and Quantum Wells, Quantum Wires and Nanowires, Quantum Dots & Nanoparticles, Fabrication Techniques for Nanostructures, Bulk crystal andheterostructure growth, Nanolithography, etching and other means for fabrication of nanostructures and nanodevices, techniques for characterization of nanostructures, clusters and nanostructures, methods of nanotube growth, chemical and biological methods for nanoscale fabrication.	12
	SECTION – D	
4	**6. NANOWIRES, BALLISTIC TRANSPORT, AND SPIN TRASPORT** Classical and Semiclassical Transport, Ballistic Transport, Electron transport in semiconductors and nanostructures, Carbon Nanotubes and Nanowires, Resonant Tunneling Diodes,Transport of Spin, and Spintronics	12

Course Outcomes:	
1	Understanding of the behavior of quantum and nano materials.
2	Ability to carry out research in nano electronics and spintronics.

Suggested / Reference Books:	
1	Introduction to Nanoelectronics: Science, Nanotechnology, Engineering and Applications, Vladimir V. Mitin, Viatcheslav A. Kochelap,Michael A. Stroscio, Cambridge University Press, New Delhi (2011)
2	Fundamentals of Nanoelectronics, George W. Hanson, Pearson Education Inc.
3	Introduction to Nanoscience, Stuart Lindsay, Oxford University Press
4	Electron Transport in Mesoscopic Systems, Supriyo Datta, Cambridge University Press,

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–III)
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Biomedical Signal Processing**
Course Code	**:**	**ECL-619**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Course Objectives:

To introduce the fundamentals of discrete-time signals and systems and to provide a working knowledge necessary for performing signal processing of common signals derived from the human body.

Total No. of Lectures –48

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	**Introduction to Biomedical Signals:**Brief description of neuronal, cardiovascular musculoskeletal and and respiratory systems; electrical, mechanical and chemical activities. Natural of Biomedical Signals, Objectives of Biomedical Signal Analysis, ECG, EEG, EMG, Difficulties in Biochemial Signal Analysis, Computer-aided Diagnosis.	12
	SECTION – B	
2	**Biomedical Signal Analysis:**Basic electrocardiography; ECG data acquisition; ECG lead system; ECG parameters and their estimation; Heart rate variability-definition; comparison of short term and long term HRV analysis; Time domain and spectral domain parameters of short-term recording. The Brain and its potentials; The Electrophysiotherapy origin of brain waves; the EEG Signal and its characterstics; EEG amplitude and frequency bands.	12
	SECTION – C	
3	**Filtering for Biomedical Signals**: Random noise, structured noise, and physiologicalinterference, stationery versus nonstationary processes, Noise in the event-related potentials,	12

SECTION – D		
4	High-frequency noise in the ECG, Motion artififact in the ECG, cancellation of theelectrocardiography signal from the electrical activity of the chest muscles, Wiener Filter,Adaptive Filters for Removal of Interference.	12

Course Outcomes:	
1	An ability to design and conduct experiments, as well as to analyze and interpret data
2	Acomprehensiveknowledge necessary to understand the impact of engineering solutions in Biomedical.
3	Understanding about the modern engineering tools necessary for biomedical practice.

Suggested / Reference Books:	
1	Reddy D.C. “Modern Biomedical Signal Processing – Principles and Techniques”, TMH, New Delhi, 2005.
2	Akay M. “Biomedical Signal Processing”, Academic Press, California, 1994.
3	Tompkins W J “Biomedical Signal Processing”, Prentice Hall of India, New Delhi, 1999.
4	Rangayyan RM, “Biomedical Signal Analysis”, Wiley India.

M.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING) SPECIALIZATION (COMMUNICATION SYSTEMS) (SEMESTER–IV)
(Credit Based Evaluation and Grading System)

ECD– 621: DISSERTATION

Credits		
L	**T**	**P**
0	**0**	**15**