Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PCEC-115
Subject Name: Digital Communication Systems

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:**3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Fundamentals of analog communication system.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the basic concept of signal processing sub-systems in digital communications.	1(2)	1(3)
CO2	Apply the knowledge of working principles of various signal processing operations for conversion of signals from analog to digital.	1(3), 2(2)	1(3)
CO3	Demonstrate the basic concept of source coding theorem, sampling theorem, Nyquist's criterion and applying them for the designing of digital communication system.	1(2), 2(3), 3(2)	1(3)
CO4	Select and utilize tools to analyze the performance of digital communication system.	2(3)	1(3)
CO5	Demonstrate the basic concept of Noise in Pulse Code & Delta Modulation Systems	2(3),3(1)	1(3)
CO6	Engage in self-learning of advanced concepts and application of Digital Communication.	2(3), 3(1), 12(1)	1(3)

Detailed Contents:

Part -A

Introduction: **5 hours**

Block Diagram of Digital Communication System, Advantages & disadvantages of Digital communication system, Applications, Sampling theorem, Aliasing.

Analog to Digital Conversion: **7 hours**

The sampling Theorem, low pass signals and band pass signals, pulse Amplitude modulation, channel bandwidth for a PAM signal, signal recovery & holding, Quantization of signal, Quantization error, pulse code modulation (PCM), Differential pulse code modulation, Delta Modulation, adaptive delta modulation.

Digital Modulation Techniques: 8 hours

Amplitude Shift Keying (ASK), ASK Spectrum, ASK Modulator, Coherent ASK Detector, Noncoherent ASK Detector, Frequency Shift Keying (FSK), FSK Bit Rate and Baud, FSK Transmitter, Non-coherent FSK Detector, Coherent FSK Detector, FSK Detection Using PLL, Quadrature Phase Shift Keying (QPSK), Binary Phase Shift Keying, Quadrature Amplitude Modulation (QAM), Differential PSK.

Part-B

Data Transmission: 6 hours

Base band signal receiver, the optimum filter, the matched filter, correlation, correlative coding, Intersymbol interference, Nyquist's criterion for distortion less baseband binary transmission, correlative coding, , adaptive equalization for data transmission.

Noise in Pulse Code & Delta Modulation Systems: 7 hours

Calculation of quantization noise, the O/P signal power in PCM, the effect of thermal noise, O/P signal to noise ratio in PCM, Delta Modulation, Quantization noise in delta modulation, the O/P signal to quantization noise ratio in delta modulation, O/P signal to noise ratio in delta modulation.

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Elements of Information Theory: 6 hours

Basic signal processing operations in digital communications, uncertainty, information and entropy, source coding theorem, Huffman coding, discrete memory less channels, mutual information, channel capacity, channel coding theorem, differential entropy, channel capacity theorem,

Text Books:

1. S. Haykin, "Digital Communications", Wiley publication, 2012.
2. W. Tomasi, "Advanced Electronic Communication System", PHI, 6th Edition, 2015.

Reference books and other resources:

1. G. M. Miller, "Modern Electronic Communication", Prentice-Hall, 6th edition, 1999.
2. F. G. Stremler, "Introduction to Communication Systems", Addison- Wesley, 1990.
3. E.A. Lee and D.G. Messerschmitt, "Digital Communication", Kluwer Academic Publishers, 1994.
4. H. Meyr, M. Moeneclaey, and S.A. Fechtel, "Digital Communication Receivers", Wiley, 1998.
5. J. G. Proakis, "Digital communications", McGraw-Hill Education, 4th edition, 2001.

E books and online learning materials:

1. http://nptel.ac.in/courses/Webcoursecontents/IIScBANG/Data%20Communication/Learning%20Material%20%20DataCommunication.pdf
2. http://home.iitk.ac.in/~vasu/book0.pdf

MOOCS and Video Course:

1. http://nptel.ac.in/courses/114101051/3
2. http://nptel.ac.in/courses/114101051/6

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PCEC-116

Subject Name: Microwave and Radar Engineering

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours:** L: 39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 15%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Fundamentals of electromagnetics
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Definition	POs	PSOs
CO1	Describe and analyze microwave components using S parameters.	1(2)	1(3)
CO2	Explain the various techniques of measurement at microwave frequencies	1(3), 2(2)	1(3)
CO3	Demonstrate the basic principle of RADAR System and describe the operation of different types of radar.	1(2), 2(3), 3(2)	1(3)
CO4	Analyze scanning and tracking techniques in radar.	2(3)	1(3)
CO5	Develop systems using microwave devices with concern to public health and safety.	3(1)	1(3)
CO6	Design and develop radar solutions to meet societal and environmental needs.	2(3), 12(1)	1(3)

Detailed Contents:

Part -A

Microwave Tubes: 5 hours

Introduction to Microwaves: Characteristic features, advantages and applications, Limitations of conventional tubes, Frequency allocations, Construction, operation and properties of Klystron Amplifier, Reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Backward Wave Oscillator (BWO), Crossed field amplifiers.

Microwave Solid State Devices: 8 hours

Limitation of conventional solid state devices at Microwaves, Transistors (Bipolar, FET), Diodes (Tunnel, Varactor, PIN), Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT, SBD), Microwave Amplification by Stimulated Emission of Radiation (MASER), Microwave integrated circuit and it's classification techniques.

Microwave passive devices & components: 7 hours

Scattering matrix- Concept of N port scattering matrix representation- Properties of S matrix- S matrix formulation of two-port junction. Passive microwave devices- T junctions- H plane, E plane and EH plane Tee junctions, its S matrix and properties, Directional coupler, Bends and Corners, Microwave posts, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator),Cavity resonator, Matched termination.

Microwave Measurements: **4 hours**

Power measurements using calorimeters and bolometers, Measurement of Standing Wave Ratio (SWR), Frequency and wavelength, Microwave bridges.

Part-B

Introduction to Radar Systems: **3 hours**

Basic Principle: Block diagram and operation of Radar, Radar range Equation, Pulse Repetition Frequency (PRF) and Range Ambiguities, Applications of Radar.

Doppler Radars: **5 hours**

Doppler determination of velocity, Continuous Wave (CW) radar and its limitations, Frequency Modulated Continuous Wave (FMCW) radar, Basic principle and operation of Moving Target Indicator (MTI) radar, Delay line cancellers, Blind speeds and staggered PRFs.

Scanning and Tracking Techniques: **7 hours**

Various scanning techniques (Horizontal, vertical, spiral, palmer, raster, nodding), Angle tracking systems (Lobe switching, conical scan, monopulse), Range tracking systems, Doppler (velocity) tracking systems. Direction finders- Instrument Landing System- Radio ranges. Navigation- Hyperbolic navigation-LORAN. Satellite navigation- Doppler navigation – Global positioning system.

Text Books:

1. S. Liao, “Microwave devices and circuits”, 3rd edition,PHI.
2. M.I. Skolnik, “Introduction to radar systems”, McGraw Hill .
3. R.E. Collin, “Foundation of Microwave Engg”, 2nd edition McGraw Hill, 1992.

Reference books and other resources:

1. M.Kulkarni, “Microwave devices and Radar Engg”, Umesh Publications.
2. K.C Gupta, “Microwave Engg”, Tata McGraw-Hill, 7thEdition, 2007.
3. D.Pozar, “Microwave Engineering”, John Wiley & Sons, New York, 1998.
4. Radar systems and radio aids to navigation — A K Sen & A B Bhattacharya, Stylus Publishing, LLC, 2018.

E books and online learning materials:

1. https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_tutorial.pdf

2. https://ecedmans.files.wordpress.com/2014/10/microwave-devices-and-circuits-samuel-liao.pdf

MOOCS and Video Course:

1. http://nptel.ac.in/courses/114105130/2
2. http://nptel.ac.in/courses/114105130/9

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPCEC-111

Subject Name: Digital Communication Systems Laboratory

Programme: B.Tech.	**L: 0 T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26
Theory/Practical: Practical	**Credits:**1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Fundamentals of Communication Systems.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the concept of Time division multiplexing using communication system modules	1(3)	1(3)
CO2	Demonstrate the various pulse coding and decoding techniques	1(3), 2(3)	1(3)
CO3	Illustrate the modulation and demodulation process for amplitude shift keying, frequency shift keying and phase shift keying.	2(3), 3(2)	1(3)
CO4	Conduct experiments using system modules to demonstrate the operation of PCM and DM and analyze their performances.	2(3),4(1)	1(3)
CO5	Apply hamming codes and demonstrate its use in detection and correction of errors.	1(2),2(3)	1(3)
CO6	Select and utilize tools like SIMULINK to model delta modulation and binary phase shift keying	2(3),4(1), 12(1)	1(3)

Detailed Contents:

Experiment 1. To demonstrate time division multiplexing system.
Experiment 2. To demonstrate pulse code modulation and demodulation.
Experiment 3. To demonstrate adaptive delta modulation and demodulation.
Experiment 4. To study pulse data coding and decoding techniques for various formats.
Experiment 5. To study of amplitude shift keying modulator and demodulator.
Experiment 6. To study of frequency shift keying modulator and demodulator.
Experiment 7: To study of phase shift keying modulator and demodulator.
Experiment 8. To study of quadrature phase shift keying modulator and demodulator.
Experiment 9. To demonstrate error detection & correction using Hamming Code.
Experiment 10. To simulate delta modulation and demodulation using MATLAB SIMULINK.
Experiment 11. To simulate amplitude shift keying using MATLAB SIMULINK.
Experiment 12. To simulate binary phase shift keying using MATLAB SIMULINK.

Reference Books and Other Resources:

Lab manuals available in lab.

MOOCS and Video Course:

1. http://nptel.ac.in/courses/114101051/30
2. http://nptel.ac.in/courses/114101051/31

Student has to complete one project based on lab experiments.

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPCEC-112

Subject Name: Microwave and Radar Engineering Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Fundamentals of Electromagnetics.

On Completion of the course, the student will have the ability to:

CO#	Definition	POs	PSOs
CO1	Describe and analyze microwave components using S parameters.	1(2)	1(3)
CO2	Explain the various techniques of measurement at microwave frequencies	1(3), 2(2)	1(3)
CO3	Demonstrate the basic principle of RADAR System and describe the operation of different types of radar.	1(2), 2(3), 3(2)	1(3)
CO4	Analyze scanning and tracking techniques in radar.	2(3)	1(3)
CO5	Develop systems using microwave devices with concern to public health and safety.	3(1)	1(3)
CO6	Design and develop radar solutions to meet societal and environmental needs.	2(3), 12(1)	1(3)

Detailed Contents:

Experiment 1. Study of microwave components and instruments.
Experiment 2. Measurement of crystal characteristics and proof of the square law characteristics of the diode.
Experiment 3. Measurement of klystron characteristics.
Experiment 4. Measurement of VSWR and standing wave ratio.
Experiment 5. Measurement of Dielectric constants of a given material.
Experiment 6. Measurement of directivity and coupling coefficient of a directional coupler.
Experiment 7. Demonstration of characteristics of the circulator.
Experiment 8. Measurement of Q of a cavity.
Experiment 9. Calibration of the attenuation constant of an attenuator.
Experiment 10. Determination of the radiation characteristics of Horn antenna.
Experiment 11. Determination of the phase-shift of a phase shifter.
Experiment 12. Measurement of return loss of patch antenna using Vector Network Analyzer.

Reference Books and Other Resources:

Lab manuals available in lab.

MOOCS and Video Course:

1. http://nptel.ac.in/courses/114101119/6
2. http://nptel.ac.in/courses/114101119/16

Students have to complete one project based on lab experiments.

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Track I
(Signal Processing and Communication)

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-101
Subject Name: Optical Communication

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of electronic devices and communication.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	PO	PSO
CO1	Apply the knowledge of engineering fundamentals for the concept of optical fibercommunication.	1(2)	2(1)
CO2	Demonstrate the basic concept of degradation, fabrication and measurement techniques.	1(1)	1(1)
CO3	Design system components of optical sources and detectors and derive theexpression for their efficiency.	3(2)	1(2)
CO4	Select electronic components to describe the concept of Optical link design.	2(1)	1(1)
CO5	Analyze the performance of different optical amplifiers and integrated opticaldevices.	2(1)	1(2)
CO6	Use research-base knowledge to describe the concepts advanced opticalcommunication technologies.	1(2)	1(2)

Detailed Contents:

Part A

Introduction: **7+2(T)=9 hours**

Elements of an optical fiber transmission link, introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

Optical Fibers: **10+4(T)=14 hours**

Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation in optical waveguides due to dispersion and attenuation, pulse broadening in graded-index waveguides, mode coupling, Non linear effects: Stimulated Brillion and Raman scattering, Self and Cross phase modulation, Four wave mixing, fiber fabrication: vapor-phase axial deposition, plasma-activated chemical deposition and double-crucible method.

Measurement techniques: optical spectrum analyzers, optical time domain reflectometer (OTDR).

Part-B

Optical Sources and Detectors: 7+3(T)=10 hours

Optical sources - LEDs and Lasers, Photo-detectors - pin-detectors, Avalanche photodiode, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Optical Amplification and Integrated Optic 7+2(T)=09 hours

Optical amplifiers – semiconductor optical amplifier, EDFA, Raman amplifier, Integrated optical devices: directional couplers, electro-optic switches, modulator, polarization transformer, frequency translators.

Advances in Optical communication: 8+2(T)=10 hours

Introduction of Free Space Optical Communication and its applications, High speed light wave links, DWDM, Photonics Microwave.

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Text Books:

1. G. Keiser, "Optical Fiber communications", McGraw Hill Education, 3rd Edition, 2000.
2. J. M. Senior, "Optical Fiber Communications, Principles and Practices", Pearson Education, 3rd Edition, 2010.
3. Arun Majumdar "Optical Wireless Communications for Broadband Global Internet Connectivity'' 1st edition

Reference books and other resources:

1. J.E. Midwinter, "Optical Fibers for Transmission", John Wiley, 1979.
2. J. Gowar, "Optical Communication Systems", Prentice Hall India, 1987.
3. G. Agrawal, "Nonlinear Fibre Optics", Academic Press, 2nd Edition 1994.
4. G. Agrawal, "Fiber Optic Communication Systems", John Wiley and Sons, New York, 1992
5. Djafar K. Mynbaev, "Fiber optic communications technology", Pearson, 2001.

E books and online learning materials:

1. https://eceagmr.files.wordpress.com/2014/09/optical-fiber-communications-principles-and-pr.pdf
2. https://www.utdallas.edu/~torlak/courses/ee4367/lectures/FIBEROPTICS.pdf.
3. https://www.sciencedirect.com/topics/physics-and-astronomy/free-space-optical-communication
4. https://link.springer.com/article/10.1007/s11277-018-5870-7
5. https://ieeexplore.ieee.org/document/4063431
6. https://ieeexplore.ieee.org/book/5361049
7. https://ieeexplore.ieee.org/document/6320333

MOOCS and Video Course:

1. http://nptel.ac.in/courses/117101002/34
2. http://nptel.ac.in/courses/117101002/38

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-105
Subject Name: Cyber Security

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of networking and number theory.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the classification of cyber security attacks.	2(2)	2(2)
CO2	Illustrate security solutions for the phenomenon of copyright infringement and enumeration of computer forensics.	2(3), 3(2)	2(3)
CO3	Describe the design idea of symmetric ciphers and the evolution of modern cryptography.	1(2), 2(2) 4(3)	2(3)
CO4	Interpret the essentials of Public-key cryptosystem.	4(2), 5(2)	2(2)
CO5	Analyze the security issues of M2M, IoT and Bluetooth communications.	2(2)	2(3)
CO6	Comprehend the evolution of Blockchain technology.	2(3), 5(3)	2(2)

Detailed Contents:

Part A

Cyber Threats and Attacks: 7+2(T)=9 hours

Definition – Cyber Security, Cyber-attack categorization, Typical attack sequence, Types of cyber-attacks, Footprinting, Wiretapping, Social Engineering, Packet sniffing, Known ports, Password vulnerabilities, Track covering, Malware, Viruses and worms, Logic bombs, BOT and BOTNET, Trojan Horse, Cryptojacking, Supply chain attack.

Copyright Infringement and Cyber Forensics: 5+2(T)=7 hours

Introduction, Owner's Rights and Copyright Infringement, Digital Watermarking – Overview and Properties, Classification of Digital Watermarking Techniques, Introduction to Cyber Forensics, Cyber Crime – Threat Scenarios, Computer-oriented Forensics.

Essentials of Cyber Security: 8+3(T)=11 hours

Overview of Cryptology, Modular Arithmetic, Integer Rings, Stream ciphers vs. Block ciphers, Encryption and decryption with stream ciphers, Data Encryption Standard–

Overview, Internal Structure, Decryption; DES Alternatives, Introduction to Galois Fields – Existence of Finite Fields, Prime Fields, Extension Fields GF (2^m); Addition, Subtraction, Multiplication, Inversion in GF (2^m); Encryption and Decryption structure of Advanced Encryption Standard.

Part-B

Public-Key Cryptography: 9+3(T)=12 hours

Introduction, Practical aspects of Asymmetric Cryptography, Number Theory – Euclidean Algorithm, Extended Euclidean Algorithm, Euler's Phi Function, Fermat's Little Theorem, Euler's Theorem, Encryption and Decryption of RSA Cryptosystem – Key generation, Fast Exponentiation, Diffie-Hellman Key Exchange.

Security Issues: 6+2(T)=8 hours

M2M and IoT – Overview, Differences, Use cases, Security and Privacy Issues of IoT, Challenges; Bluetooth and Cyber Crime, Classification of Bluetooth communication attacks.

Blockchain Technology: 4+1(T)=5 hours

Blockchain – Introduction, Evolution, Working; Blockchain Systems and Cryptocurrencies, Applications of Blockchain.

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Text Books:

1. Ramjee Prasad and Vandana Rohokale, "Cyber Security: The Lifeline of Information and Communication Technology", Springer, 2020.
2. Christof Paar and Jan Pelzl, "Understanding Cryptography", Springer, 2010.

Reference books and other resources:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, 7th Edition, 2017.
2. Nigel P. Smart, "Cryptography Made Simple", Springer, 2016.
3. Rick Howard, "Cyber Security Essentials", CRC Press, 2011.
4. Niels Ferguson, Bruce Schneier and Tadayoski Kohno, "Cryptography Engineering: Design Principles & Practical Applications", Wiley Publishing Inc., 2010.
5. Kutub Thakur and Al-Sakib Khan Pathan, "Cybersecurity Fundamentals: A Real-World Perspective", CRC Press, 2020.
6. Danda B. Rawat and Kayhan Zrar, "Smart Cities Cybersecurity and Privacy", Elsevier, 2018.
7. Hamid R. Nemati and Li Yang, "Applied Cryptography for Cyber Security and Defense: Information Encryption and Cyphering", IGI Global, 2010.

E books and online learning materials:

1. https://www.itu.int/en/ITU-D/Cybersecurity/Documents/Introduction%20to%20the%20Concept%20of%20IT%20Security.pdf
2. https://www.cs.umd.edu/~waa/414-F11/IntroToCrypto.pdf

3. http://swarm.cs.pub.ro/~mbarbulescu/cripto/Understanding%20Cryptography%20by%20Christof%20Paar%20.pdf
4. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121051/cybersecurity_online.pdf
5. https://www.itu.int/en/ITU-D/Cybersecurity/Documents/01-Introduction%20to%20Cryptography.pdf
6. https://www.fcc.gov/cyber/cyberplanner.pdf

MOOCS and Video Course:

1. https://onlinecourses.swayam2.ac.in/cec20_cs15/preview
2. https://www.coursera.org/specializations/cyber-security
3. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-103

Subject Name: Mobile Communication and Networks

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)=52 hours
Theory/Practical: Theory	**Credits:**4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of analog and digital communication system.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Definition	POs	PSOs
CO1	Comprehend the basics and parameters of cellular systems.	1(2)	1(2)
CO2	Describe different types of interferences.	1(3)	1(3)
CO3	Analyze handoffs and dropped calls	2(1)	1(1)
CO4	Explain functioning of wireless communication system and evolution of different wireless communication systems and standards.	1(2)	1(2)
CO5	Describe working of various intelligent networks.	1(2)	1(2)
CO6	Identify the requirements of mobile communication as compared to static communication.	3(2)	2(1)

Detailed Contents:

Part -A

Cellular Systems: 8+2(T)=10 hours

Basic cellular systems, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, concept of frequency reuse channels, handoff mechanism, cell splitting, cell sectoring, consideration of the components of cellular systems

Interference in Mobile Systems: **9+4(T)= 13 hours**

Cochannel interference, cochannel interference reduction factor, desired C/I from a normal casein an omnidirectional antenna system, exploring cochannel interference areas in a system, real time cochannel interference measurement at mobile radio transceivers, design of an omnidirectional antenna system in the worst case, adjacent-channel interference, near-end–far end interference.

Handoffs and dropped calls: 8+3(T)=11hours

Value of implementing handoffs, initiation of a hard handoff, delaying a handoff, forced handoffs, queuing of handoffs, power-difference handoffs, mobile assisted handoff (maho)

and soft handoff, cell-site handoff only, intersystem handoff, introduction to dropped call rate, formula of dropped call rate.

Part B

2G, 3G and 4G systems: 8+2(T)=10 hours

2G systems: GSM Architecture and channels, 3G systems, WCDMA-UMTS (UTRA-FDD) physical layer, WCDMA-ARIB physical layer, WCDMA-TDD physical layer UMTS network architecture, CDMA2000 physical layer, CDMA2000 network, 4G – LTE: LTE Network architecture.

Intelligent Network for wireless communication: 6+2(T)=8 hours

Advanced intelligent network (AIN), SS7 network and ISDN for AIN, AIN for mobile communication, asynchronous transfer mode (ATM) technology, IP Network, future of IP networks, an intelligent system: future public land mobile telecommunication system (FPLMTS), wireless information superhighway

Text Books:

1. W. C. Lee, "Wireless and Cellular Communications". 3rd Edition, McGraw Hill.
2. T.S. Rappaport, Wireless Communication-Principles and practice, Pearson Publications,Second Edition.
3. Misra, Wireless Communication & Network: 3G & Beyond, McGraw Hill Education
4. T L Singal ,Wireless Communications , McGraw Hill Education.

Reference books and other resources:

1. Jochen H. Schiller, "Mobile Communications", Second Edition, Pearson Education.
2. IEEE Communication Magazine

E books and online learning materials:

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/BEC703%20%20-CELLULAR%20MOBILE%20COMMUNICATION.pdf
2. IEEE Communication Magazine

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/102/117102062/
2. https://nptel.ac.in/courses/117/104/117104099/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-104
Subject Name: Multimedia Signal Processing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)=52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of Signal Processing.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Definition	POs	PSOs
CO1	Comprehend the representation of various multimedia information.	1(3)	1(2)
CO2	Describe the basic techniques of multimedia data compression.	1(3)	1(2)
CO3	Make use of audio signals in development of various audio coding standards.	3(3)	2(3)
CO4	Explain the standards defined for storage of image data.	3(2)	2(2)
CO5	Demonstrate the concept of compression and temporal redundancy in video signals.	4(2)	1(3)
CO6	Apply the concept of motion compensation and estimation in video coding standards	4(3)	2(3)

Detailed Contents:

Part -A

Multimedia Information Representation: 7+2(T)=9 hours

Digitization Principles, Digital representation of multimedia signals: Text and Images; Audio – PCM Speech, CD-quality audio, Synthesized audio; Video – Broadcast television, digital video and its formats, PC video.

Multimedia Data Compression: 7+2(T)=9 hours

Lossless compression Algorithms: Run-length Coding, Variable-Length Coding, Dictionary based Coding, Arithmetic Coding. Lossy Compression: Distortion Measures, Rate-Distortion Theory, Quantization, Transform coding - K-L Transforms, Discrete Cosine Transform, Wavelet-Based Coding, SPIHT.

Audio Coding: 7+2(T)=9 hours

Audio-Compression Theory, Audio as a Waveform: DPCM, DM, ADPCM, Logarithmic Quantization Scales. Audio Compression using Psychoacoustic, Audio Coding Standards: MPEG-1, MPEG-2, Dolby AC-2 and AC-3, MPEG-4, MIDI.

Part-B

Image Compression Standards: 8+3(T)=11 hours

JPEG Standard: Encoding and its mode, JPEG 2000 Standard: Adapting EBCOT to JPEG2000, Regions of Interest Coding, Comparison of JPEG and JPEG2000 Performance, JPEG-LS Standard, Bi-level Image Compression Standards: JBIG and JBIG2.

Motion Estimation and Video Coding: 10+4(T)=14 hours

Theory of Video Compression: Temporal redundancy, Block based frame prediction, motion vectors, macro blocks, Motion Compensation, Types of Predictions, Video Coding standards: H.261 and H.263, MPEG-1, MPEG-2, MPEG-4.

Text Books:

1. Halsall F., "Multimedia Communications: Applications, Networks, Protocols, and Standards", Pearson, 2004.
2. Li Z., Drew M. S., Liu J., "Fundamentals of Multimedia", Springer, 2014.
3. Havaldar P. and Medioni G., "Multimedia Systems - Algorithms, Standards, and Industry Practices, Pearson, 2009.

Reference books and other resources:

1. Stankovic S., Orovic I. & Sedjic E., "Multimedia Signals and Systems", Springer US, 2012.
2. Sanders A., "Multimedia Signals: Image, Audio and Video Processing", NY Research Press, 2017.
3. Ohm J-R., "Multimedia Signal Coding and Transmission", Springer Berlin Heidenberg, 2015.
4. Guan L., He Y. & Kung S-Y., "Multimedia Image and Video Processing", CRC Press, 2012.
5. Vaseghi S.V., "Multimedia Signal Processing: Theory and Applications in Speech, Music and Communications", John Wiley & Sons, Ltd., 2007.

E books and online learning materials:

1. http://classweb.ece.umd.edu/enee408g.S2013/index.xml
2. http://staff.um.edu.mt/csta1/courses/lectures/csa3020/index.html

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/105/117105083/
2. https://www.coursera.org/lecture/digital/on-video-compression-standards-LluJC

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-101

Subject Name: Optical Communication Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of electronic devices and communication.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the working of optical fiber communication system and analyze the propagation and bending loss of fiber.	1(1)	1(2)
CO2	Measure the numerical aperture, sensitivity and BER in optical fibers	1(2)	1(1)
CO3	Demonstrate and measurement of sensitivity of the fiber optic link	2(1)	1(2)
CO4	Comprehend the voice Transmission through optical fiber using PWM.	1(1)	1(1)
CO5	Understand the V-I characteristics of LED and photo detector.	2(1)	1(1)
CO6	Work in a team to demonstrate designing and analyze the free space optical communication using Optisystem.	9(2)	1(1)

Detailed Contents:

Experiment 1. To demonstrate fiber optic analog and digital link.
Experiment 2. To Study and measurement of propagation loss in optical fiber.
Experiment 3. To demonstrate and measurement of bending loss in optical fiber.
Experiment 4. To demonstrate and measurement of numerical aperture of optical fiber.
Experiment 5. To Measure the optical power using optical power meter.
Experiment 6. To demonstrate Voice Transmission through optical fiber using PWM.
Experiment 7. To measure the sensitivity of the fiber optic link.
Experiment 8. To demonstrate V-I characteristics of fiber optic LEDs.
Experiment 9. To demonstrate V-I characteristics of photo detector.
Experiment 10. To design free space optical communication using FSO channel in Optisystem and analyze the outputs using various optical analyzers.
Experiment 11. To demonstrate parametric effect on free space optical communication using Optisystem.
Experiment 12. To analyze Free space optical communication for different weather conditions in terms of BER and Q factor using Optisystem.

Reference Books and Other Resources:

Lab manuals available in lab.

MOOCS and Video Course:

1. http://nptel.ac.in/courses/117101002/2
2. http://nptel.ac.in/courses/117101002/12

Student has to complete one project based on lab experiments.

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-108
Subject Name: Cyber Security Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of number theory

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the ways to analyze the multimedia information.	1(2), 5(2)	1(2)
CO2	Develop a program to realize the concepts of number theory.	2(2)	2(2)
CO3	Demonstrate the operation of fundamental encryption methods.	4(3)	2(3)
CO4	Compose an algorithm to demonstrate the fundamental idea of Image Steganography.	3(3), 4(2), 5(2)	2(2)
CO5	Categorize the response of stream and block ciphers.	2(2)	2(3)
CO6	Interpret the functioning of modern encryption algorithms.	3(3), 5(2), 9(2)	1(2), 2(2)

Detailed Contents:

Experiment 1. To develop a program to read multimedia information such as text, audio, image.

Experiment 2. To develop an algorithm for finding a greatest common divisor of two integers.

Experiment 3. To demonstrate the following properties of modular arithmetic.

$$[(a \bmod n) + (b \bmod n)] \bmod n = (a + b) \bmod n$$
$$[(a \bmod n) - (b \bmod n)] \bmod n = (a - b) \bmod n$$
$$[(a \bmod n) \times (b \bmod n)] \bmod n = (a \times b) \bmod n$$

Experiment 4. To construct a program for evaluating inverse of an integer.

Experiment 5. To develop an extended Euclidean algorithm.

Experiment 6. To understand the concept of key using Caesar Cipher.

Experiment 7. To evaluate the cipher text using Hill Algorithm.

Experiment 8. To understand the concept of transposition of data using rail fence technique.

Experiment 9. To develop a program for understanding the concept of Image Based

Steganography using least-significant bit insertion technique.

Experiment 10. To develop a program for analyzing the working of stream cipher and block cipher.

Experiment 11. To develop a program for creating the s-box(es) of DES algorithm.

Experiment 12. To analyze the output of mix column transformation of AES algorithm.

Experiment 13. To develop a generic program of the popular Diffie-Hellman secure key exchange protocol.

Project: A group of 3 to 4 students will be encouraged and supervised to develop the modern cryptographic algorithms in accordance to the archived publications of Federal Information Processing Standards and National Institute of Standards and Technology.

Reference Books and Other Resources:

Lab Manuals.

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Name: PEEC-117
Subject Code: Optical Networks

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:**30-40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basic knowledge of Optical Communication
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend different Optical network Components.	2(3)	2(3)
CO2	Analyze topologies and different networks used in optical communication	1(2)	1(2)
CO3	Examine high-capacity networks.	2(3)	1(2)
CO4	Describe the optical switching networks and their applications.	2(2)	1(3)
CO5	Discuss the optical access networks and modern optical techniques.	2(3)	1(3)
CO6	Able to design optical networks and their management.	3(2)	2(2)

Detailed Contents:

Part A

Optical Networking Components: 8+2(T)=10 hours
First- and second-generation optical networks, Components: couplers, isolators, circulators, multiplexers, filters, switches, and wavelength converters.

Broadcast – And- Select Networks: 7+3(T)=10 hours
Topologies, Single-hop, Multihop, and Shufflenet multihop networks, Media-Access control protocols.

High-Capacity Networks: 9+3(T)=12 hours
SDM, TDM, and WDM approaches, Application areas, Optical TDM Networks: Multiplexing and demultiplexing, Synchronization, Broadcast networks, Switch-based networks.

Part-B

Optical Switching & Networks: 11+3(T)=14 hours
Transport Networks, SONET/SDH: Architecture, Network Elements, Applications. Introduction to Optical Access Networks, photonic packet switching, Overview of PON technologies, WDM-PON, Free space optics, Radio over Fiber, Passive optical network.

Network Design and Management: **4+2(T)=6 hours**

Transmission System Engineering – System model, Power penalty – transmitter, receiver, crosstalk, dispersion; Wavelength stabilization; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

Text Books:

1. Rajiv Ramaswami and Kumar Sivarajan, Optical Networks: A practical perspective, Morgan Kaufmann, 2nd edition, 2001.
2. Vivek Alwayn, Optical Network Design and Implementation, Pearson Education, 2004.

Reference books and other resources:

1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
2. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

E books and online learning materials:

1. Lec 107: Introduction to Optical Networks - YouTube
2. https://nptel.ac.in/content/storage2/courses/106105080/pdf/M4L3.pdf
3. Fiber Optic Networks - an overview | ScienceDirect Topics

MOOCS and Video Course:

1. https://onlinecourses.nptel.ac.in/noc20_ee79/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee42/preview

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-118
Subject Name: Python Programming

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Design/ Programming Problems:** 10%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hours
Total marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Information Management and data analysis
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic concepts of python programming	5(2)	2(2)
CO2	Apply the principles of data collection methods and language components	5(2)	2(2)
CO3	Create applications using 'functions' in python programming	3(1), 5(2)	2(2)
CO4	Access database using python programming	3(1), 5(2)	2(2)
CO5	Develop web applications using python programming	1(2), 5(2)	2(2)
CO6	Develop and use Web Services using python	3(1), 5(2)	2(2)

Detailed Contents:

Part A

Introduction: **9+2(T)=10 hours**

Strengths and Weaknesses, IDLE, Dynamic Types, Naming Conventions, String Values, String Operations, String Slices, String Operators, Numeric Data Types, Conversions and Built In Functions.

Data Collections and Language Component: **7 +2(T)=9hours**

Introduction, Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical, Operators, True or False, Bit Wise Operators, The while Loop, break and continue, the for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries and Copying Collections.

Functions: **7+2=(T)hours**

Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, Functions - "First Class Citizens", Passing Functions to a Function, Mapping Functions in a Dictionary and Lambda.

Part B

Modules: **5+2(T)=7 hours**

Introduction, Standard Modules – sys, Standard Modules – math, Standard Modules – time and the dir Function.

Data Streams and Metadata: **6+2(T)=8 hours**

Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Using Pipes as Data Streams, Handling IO Exceptions, Working with Directories and Metadata.

Errors and Error Handling in Python: **5+3(T)=8 hours**

Introduction, Errors, Run Time Errors, the Exception Model, Exception Hierarchy, Handling Multiple and Exceptions.

Text Books:

1. Martin C. Brown, "Python the complete reference", McGraw-Hill Education, Fourth Edition, 2018
2. Allen B. Downey, "Think Python", green tea press; 2nd edition, 2015.

Reference books and other resources:

1. Eric Matthes, "Python Crash Course", no starch press, 1st edition, 2016
2. Paul Barry "head first python", O'rielly, 2016

E books and online learning materials:

1. Python Website: https://www.learnpython.org/
2. YouTube: https://www.youtube.com/watch?v=_uQrJ0TkZlc
3. https://developers.google.com/edu/python/

MOOCS and Video Course:

1. Udemy.com: https://www.udemy.com/topic/python/
2. Edx.org: https://www.edx.org/learn/python
3. Coursera.org: https://www.coursera.org/learn/python

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-119
Subject Name: Cloud Computing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** NA
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basic knowledge of computer and network
Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Assess existing hosting platforms and computing paradigms currently being used in industry and academia	2(2)	2 (3)
CO2	Comprehend need of data centre, its virtualization techniques and types of clouds	1(2)	2(2)
CO3	Illustrate different services related to cloud	1(2)	2(1)
CO4	Identify various security issues in cloud computing	2(3)	2(2)
CO5	Demonstrate the implementation of cloud by using commercial and open source cloudplatforms and its virtualization.	3(2)	2(2)
CO6	Analyze various commercial cloud platforms	4(2)	2(2)

Detailed Contents:

Part A

Introduction: 8+3(T)=11 hours

Overview of Computing Paradigms: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, Cloud Computing (NIST Model) properties and Characteristics of Cloud.

Cloud Computing Architecture: 8+3(T) =11 hours

Cloud computing stack Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models: Public cloud, Private cloud, Hybrid cloud, Data Center Architecture.

Cloud Service Administration: 8+3(T) =11 hours

Service Level Agreements and Monitoring-Support Services- Accounting Services, Resource Management- IT Security- Performance Management- Provisioning- Service Management, Untangling Software Dependencies.

Part-B

Security in Clouds: 8+2(T)=10 hours

Cloud security issues and challenges, Cloud security reference model, Encryption techniques – Symmetric key encryption, Asymmetric key encryption, Identity and key management, Digital signature, Secure Socket Layer (SSL).

Cloud Computing Platforms: 7+2(T)=9 hours

Study and comparison of various open source and commercial cloud platforms, Open source cloud platforms – Openstack, Eucalyptus, Nebula. Commercial cloud platforms – Amazon Elastic Compute Cloud (EC2), Google App engine, MS Azure.

Text Books:

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd, 2013.
2. Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski, "Cloud computing: Principles and paradigms", Wiley India Pvt. Ltd, 2011.
3. Anthony Velte, TobyVelte, Robert Elsenpeter,"Cloud Computing:ApracticalApproach",TataMcGrawHill, 2009
4. John Rittinghouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press Taylor and Francis Group,2009.

Reference books and other resources:

1. Michael Miller, "Cloud Computing", Que Publishing, 2008.
2. Judith S. Hurwitz, Daniel Kirsch , "Cloud Computing for dummies", Wiley Pubishers, 2nd Edition, 2020
3. Mr. Ray Rafaels, "Cloud Computing" CreateSpace Independent Publishing Platform, 2nd edition, 2018.
4. Thomas Erl, ZaighamMahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture" ,The Pearson Service Technology Series, 2014

E books and online learning materials:

1. https://cloudonaut.io/free-ebook-exploring-cloud-computing/
2. https://www.motc.gov.qa/sites/default/files/cloud_computing_ebook.pdf
3. https://bookauthority.org/books/new-cloud-computing-ebooks

MOOCS and Video Course:

1. Cloud computing By Prof. Soumya Kanti Ghosh, IIT Kharagpur
2. https://swayam.gov.in/nd1_noc20_cs20/preview
3. Google Cloud Computing Foundations CourseBy Prof. Soumya Kanti Ghosh, Multifaculty, IIT Kharagpur, Google Cloud
   https://swayam.gov.in/nd1_noc20_cs55/preview

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-120
Subject Name: Mobile Computing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10-20 %
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of Wireless communication and networking
Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the wireless telephony concepts and issues in mobile computing.	1(2) 2(2)	2(2)
CO2	Analyze next generation Mobile Communication System.	3(2)	2(2)
CO3	Identify the requirement of mobile networks and protocols related to transport layer.	1 (2)	2(2)
CO4	Explain wireless LAN architecture, applications and advantages.	1 (2)	2(2)
CO5	Classify various Wireless application areas and multiple access protocols.	1 (2)	2(2)
CO6	Analyze and apply various algorithms related to mobile Adhoc networks	1 (2)	2(2)

Detailed Contents:

Part-A

Introduction: 10+4(T)=14 hours

Mobile computing: Introduction, Issues, applications, overview of wireless telephony: cellular concept, frequency reuse, handoff, GSM: services and features, GSM system architecture, GSM channel structure, air interfaces, GSM frame Structure, overview of 4G and 5G.

Mobile Network & Transport Layer: 11+4(T)=15 hours

Mobile IP Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, Dynamic Host Configuration Protocol (DHCP), TCP over wireless Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

Part-B

Wireless Networking: 9+2(T)=11 hours

Wireless LAN Overview: WLAN architecture, WLAN applications, WLAN advantages, Wireless multiple access protocols, Wireless applications, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

Mobile Ad hoc Networks: 9+3(T)=12 hours

Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment, Mobile Ad hoc Networks (MANETs): Overview, architecture of MANET, Properties of a MANET, application of MANET, various routing algorithms, security in MANETs.

Text Books:

1. Prasant Kumar Pattnaik, Rajib Mall "Fundamentals Of Mobile Computing" PHI Learning Private Limited.
2. J. Schiller, Mobile Communications, Addison-Wesley, second edition, 2004.

Reference books and other resources:

1. Raj Pandya, Mobile & Personal Communication Systems and Service, PHI.
2. Theodore S Rappaport wireless communications: principles & practice, second edition, Pearson publications.
3. Asoke k Talukder, Roopa R Yavagal, Mobile Computing, Technology, Application &Service Creation. Tata McGraw Hill Stojmenovic and Cacute, ―Handbook of Wireless Networks and Mobile Computing‖, Wiley, 2002.

E books and online learning materials:

1. https://disco.ethz.ch/courses/ss04/mobicomp/lecture/1/Chapter1Introduction4Slides.pdf
2. https://www.cse.iitk.ac.in/users/rkg/Talks/mobile_main.pdf

MOOCS and Video Course:

1. http://nptel.ac.in/courses/106106177/6
2. http://nptel.ac.in/courses/106106177/9

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-109
Subject Name: Optical Network Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Laboratory

Prerequisites: Optical Communication

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Create optical subsystems in software.	1(3)	1(2)
CO2	Simulate WDM system and optical amplifiers in optical networks.	3(2)	2(2)
CO3	Demonstrate non linear effects in optical communication.	1(2)	1(2)
CO4	Analyze designed optical system using different modulation format.	3(2)	2(2)
CO5	Conduct experiments to design FSO, RoF and PON systems.	3(2)	2(2)
CO6	Simulate optical time division multiplexing in optical network.	3(2)	2(2)

Detailed Contents:

Experiment 1: To create Subsystems (Hierarchical Simulation) in software.
Experiment 2: To design 8 channel WDM System with proper channel spacing.
Experiment 3: To study Parameter Sweeps of various components using OptiSpice.
Experiment 4: To implement SOA and EDFA optical Amplifiers in optical network and calculate their gains.
Experiment 5: To visualize the effects of Cross Phase Modulation (XPM) and Four-Wave Mixing (FWM) in optical fiber communication.
Experiment 6: To study Stimulated Raman Scattering in optical communication.
Experiment 7: To Design optical system using different Modulation Formats and compare them in terms of BER and Q factor.
Experiment 8: To Design Radio over fiber Optical Network.
Experiment 9: To design free space optical communication using FSO channel and analyze the outputs using Eye diagrams.
Experiment 10: Analyze BER and Q factor for Different weather condition in Free space optical communication system.
Experiment 11: To design Optical System for channel multiplexing techniques using OcSim software.
Experiment 12: Demonstrate bidirectional WDM-PON network and analyze the performance.

Experiment 13: Design and analyze an optical communication system for SMF and MMF using OptiSpice software.

Reference Books and Other Resources:

1. Fiber-optic Communications Technology by Djafar K. Mynbaev, Lowell L. Scheiner
2. [PDF] eBook Free Space Optics Download Full – PDF Rewire Adventures
3. An Overview of Free Space Optical Communication (ijettjournal.org)

Student has to complete one project based on FSO/ RoF/ PON network.

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-110

Subject Name: Python Programming Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Computer Programming, Intelligent Signal Processing Lab

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the principles of python programming	5(2)	2(3)
CO2	Programme python code systematically	5(2)	2(1)
CO3	Create applications using python programming	3(1)	2(2)
CO4	Develop and use data management using python	5(2)	2(3)
CO5	Solve mathematics problems using Python	5(2)	2(3)
CO6	Construct a project in team of their own calendar and clock using python	3(1)	2(2)

Detailed Contents:

Experiment 1. Write a program to print basics information of a student.

Experiment 2. Write a program to perform basic mathematical operations on simple and Complex numbers.

Experiment 3. Write a program to display first character, last character, all characters except first character, all characters except the last character, all characters except the first and last character and the reverse of the given string.

Experiment 4. Write a program to calculate the simple interest.

Experiment 5. Write a program to perform the assignment operations and bitwise operations.

Experiment 6. Write a program using operators to check whether the character you entered is a consonant or not.

Experiment 7. Write a program to print the table of any given number using loops.

Experiment 8. Write a program to draw the given pattern using loops.

Experiment 9. Write a program to print the information of a customer name using list.

Experiment 10. Write a program to create dictionary with key as string and perform basic string functions

Experiment 11. Write a program to print credentials of a student using functions only

Experiment 12. Illustrate the use of local and global variables with the help of a program.

Experiment 13. Write a program to display the calendar by taking input from the user.

Experiment 14. Write a program to execute any five functions in the math module.

Reference Books and Other Resources:

Lab Manual

Student has to create one project on their own calendar and clock in a group.

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-121
Subject Name: Information Theory and Coding

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 50-60%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundaments of Digital Communication
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of various channel coding techniques for effective communication in digital systems.	1(3)	1(2)
CO2	Construct the linear block codes for detecting error while transmission of data in digital communication system.	3(2)	2(2)
CO3	Build the circuits for implementation of error codes.	3(1)	2(1)
CO4	Construct advanced error control codes for error- free decoding on receiver side in digital communication system.	4(1)	2(2)
CO5	Develop advanced error coding techniques for given set of specifications in communication system.	2(2)	1(2)
CO6	Compare various automatic repeat request strategies.	2(1)	2(1)

Detailed Contents:

Part A

Elements of Information Theory: 8+4(T)=12 hours

Introduction to Information theory, Uncertainty and information, information measures, entropy, Information rate, Shannon's Theorem, Mutual information; Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth – S/N Trade-off , Information Capacity Theorem , Shannon Limit, Source Coding Theorem, Huffman coding, Lempel Ziv Coding, Run Length encoding.

Error Control Coding: 6+2(T)= 8 hours

Linear Block Codes: Introduction, Basic Definition, Equivalent codes, parity – check matrix, decoding of Linear Block codes, syndrome decoding, Perfect Codes, Hamming Codes, Optimal Linear codes, Maximum Distance Separable (MDS) codes.

Cyclic Codes: 7+2(T)=9 hours

Introduction to polynomials, The Division Algorithm, Method for generating cyclic codes, Burst Error correction, CRC Codes, Circuit implementation.

Part-B

Bose Chaudhuri Hocquenghem (BCH) Codes: 5+1(T)=6hours

Introduction, Primitive elements, minimum polynomial, Examples of BCH codes, Decoding of BCH codes.

Convolution Codes: 9+1(T)=10 hours

Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating Function, Matrix Description, Viterbi Decoding, Distance bounds.

Automatic Repeat Request Strategies: 4+3(T)=7 hours

Framing and its methods, Sliding window protocols: One bit, Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes.

Text Books:

1. Ranjan Bose, Information Theory, Coding and Cryptography, TMH Publication, 2005.

Reference books and other resources:

1. Roberto Togneri, Christopher J.S. deSilva, Fundamental of information theory and coding design, CRC Press, ISBN: 978-1584883104IOT
2. Cover, Thomas, and Joy Thomas. Elements of Information Theory. 2nd ed. New York, NY: Wiley-Inder Science, 2006. ISBN: 9780471241959
3. Coding Theory, Algorithm, Architectures and Application. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn. John Wiley & Sons, Ltd.

E books and online learning materials:

1. http://poincare.matf.bg.ac.rs/nastavno/viktor/main2.pdf
2. http://www.gopalancolleges.com/gcem/course-material/ece/course-plan/sem-V/information-theory-and-coding-10EC55.pdf

MOOCS and Video Course:

1. https://www.youtube.com/playlist?list=PLGKOBYm7AC8F1FI3johvxzEWwZDd-a5Jq
2. https://www.youtube.com/playlist?list=PLbMVogVj5nJRI_hU-0yxRyHTsCg4iXCEd

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-122
Subject Name: Soft Computing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10-20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: NA
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the concept of soft computing techniques in various applications	1(3), 7(1)	2(1)
CO2	Analyze neural network architecture, learning rules and its applications	1(3),2(2)	2(1)
CO3	Summarize the concepts of fuzzy logic, fuzzy systems and their functions	1(3)	2(1)
CO4	Develop air conditioner controller using fuzzy logic system	3(3)	2(1)
CO5	Comprehend the basic concepts of genetic algorithms in various fields	1(3), 7(1)	2(1)
CO6	Examine the Genetic algorithm-based backpropagation networks and their implementation in MATLAB	1(3), 3(3), 7(1)	1(2), 2(1), 3(2)

Detailed Contents:

Part A

Introduction: **6+2(T)= 8 hours**

Introduction to Soft Computing, Historical Development, Definitions, advantages and disadvantages, Hard computing vs soft computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing.

Artificial Neural Networks: **12+4(T)= 16 hours**

Basic concept of Neuron networks, Artificial Neuron model, Neural network architecture: single layer, multilayer feed forward networks and recurrent networks, single layer and multilayer perceptron networks, Learning, Learning types: supervised, unsupervised learning, re-enforcement learning, learning rules and methods, back propagation learning algorithm, architecture of back propagation networks, applications.

Part-B

Fuzzy Logic systems: 9+3(T)=12 hours

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion, Membership functions, interference in fuzzy logic, fuzzy rule-based system, fuzzy if-then rules, fuzzifications and defuzzifications, application: Air conditioner controller using fuzzy logic.

Genetic Algorithm: 12+4(T)= 16 hours

GA history, Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, stopping criteria, fitness function, applications of Genetic Algorithm, Genetic algorithm-based backpropagation networks, Introduction to MATLAB environment for Soft computing Techniques.

Text Books:

1. S. Rajsekaran& G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India.
2. Timothy J. Ross, "Fuzzy logic with engineering applications", 3ed edition, Wiley. Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

Reference books and other resources:

1. S N Sivanandam, S. Sumathi, "Principles of Soft Computing", 2nd edition, John Wiley & Sons.
2. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Pearson Prentice Hall Education, India.
3. Laurene Fausett, "Fundamental of Neural Networks: Architecture, Algorithms and Applications", Prentice Hall, 2004

E books and online learning materials:

1. https://www.digimat.in/nptel/courses/video/127105006/L01.html
2. https://nptel.ac.in/courses/127/105/127105006/
3. https://nptel.ac.in/courses/106/105/106105173/

MOOCS and Video Course:

1. https://www.youtube.com/watch?v=vT1JzLTH4G4
2. https://www.youtube.com/watch?v=aircAruvnKk
3. https://www.youtube.com/watch?v=R66Mn6gNhEs

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-123
Subject Name: Artificial Intelligence

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40-50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic concept of Artificial Intelligence and its applications.	1(2)	2(2)
CO2	Modeling a problem as Search problem, Uninformed Search and problem spaces.	3(2)	2(3)
CO3	Apply the knowledge of AI for the analysis of various search techniques and develop its algorithms.	2(2), 3(2)	2(3)
CO4	Analyze and apply knowledge representation using various approaches and rules.	2(2)	2(2)
CO5	Describe and list the key aspects of planning in artificial intelligence.	3(2)	2(2)
CO6	Formulate valid solutions for problems involving uncertain inputs or outcomes.	5(3)	2(2)

Detailed Contents:

Part A

Artificial Intelligence: Meaning and techniques: 5+1(T)= 6 hours

Meaning of artificial intelligence, AI problems, Physical symbol and Physical system hypothesis, AI technique, the level of the model, criteria for success.

Problems, Problem spaces and Search : 7+2(T)=9hours

Defining the problem as a state space search, Production systems: control strategies and Depth first search and Breadth first search, Heuristic search, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional problems.

Heuristic Search Techniques: 7+3(T)= 10 hours

Search Strategies: Generate-and-test, Hill-climbing: Simple hill climbing, Steepest Ascent

hill climbing and Simulated Annealing, Best-first search: OR graphs, A* Algorithm and Agendas, Problem reduction: AND-OR graphs and AO* Algorithm, Constraint satisfaction, Means-ends analysis.

Part-B

Knowledge Representation: 7+2(T)= 9 hours

Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The Frame problem, Knowledge representation using Predicate Logic, Representing knowledge using rules: Logic programming, Forward versus Backward reasoning, Matching, Control Knowledge.

Planning: 6+2(T)= 8 hours

Introduction to planning, planning in the blocks world, Components of a planning system, Goal stack planning, Nonlinear planning using constraint posting, Hierarchical planning, Reactive systems, Other planning techniques.

Uncertainty Reasoning : 7+3(T)=10 hours

Introduction to Nonmonotonic reasoning, Logics for Nonmonotonic reasoning, Implementation issues, Augmenting a problem-solver, Implementation: Depth-First search, Breadth-First Search, Statistical reasoning: Probability and Bayes' Theorem, Certainty Factors and Rule based Systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic.

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Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India.

Reference books and other resources:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
2. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.
3. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University.

E books and online learning materials:

1. https://cisse.info/pdf/2019/rr_01_artificial_intelligence.pdf
2. https://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-825 techniques-in-artificial-intelligence-sma-5504-fall-2002/lecture-notes/Lecture1Final.pdf

MOOCS and Video Course:

1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. https://nptel.ac.in/courses/106/102/106102220/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-124
Subject Name: Satellite Communication

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20-30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Antenna basics
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the basic concept of Satellite Systems and apply in different domains.	1(2)	1(3)
CO2	Develop an understanding of Kepler's laws, satellite orbital elements and the Space segment	1(2)	1(3)
CO3	Comprehend the basic concept of propagation impairments in Satellite Systems	1(2), 7(1)	1(3)
CO4	Design and analyze Satellite System Link budget.	1(2), 3(2)	1(3)
CO5	Analyze performance of different types of Multiple Access systems	1(2), 2(2)	1(3)
CO6	Explain the importance of various Satellite applications & Specialized services.	1(2), 12(1)	1(3)

Detailed Contents:

Part A

Introduction to Satellite Communication: 5+1(T)=6hours

Historical evolution of Satellite Communication, Frequency allocation of Satellite Services, INTELSAT, Applications, Future trends in Satellite Communication.

Orbital Mechanism and Space Segment: 8+4(T)=12hours

Kepler's laws of planetary motion, terms used for earth orbiting satellites, orbital elements, Geostationary orbit and non-Geostationary orbits, Angle of azimuth & Angle of elevation, Satellite Attitude Control, Satellite Station Keeping; Telemetry, Tracking, Command & Monitoring (TTC&M); Transponder.

Propagation impairments: 5+3(T)=8 hours

Propagation impairments: Atmospheric loss, Ionospheric effects, Rain attenuation, Depolarization, Tropospheric scintillation, Cloud attenuation and other impairments.

Part-B

Satellite Link design: 8+2(T)=10hours

Basic transmission theory, System Noise Temperature, C/N and G/T ratios, Satellite Downlink design- link budget, Uplink design, System design examples.

Satellite Access: 7+2(T)=9hours

Multiple access schemes: FDMA: Fixed assigned FDMA, Demand Assigned FDMA-SPADE System, TDMA: Frame Structure, Reference Burst structure, Traffic burst structure, Frame acquisition & synchronization, Fixed assigned TDMA, Demand assigned TDMA, Introduction to CDMA.

Satellite Service: 6+1(T)=7hours

INSAT, VSAT, Mobile satellite services-GPS, Satellite Navigation system, Direct Broadcast satellite (DBS)-television, Digital Audio Broadcast (DAB).

Text Books:

1. T. Pratt, C. Bostian& J. Allnutt, 'Satellite Communications', 2nd Ed., Wiley India, New Delhi, 2008
2. D. Roddy, 'Satellite Communications',4th Ed., Tata Mc-Graw-Hill, New Delhi, 2009

Reference Books:

1. A. K. Maini and V. Agrawal, 'Satellite Communications',1st Ed., Wiley India Pvt. Ltd., New Delhi, 2010
2. Tri T.Ha, 'Digital Satellite Communications',2nd Ed., Tata McGraw-Hill, New Delhi, 2009
3. Dr. D. C. Agarwal, 'Satellite Communications', 6th Ed., Khanna Publishers,2008

E books and online learning materials:

1. http://archive.mu.ac.in/myweb_test/Satelight%20Comm.pdf
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall2003/lecture-notes/l21satelitecomm2_done.pdf

MOOCS and Video Course:

1. http://nptel.ac.in/courses/106105082/4

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-111

Subject Name: Information Theory and Coding Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Knowledge of MATLAB

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply coding theory in MATLAB	1(2)	2(1)
CO2	Generate basic coding theory in MATLAB	1(1)	2(1)
CO3	Develop an algorithm for determination of entropy and information rate.	2(2)	2(1)
CO4	Generate variable length source coding using MATLAB	1(2)	1(1)
CO5	Develop coding and decoding of Various codes.	3(1)	1(1)
CO6	Compute simulation program to implement ARQ techniques	3(1)	2(1)

Detailed Contents:

Experiment 1. Application of MATLAB to coding theory.
Experiment 2. Learning basic commands of MATLAB.
Experiment 3. Write a program to implement an algorithm for determination of Entropy.
Experiment 4. Write a program to implement an algorithm for determination of Information, Information Rate.
Experiment 5. Write a program for generation and evaluation of variable length source coding using MATLAB.
Experiment 6. Write a program for coding and decoding of Linear Block Codes.
Experiment 7. Write a program for coding and decoding of Cyclic Codes.
Experiment 8. Write a program for coding and decoding of BCH codes.
Experiment 9. Write a program for coding and decoding of Convolution codes.
Experiment 10. Write a program to implement ARQ techniques.
Experiment 11. Write a program to study performance of a coded and uncoded communication system (Calculate the error probability).
Experiment 12. Write a simulation program to implement source coding and channel coding for transmitting a text file.

Reference: Lab Manual.

Student has to complete one project based on lab experiments.

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-112
Subject Name: Soft Computing Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Basics of MATLAB operations

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand basic concepts of MATLAB and its toolboxes used in soft computing.	1(2), 5(1)	2(1)
CO2	Describe the fundamentals of fuzzy, crisp logic and create FIS editor.	1(3), 2(1), 3(1)	2(1)
CO3	Comprehend and implement fuzzy logic system for model tip value and air conditioner controller in MATLAB.	4(1), 5(2)	2(3)
CO4	Implement various activation functions, Perceptron Training Algorithm and plot membership functions using MATLAB.	3(1), 4(2), 5(3)	2(3)
CO5	Design Artificial Neural Network by implementing with and without the back-propagation algorithm.	3(1), 4(2), 5(3)	2(3)
CO6	Analyze and apply Genetic Algorithm for Travelling sales person problem in MATLAB	1(3), 2(1)	2(2)

Detailed Contents:

Experiment 1. To study MATLAB tool and its Toolboxes.
Experiment 2. To study of fundamental of Fuzzy Logic and Basic Operations.
Experiment 3. Use Fuzzy toolbox to model tip value that is given after a dinner which can be-not good, satisfying, good and delightful and service which is poor, average or good and the tip value will range from Rs. 10 to 100.
Experiment 4. Write a program in MATLAB to plot various membership functions.
Experiment 5. Implement FIS Editor.
Experiment 6. To study and analysis Crisp Logic using MATLAB.
Experiment 7. Write a program to implement Activation functions in MATLAB.
Experiment 8. To design air conditioner controller using Fuzzy logic in MATLAB.
Experiment 9. To build an Artificial Neural Network by implementing with the back-propagation algorithm and without back propagation and test the same using appropriate data sets.
Experiment 10. Write a program of Perceptron Training Algorithm using MATLAB.

Experiment 11. Given the dataset {-2,-1,0,1,2} with targets t(-2)=0, t(-1)=0.25, t(0)=0.5, t(1)=0.75 and t(2)=1. Determine the weights of all neurons with sigmoid transfer function such that the MSE is almost zero and if we use the neural network with five neurons in the first layer and one neuron in the second layer.

Experiment 12. To study GA tool in MATLAB.

Experiment 13. Implement travelling sales person problem using genetic Algorithm in MATLAB.

Project: Students are required to develop an expert system for real life problems/games, Expert system; implement a production system, medical diagnosis expert system, agriculture expert system, troubleshooting of computer systems, and implementation of neural/fuzzy network.

Reference Books and Other Resources:

1. Timothy J. Ross, John Wiley and Sons, "Fuzzy logic with engineering applications",
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI.
3. S N Sivanandam, S. Sumathi, "Principles of Soft Computing" , John Wiley & Sons
4. David E. Goldberg, "Genetic Algorithms in search, Optimization & Machine Learning",
5. Jang, Sun, Mizutani, "Neuro-Fuzzy and Soft computing" , PHI.
6. David E. Goldberg, "Genetic Algorithms in search, Optimization & Machine learning", Pearson/PHI.
7. Samir Roy &UditChakraborty, "A beginners approach to Soft Computing", Pearson.

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Track II
(VLSI design and Embedded System)

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-102
Subject Name: ARM based Embedded System

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)=52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Courses

Prerequisites: Digital Electronics, Knowledge of Microprocessor and microcontroller.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Develop the ability to understand the role of embedded system in industry.	1(2)	3 (1)
CO2	Explain the internal architecture of ARM.	1(3)	3(1)
CO3	Apply the knowledge of instruction set for performing various operations on ARM.	2(3)	3(2)
CO4	Illustrate programming concepts to interface peripheral devices with ARM.	3(3), 9(2)	3(3)
CO5	Demonstrate the ability to write the programs for ARM.	3(2)	3(3)
CO6	Comprehend Real-Time Embedded System concepts.	2(2)	3(1)

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Detailed Contents:

Part -A

Introduction to Embedded Systems: 7+1(T)=8 hours

Overview of Embedded systems, Embedded processors, Embedded hardware units and devices, Design parameters of an embedded system, present trends and applications of Embedded
systems.

ARM Processor Architecture: 8+2(T)=10 hours

Overview ARM processor families, the ARM design philosophy, ARM data flow architecture, Registers, Interrupts & vector table.

ARM Instruction Set: 10+5(T)=15 hours

Instruction Set: Data processing instructions, Load-store instructions, Branch instructions, Software interrupt instruction, Program status register instructions, Conditional execution.

Part-B

Design Examples Using ARM7: 6+3(T)=9 hours

ARM7 I/O Port Description, Interfacing Programs for LED, LCD, Stepper motor and Relay.

Real-Time Embedded Systems Software: 8+2(T)=10 hours

Real-time Embedded Systems, Real-Time Operating Systems (RTOS)- Key characteristics, The Scheduler, Tasks, Semaphores, Message Queues.

Text Books:

1. R. Kamal, "Embedded Systems, Architecture Programming and Design", Second Edition, Tata McGraw Hill, 2008.
2. N. Sloss, D. Symes, C. Wright and J. Rayfield, "ARM System Developer's Guide, Designing and Optimizing System Software", Elsevier, 2004.

Reference books and other resources:

1. T. Martin, "The Insider's Guide to The Philips ARM7-Based Microcontrollers, An Engineer's Introduction to The LPC2100 Series", Hitex, 2005.
2. Q. Li, "Real Time Concepts for Embedded Systems", CMP Books, 2003.
3. UM10139 LPC214x User manual.
4. Website: www.arm.com.

E books and online learning materials:

1. http://web.eecs.utk.edu/~roberts/ECE342/AnalogCommunicationSystems.pdf
2. http://www.ee.iitm.ac.in/~giri/pdfs/EE4140/textbook.pdf

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117105143/
2. https://nptel.ac.in/courses/117102059/

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-106

Subject Name: RISC Microcontroller programming and Interfacing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Digital Electronics and Microcontrollers
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the internal architecture of Arduino and MSP 430.	1(3)	3(1)
CO2	Demonstrate the working of Arduino IDE and Energia IDE.	5(2)	3(2)
CO3	Analyze the programming concepts of Arduino and MSP 430.	3(3)	3(2)
CO4	Design and validate the interfacing of different devices like sensors, LCD, motors etc. with Arduino.	3(3)	3(3)
CO5	Describe working of interrupts and processor modes.	1(2)	3(1)
CO6	Select and utilize tools for interfacing of different devices like ADC, LCD etc. with MSP 430.	3(3)	3(3)

Detailed Contents:

Part -A

Getting Started With Arduino: 3+1(T)=4 hours

Architecture of Arduino UNO, AVR ATMega328 pin out and features, pin mapping between Arduino and AVR.

Arduino Programming: 6+2(T)=8 hours

Arduino IDE: installing Arduino IDE, setting up Arduino board, using the Integrated Development Environment (IDE) to prepare an Arduino sketch, uploading and running the blink sketch, creating and saving a sketch.

Basic Concepts: Arduino data types, variables and constants, operators, control statements, arrays, functions, and communications.

Arduino I/O Functions: 10+4(T)= 14 hours

General purpose Input/Output: using a switch, using a switch without external resistors, detecting the closing of a switch, reading analog values.

Visual Output: connecting and using LEDs, adjusting LED brightness, 7-segment Interfacing, driving multi-digit 7-segment LEDs, LCD interfacing.

Getting Input from Sensors: measuring distance using Ultrasonic sensor, interfacing Infrared sensor (IR).

Actuators: controlling direction and speed of DC motor using L293D, interfacing servo motor: position control, interfacing DC motor, controlling one or two servos with a Potentiometer or sensor

Part-B

C for Embedded SystemsandMSP430/432 ARM I/O Programming: 7+2(T)=9 hours

Installing Energia IDE, setting up MSP430/432 board, C Data types for embedded systems bit wise operations in C. MSP 430/432 micro-controller architecture and launch pad. GPIO programming and interfacing. LED and 7-segmentdisplay interfacing. I/O PORT programming and PORT mapping.

Timers, Serial Port and Interrupts Programming: 9+3(T)= 12hours

Basics of serial communication, Programming UART ports. MSP430/432 ARM timer programming. System Tick Timer. Delay generation and counter programming. Interrupts and exception in ARM Cortex-M. ARM Cortex-M processor modes. MSP430/432 I/O Port, UART Serial Port and SysTick programming and interrupt. Interrupt priority programming.

LCD, Keyboard, ADC, DAC and Sensors Interfacing: 4+1(T)= 5 hours

LCD and keyboard interfacing, ADC characteristics, ADC programming with MSP430/432, sensor interfacing and signal conditioning. Interfacing to DAC.

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Text Books:

1. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw-Hill Education, Second Edition, 2016
2. Shujen Chen, Sarmad Naimi, Muhammad Ali Mazidi, Sepehr Naimi, "TI MSP432 ARM Programming for Embedded Systems", Microdigitaled; 1st edition, 2016.

Reference books and other resources:

1. Cornel Amariei, "Arduino Development Cookbook",Packt Publishing, 1st edition, 2015
2. Shujen Chen, Eshragh Ghaemi, Muhammad Ali Mazidi, "TI ARM Microcontroller Programming with Energia: Going from Arduino to ARM", MicroDigitalEd.com, 2019

E books and online learning materials:

1. A https://www.arduino.cc/
2. https://www.programmer-books.com/wp-content/uploads/2020/01/Arduino-Development-Cookbook.pdf
3. http://www.microdigitaled.com/ARM/EnergiaForArduino.htmlGetting started with Energia
4. https://training.ti.com/msp430-workshop

MOOCS and Video Course:

1. https://www.udemy.com/course/arduino-sbs-17gs/
2. https://www.edx.org/course/arduino-programming-from-novice-to-ninja?source=aw&awc=6798_1622362606_adb09e0e3435df3aa882f2b176c6880a&utm_source=aw&utm_medium=affiliate_partner&utm_content=text-link&utm_term=428263_Hackr.io
3. https://www.udemy.com/course/mcu_msp430/learn/lecture/3468720#overview
4. https://www.youtube.com/playlist?list=PLGs0VKk2DiYx6CMdOQR_hmJ2NbB4mZQn-

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-107
Subject Name: VLSI Physical Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0-10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basics of Electronics.
Additional Material Allowed in ESE: Scientific Calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe and identify the issues at various stages of VLSI physical design.	1(3), 2(1)	3(1)
CO2	Explain the fabrication process, design and packaging styles of an integrated circuit.	1(3)	3(1)
CO3	Illustrate the concepts of partitioning, floorplanning, placement and routing and categorize them as per memory or computation requirements.	2(3), 4(1)	3(2)
CO4	Develop algorithms to solve the complex physical design problems in ICs.	3(3), 4(3)	3(3)
CO5	Classify the various Routing Algorithms and explain the Clock, power and ground routing in Physical Design.	1(3)	3(2)
CO6	Apply physical design techniques and devise various sustainable methods for specific area, delay and power requirements of a circuit practically.	3(3), 7(1), 12(1)	3(3)

Detailed Contents:

Part A

Introduction: **4+2(T)= 6 hours**

VLSI Design Cycle, Physical Design Cycle, Design representation, Design Rules, Layout of Basic Devices, NMOS fabrication process, CMOS fabrication process and its impact on physical design, Design styles and system packaging styles.

Partitioning: **7+2(T)= 9 hours**

Graph theory fundamentals, partitioning, problem definition, objective and classification of partitioning algorithms, Kernighan-Lin algorithm, Fiduccia-Mattheyses algorithm and simulated annealing.

Floorplanning: 6+2(T)= 8 hours

Floorplanning, problem definition, objective and Classification of floorplanning algorithms, slicing, non-slicing floorplan, constraint based floorplanning, rectangular dual graph floorplanning and Pin assignment.

Part-B

Placement: 8+2(T)= 10 hours

Placement, problem definition, objective of Placement, difference between placement and floorplanning, different design styles, ASICs, SoC, microprocessor, classification of Placement techniques, simulated annealing and breuer's algorithm.

Routing: 10+2(T)= 12 hours

Routing, problem definition, objective and classification of Routing, Grid, detailed and global routing, Global routing, maze routing, line search, Steiner tree based algorithms, Detailed routing, constraint graphs, Channel routing, Clock routing , power routing and ground routing.

Performance Issues in circuit layout: 6+2(T)= 8 hours

Delay model, timing driven placement, timing driven routing, via minimization and power minimization.

Text Books:

1. Majid Sarrafzadeh and C.K. Wong, "An Introduction to VLSI Physical Design", 4th ed., New York: McGraw-Hill, 1996.
2. Naveed A. Sherwani, "Algorithm for VLSI Physical Design Automation", 2nd ed. Berlin: Kluwer, 1999.
3. Andrew B. Kahng, Jens Lienig, Igor L. Markov and Jin Hu, "VLSI Physical Design: from graph partitioning to timing closure", Springer Science & Business Media, 2011.

Reference books and other resources:

1. Charles J. Alpert, Dinesh P. Mehta, and Sachin S. Sapatnekar, "Handbook of algorithms for physical design automation", CRC press, 2008.
2. S.M. Sait and H. Youssef, "VLSI Physical Design Automation: Theory and Practice", Singapore: World Scientific, 1999.
3. Sabih H Gerez , "Algorithms for VLSI Design Automation", John Wiley & Sons, 2006.
4. R. Dreschler, "Evolutionary Algorithms for VLSI CAD", 3rd ed. Massachusetts: Springer, 2002
5. S.K. Lim, "Practical Problems in VLSI Physical Design Automation", Massachusetts: Springer, 2008

E books and online learning materials:

1. https:// www.youtube.com/channel/UCXpT8JbMgRDU8twicEUzHaw/videos
2. https://vlsicad.eecs.umich.edu/KLMH/presentations.html
3. https:// imsk.ece.gatech.edu/book/slides.htm

4. Related IEEE Publications

MOOCS and Video Course:

1. https://nptel.ac.in/courses/106/105/106105161/

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering
B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-108
Subject Name: Digital VLSI Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basics of MOS Transistors
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Discuss the process and challenges in VLSI Design.	1(3), 2(1), 7(1)	3(1)
CO2	Design MOS inverters and analyze their static and switching characteristics.	2(3), 3(2)	3(3)
CO3	Design Combinational circuits using CMOS Logic.	3(3)	3(3)
CO4	Illustrate the behavior of CMOS latches and flip-flops.	2(3), 3(2)	3(2)
CO5	Examine the operation of ROM and RAM circuits.	2(3), 3(2)	3(3)
CO6	Use the concepts for research in the area of Digital Integrated Circuits design.	7(1), 12(1)	3(3)

Detailed Contents:

Part A

Introduction **8+2(T)= 10 hours**

Introduction to VLSI Design, VLSI Design Flow, Challenges of VLSI design: power, timing, area, noise, testability, reliability and yield, CAD tools: simulation, layout, synthesis, testing, MOS Transistors, Scaling of MOS circuits and short channel effects.

MOS Inverter **8+3(T)= 11 hours**

Resistive Load Inverter, Inverters with n-Type MOSFET Load, CMOS inverter, Design of CMOS Inverter, Threshold voltage, Voltage Transfer Characteristics, Power and Area Considerations, Cascaded CMOS inverter, Delay Time Calculation, Interconnect Parasitics, Interconnect Delay, Switching Power Dissipation of CMOS Inverters, Power-Delay Product.

Part-B

Combinational Circuit Design **8+3(T) = 11 hours**

CMOS logic circuits: CMOS Two-Input NOR Gate, CMOS Two-Input NAND Gate, Layout of CMOS NOR and NAND Logic Gates, CMOS Full-Adder Circuit, Power consumption in CMOS logic gates, CMOS transmission gates, Dynamic Combinational Circuits: Domino Logic.

Sequential Circuit Design **9+3(T)= 12 hours**

Behavior of Bistable Elements, Clocked Latch and Flip-Flop Circuits: Clocked SR Latch, Clocked JK Latch, Master-Slave Flip flop, CMOS D-Latch and Edge-Triggered Flip-Flop, Schmitt Trigger Circuit.

Semiconductor Memories **6+2(T)=8 hours**

ROM Circuits, Static RAM Circuits: SRAM Operation, CMOS SRAM Cell: SRAM Write and Read Circuitry, SRAM versus DRAM.

Text Books:

1. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", Tata McGraw Hill, 2003
2. D.A. Pucknell and K. Eshraghian, "Basic VLSI Design", PHI, 3rd edition, 1995.

Reference books and other resources:

1. J. M. Rabaey, Anantha P. Chandrakasan, and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2003.
2. N. H. Weste and D. M. Harris, "CMOS VLSI Design: A Circuits and System Perspective", Fourth Edition, Pearson, 2015.
3. Brunvand, "Digital VLSI Chip Design with Cadence and Synopsys CAD tools," Addison Wesley, 2010.

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E books and online learning materials:

1. http://people.ee.duke.edu/~jmorizio/ece261/classlectures/dynamicCMOS.pdf
2. https://digitalsystemdesign.in/wp-content/uploads/2018/05/C-MOSkang.pdf
3. Related IEEE Publications

MOOCS and Video Course:

1. https://nptel.ac.in/courses/108/107/108107129
2. https://nptel.ac.in/courses/117/105/117105080/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-102

Subject Name: ARM Based Embedded System Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks:50	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of digital systems, microprocessor and microcontroller.

On Completion of the course, the student will have the ability to:

CO	Definition	POs	PSOs
CO1	Comprehend the working of ARM based development boards	2(1)	3(2)
CO2	Develop programs of ARM for performing mathematical operations.	3(2)	3(2)
CO3	Illustrate programming concepts to interface peripheral devices with the ARM.	5(3)	3(3)
CO4	Develop source codes for interfacing of peripherals devices.	3(3)	3(2)
CO5	Design high end applications using ARM	6(2)	3(2)
CO6	Construct a project in a team or individual for given problem using ARM.	9(2)	3(3)

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Detailed Contents:

Experiment 1. Study of ARM kits.
Experiment 2. Write programs for performing addition of any two numbers.
Experiment 3. Write programs for performing subtraction of any two numbers.
Experiment 4. Write programs for performing multiplication of any two numbers.
Experiment 5. Write programs for performing logical operations of any two numbers.
Experiment 6. Write a program to blink LED connected withARM7 microcontroller.
Experiment 7. Write a program to interface a relay with ARM7 microcontroller.
Experiment 8. Write a program to control the speed and direction of a stepper motor using ARM7 microcontroller.
Experiment 9. Write a program to interface DC motor with ARM7 microcontroller.
Experiment 10. Write a program to interface RFID module with ARM7 microcontroller.
Experiment 11. Write a program to interface LCD display with ARM Cortex microcontroller.
Experiment 12. Write a program to demonstrate the use of Real Time Clock using ARM Cortex microcontroller.

Reference Books and Other Resources: Lab manuals available in lab.
Student has to complete one project based on lab experiments.

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-103

Subject Name: RISC Microcontroller programming and interfacing Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Digital Electronics and Microcontrollers

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify various modules related to Arduino Uno	1(3)	3(1)
CO2	Develop Program for operations on LED, LCD and 7 segment display using Arduino IDE.	5(2)	3(2)
CO3	Illustrate programming concepts to interface peripheral devices with Arduino.	3(3)	3(2)
CO4	Identify various modules related to MSP 430/432.	3(3)	3(3)
CO5	Develop Program for operations on LED, LCD and 7 segment display using MSP 430/432 Kits.	1(2)	3(1)
CO6	Illustrate programming concepts to interface peripheral devices with MSP 430/432 Kit.	3(3)	3(3)

Detailed Contents:

Experiment 1. Introduction to Tinkercad and its dashboard.

Experiment 2. Demonstration of the Arduino UNO board and Arduino IDE installation on Computer.

Experiment 3. Write a program to interface LED brightness control and 7-segmentdisplay using Arduino Uno.

Experiment 4. Write a program of 16x2LCDinterfacing with Arduino Uno.

Experiment 5. Write a program to interface temperature and humidity DHT-11 sensor using Arduino Uno.

Experiment 6. Write a program to interface Wi-Fi module ESP-32 with Arduino Uno.

Experiment 7. Write a program to interface Servo Motor SG-90 with Arduino Uno.

Experiment 8. Demonstration of MSP 430/432 kit and Energia IDE installation on Computer.

Experiment 9. Write a program to interface LED with tact switch and 7-segment display using MSP 430/432.

Experiment 10. Write a program of 16x2 LCD interfacing with MSP 430/432.

Experiment 11. Write a program to interface Temperature and Humidity DHT-11 sensor using MSP 430/432.

Experiment 12. Write a program to Control DC Motors Using MSP430/432.
Experiment 13. Write a program to Interface Wi-Fi module ESP-8266with MSP430/432.

Reference material: Lab Manual

Students have to complete one project based on lab experiments.

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-109
Subject Name: PLC and Industrial Automation

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basic knowledge in programming and circuits
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Acquire the hardware knowledge of PLC module	1(3)	1(2)
CO2	Understand the ladder programming skills of PLC module.	1(3)	2(3)
CO3	Develop the basic understanding of PLC Intermediate Functions	3(2)	2(3)
CO4	Acquire the advance skills of PLC Programming	4(3)	2(3)
CO5	Understand the concept of PLC interfacing with various devices	1(3)	1(2)
CO6	Illustrate the applications of automation with PLC	5(2)	3(3)

Detailed Contents:

Part A

Introduction: 6+2(T)=8 hours

Introduction, Advantages of PLC control panel, Architecture, Functions of various blocks that make PLC, Working principle, Memory types, Different types of input/output circuits, Concept of digital I/O & analog I/O, Concept of scan cycle.

Logic Concepts and PLC Programing: 6+2(T)=8 hours

Number System and Number Conversion, Principles of Boolean Algebra and Logic Concepts, PLC Circuits and Logic Contact Symbology, Programing on/off Inputs to Produce on/off Outputs, Creating Ladder Diagrams

Basic and Intermediate Functions of PLC: 7+2(T)=9 hours

PLC Timer Functions, PLC Counter Functions, Register Basics, PLC Arithmetic Functions, PLC Number Comparison Functions, PLC Number Conversion Functions.

Part-B

Advance PLC Programming: 8+2(T)=10 hours

Introduction to PLC programming, Different programming methods (Instruction list, functional block diagram, Sequential text, signal flow chart), ABB PLC programming, SIEMENS PLC & FUJIPLC programming

PLC Interfacing: 6+3(T)=9 hours

Concept of Interfacing in PLC, Sensors interfacing to PLC, Relay card interfacing with PLC, PLC to PLC, PLC to HMI, PLC to SCADA interfacing.

Applications of PLC in Industrial Automation: 6+2(T)=8 hours

Applications on the Process Control, Remote Monitoring, Controlling a Robot with a PLC, Control of a Substation, Power Plant Monitoring and Control, Data Acquisition

Text Books:

1. D. Otter & Job, "Programming Logic Controller", PH international, USA,20063
2. G. Dunning, "Introduction to PLC's", Tata McGraw Hill.2005

Reference books and other resources:

1. John W.Webb, "Programmable Logic Controllers: Principles & Applications", Prentice hall Publication, 5th Edition, (2008)

E books and online learning materials:

1. https://industrial-ebooks.com/EBOOK/FreePLCEbook.pdf
2. http://profsite.um.ac.ir/~shoraka/Delta%20PLC%20Applications%20Programmig.pdf

MOOCS and Video Course:

1. https://www.youtube.com/channel/UCzj8F0LhfOCXefe6gJd6OsA
2. https://www.udemy.com/course/plc-programming-100/

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-110
Subject Name: Advanced MOSFET based Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basics of Transistors.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the behaviour of MOS device and various parameters affecting its performance.	1(3)	3(1)
CO2	Analyze the operation of SOI MOSFETs and various factors associated with scaling.	2(3)	3(2)
CO3	Classify MOSFETs on the basis of gate position around channel and understand the need of change in device structures with technology change.	1(3), 12(2)	3(2)
CO4	Distinguish between classical and quantum physics applied in MOSFETs.	1(3), 2(2)	3(2)
CO5	Illustrate and analyze the process and technology behind MOSFETs.	2(3)	3(2)
CO6	Examine the impact of temperature, scattering and strain on MOS device mobility and develop solution to meet the desired performance.	3(3)	3(3)

Detailed Contents:

Part A

Review of MOS device: 5+2(T)= 7 hours

Band diagram, MOS working, I-V Characteristics, Subthreshold characteristics, Parameters: Transconductance, Source/Drain Resistance, Conductance; Substrate bias, Mobility: low field mobility and high field mobility; Bulk and SOI MOSFETs, Comparison.

SOI MOSFET: 6+2(T)= 8 hours

MOSFET Scaling and Moore's Law, Short Channel Effects: Drain Induced Barrier lowering, Punch through, Impact ionization, Hot carrier effects; Gate Geometry and Electrostatic Integrity, Fully Depleted and Partially Depleted SOI Devices.

Multiple gate SOI MOSFETs: 8+3(T)= 11 hours

Double gate, Triple gate, Quadruple-gate FET: Wrapped-Around Gate FET, Gate-All-Around FET, Surrounding Gate FET, Device characteristics, FinFET, Nanowire FETs, SOI Junction less Transistors, Multigate MOSFET Memory Devices.

Part-B

Multigate MOSFET Physics: 6+2(T)= 8 hours

Classical Physics: Natural Length and Short Channel Effects, Current Drive, Corner Effect. Quantum Effects: Volume Inversion, Mobility Effects, Threshold Voltage, Inter-subband scattering.

Multigate MOSFET Technology: 7+2(T)= 9 hours

Active Area: Fin width, height, pitch, surface orientation; Gate Stack: Patterning, Gate work function requirements, GIDL; Source/Drain Resistance and Capacitance: Doping, Junction Depth, Parasitic RC; Mobility and Strain Engineering.

Mobility in Multigate MOSFETs: 7+2(T)= 9 hours

DG MOSFETs and FinFETs: Phonon limited mobility, Interface roughness scattering, Coulomb Scattering, Temperature dependence of mobility, High-k dielectrics, Strained devices; Si Nanowires: Electron Transport, Surface Roughness. Radiation Effects: total ionizing dose effects, Single event effects.

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Text Books:

1. Jean-Pierre Colinge, "FinFETs and Other Multi-Gate Transistors", Springer, 2008.
2. Jean-Pierre Colinge, "Physics of Semiconductor Devices", Kluwer Academic Publishers, 2002.

Reference books and other resources:

1. Y. Taur and T.H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 1998.
2. Amara and Olivier Rozeau, "Planar Double-Gate Transistor, From Technology to Circuit", Springer, 2009.
3. Jean- Pierrie Colinge, "Silicon-on-insulator Technology: Materials to VLSI", Kluwer Academic publishers' group, 2004.

E books and online learning materials:

1. https://www.synopsys.com/designware-ip/technical-bulletin/finfet-design.html
2. https://www.youtube.com/watch?v=kL4wiiLxQ50

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/108/117108047/
2. https://www.coursera.org/learn/semiconductor-1
3. https://www.edx.org/course/fundamentals-of-transistors

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-111
Subject Name: Analog MOS Integrated Circuit

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basics of Transistors
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Discuss MOS behaviour and small signal models for analog circuit analysis and design.	1(3), 2(1)	3(1)
CO2	Explain the operation of single stage amplifiers and differential amplifiers in various configurations.	1(3)	3(1)
CO3	Design current mirror circuits with different biasing.	3(2)	3(2)
CO4	Analyze the impact of noise and role of feedback in amplifiers.	2(3)	3(2)
CO5	Assess the performance of operational amplifiers.	1(3)	3(2)
CO6	Explain the applications of switched capacitor circuits.	1(3)	3(1)

Detailed Contents:

Part A

Introduction: 5+2(T)= 7 hours

Integrated Circuits, MOSFET structure, MOS I/V characteristics, Threshold Voltage, Second order effects: Body effect, Channel Length Modulation, Subthreshold conduction, MOS Device Capacitances, MOS Small-Signal Model.

Single-Stage Amplifiers and Differential Amplifiers: 8+3(T)= 11 hours

Single-Stage Amplifiers: Common Source Stage: Resistive Load, Diode-Connected Load, Current-Source Load, Source Degeneration, Source Follower, Common Gate Stage, Cascode Stage; Differential Amplifiers: Basic Differential Pair, Common Mode Response, Differential pair with MOS Loads, Gilbert Cell.

Current Mirrors and Frequency Response of Amplifiers: 7+2(T)=9 hours

Current Mirrors: Basic Current Mirror, Cascode Current Mirror, Active Current Mirrors; Frequency Response of Amplifiers: Miller Effect, Common Source Stage, Source Follower, Common Gate stage, Cascode Stage, Differential Pair.

Part-B

Noise and Feedback in Amplifiers: 7+2(T)= 9 hours

Types of Noise, Representation of Noise in Circuits, Noise in Single Stage Amplifiers, Noise in Differential Pairs; Feedback Topologies, Effect of Loading, Effect of feedback on Noise.

Operational Amplifiers: 6+2(T)= 8 hours

Performance Parameters of Op-Amps, One-Stage OP-amps, Two Stage op-amps, Gain Boosting, Common Mode feedback, Slew Rate, Noise in Op-Amps.

Switched Capacitor Circuits: 6+2(T)= 8 hours

Sampling Switches, MOSFETs as switches: Speed and Precision considerations; Switched Capacitor Amplifiers: Unity Gain Sampler, Non-Inverting Amplifier; Switched Capacitor Integrator

Text Books:

1. B. Razavi, "Design of Analog CMOS Integrated Circuits", Tata-McGraw Hill, 2002.
2. David Johns and Ken Martin, "Analog Integrated Circuit Design", John Wiley and Sons, 2008.

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Reference books and other resources:

1. R. Jacob Baker, "CMOS: Circuit Design, Layout and Simulation", John Wiley and Sons, 2008.
2. Alan B. Grebene, "Bipolar and MOS Analog Integrated Circuit Design", John Wiley and Sons, 2003.

E books and online learning materials:

1. http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2020/start#tutorials
2. https://freevideolectures.com/course/3185/analog-integrated-circuit-design/12

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/101/117101105/
2. https://onlinecourses.nptel.ac.in/noc20_ee26/preview

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-112
Subject Name: Low Power VLSI Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basics of Electronics and MOSFETs.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the sources of power dissipation in VLSI Systems and various parameters contributing to it.	1(2), 2(1)	3(1)
CO2	Analyze the impact of technology scaling on performance of devices.	2(2)	3(2)
CO3	Explain power optimization techniques in circuits.	1(3)	3(1)
CO4	Estimate power related issues during clock distribution in VLSI circuits.	2(2)	3(2)
CO5	Illustrate power estimation and minimization techniques for the design of memories.	1(3)	3(2)
CO6	Design circuits for performing arithmetic operations considering low power consumption.	3(3), 7(1)	3(3)

Detailed Contents:

Part A

Introduction: 5+2(T)= 7 hours

Power and Energy basics, Sources of power dissipation in Digital Integrated circuits, Important parameters for low power design, Dynamic dissipation in CMOS, transistor Sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device Innovation.

Circuit Level Power Optimization Techniques: 6+2(T)=8 hours

Dynamic Power Optimization: multiple supply voltages, transistor sizing, technology mapping. Static power Optimization: Multiple thresholds, transistor stacking, Introduction to energy recovery CMOS.

Power Optimization at Standby and Runtime: 7+3(T)= 10 hours

Clock gating, Power gating, Body biasing, supply voltage ramping, Power reduction of memory in standby mode using voltage scaling and body biasing, Dynamic voltage and frequency scaling, adaptive body biasing, Power domains and power management.

Part-B

Low Power Clock Distribution: 7+2(T)= 9 hours

Power Dissipation in Clock Distribution, Single driver vs. Distributed buffers, Buffer and device sizing, Zero skew vs. tolerant skew, chip and package co-design of clock network.

Logic Synthesis for Low Power: 7+2(T)= 9 hours

Low power design flow, Power analysis methodology, Power estimation Techniques, Power minimization Techniques.

Design of Low Power Memory and Arithmetic Elements: 7+2(T)=9hours

Memory architecture, SRAM cell metrics, power in cell array, Power for read and write access, Design of circuits for addition, Multiplication and Division.

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Text Books:

1. A. Sarkar, S. De, M. Chanda, C.K.Sarkar, "Low Power VLSI Design", De Gruyter Oldenbourg, 2016.
2. K. Roy and S. C. Prasad, "Low-Power CMOS VLSI Circuit Design", John Wiley & Sons, 2009.
3. A. Pal, "Low Power VLSI Circuits and Systems", Springer, 2015.

Reference books and other resources:

1. N. H. Weste, D. M. Harris, A. Bannerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 3rd Edition, 2012.
2. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition, 2003.
3. J. M. Rabaey, M. Pedram, "Low Power Design Methodologies", Kluwer-Academic Publishers, 1996.
4. P. Chandrakasan and R. W. Broderson, "Low Power Digital CMOS Design", Springer, 1995.

E books and online learning materials:

1. https://ieeexplore.ieee.org/abstract/document/8073688
2. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.16.8780&rep=rep1&type=pdf

MOOCS and Video Course:

1. https://nptel.ac.in/courses/106/105/106105034/
2. https://nptel.ac.in/courses/117/101/117101004/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-104
Subject Name: PLC and Industrial Automation Lab

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Basic knowledge of circuits and programming

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Acquire skill in interfacing peripherals, relays, Lamps, pushbuttons and sensors with different PLC models	1(2)	1(2)
CO2	Implement and troubleshoot the circuits involving interfacing of PLC with real world.	3(3)	2(3)
CO3	Create and troubleshoot automatic process control employing PLC and embedded based modules	2(3)	2(3)
CO4	Implement logic gates using PLC	3(3)	3(3)
CO5	Controlling the output with the aid of PLC programming	3(3)	3(2)
CO6	Evaluate the performance of industrial practical circuits using PLC.	4(2)	2(3)

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Detailed Contents:

Experiment 1. Introduction to PLC control panel and I/O modules.
Experiment 2. Implementation of different logic gates using PLC.
Experiment 3. PLC Program to Latch and Unlatch Output With Time Delay.
Experiment 4. Interfacing of lamp and button with PLC for ON/OFF operation.
Experiment 5. Performed delayed operation of lamp by using push buttons.
Experiment 6. Multiple push button operation with delayed lamp for ON/OFF operation.
Experiment 7. Combination of counter & timer for lamp ON/OFF operation.
Experiment 8. Motor forward and reverse direction control using PLC.
Experiment 9. Implement a PLC based traffic light control system.
Experiment 10. PLC Program for Burglar Alarm Security System.
Experiment 11. PLC Program to control level of a single/multiple tank(s).
Experiment 12. PLC program to Industrial Monitoring system.
Experiment 13. PLC program to automate industrial or school or college time management system.
Experiment 14. Students need to make a project based on knowledge acquired from the PLC lab sessions.

Reference Books and Other Resources: Lab manual

Student has to complete one project based on lab experiments.

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-105

Subject Name: Advanced MOSFET based Structures Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of semiconductor devices

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Examine the behavior of PN diode and MOSFETs in terms of V-I characteristics.	1(3), 2(3)	3(2)
CO2	Demonstrate the use of high-k dielectric and gate stacking in MOSFET design.	3(2),4(3)	3(3)
CO3	Design MOSFET at lower technology node and examine short channel effects.	3(2),4(3), 5(3)	3(3)
CO4	Create the structure of 3D FinFET and analyze the impact of high-k dielectric material on its behavior.	3(3),4(3), 5(3)	3(3)
CO5	Design Gate-all-around transistor according to device specifications using TCAD tools.	3(3),4(3), 5(3)	3(3)
CO6	Design the device structures for current research-oriented problems and conclude significant performance metrics using TCAD tools.	4(3), 5(3), 7(3), 12(2)	3(3)

Detailed Contents:

Experiment 1. To study the main features and utilities of TCAD tools for designing and simulating electronic circuits.

Experiment 2. To design silicon PN junction diode and observe its V-I characteristics.

Experiment 3. To design single gate MOSFET and examine its V-I characteristics for 180nm.

Experiment 4. To design and analyze single gate and double gate MOSFET using low-k dielectric in terms of V-I characteristics for 90nm. Compare their results.

Experiment 5. To design double gate MOSFET using high-k gate dielectric for 90nm and draw V-I characteristics.

Experiment 6. To design double gate MOSFET and observe its V-I characteristics for 20nm technology.

Experiment 7. To analyze the Short channel effects and temperature variation on double gate MOSFET for 20nm technology.

Experiment 8. To analyze the performance of 20nm double gate MOSFET using various gate dielectrics in terms of V-I characteristics and Short channel effects.

Experiment 9. To analyze 20nm double gate MOSFET using gate stacking in terms of V-I characteristics and Short Channel Effects.

Experiment 10. To design and analyze the impact of high-k dielectric in rectangular FinFET device for 20nm gate length.

Experiment 11. To design, simulate & compare FinFET device using classical and quantum transport model.

Experiment 12. To design 3-fin Multifin FinFET device for 20nm technology.

Experiment 13. To design Gate-all-around FET device and determine V-I characteristics.

Reference Books and Other Resources:

1. Tools like Cogenda TCAD, Tspice, LTspice.
2. N. H. Weste and D. M. Harris, "CMOS VLSI Design: A Circuits and System Perspective", Fourth Edition, Pearson, 2015.
3. Y.Taur and T. H. Ning, "Fundamentals of Modern VLSI Devices", Second Edition, Cambridge University Press, 2013.
4. N. Arora, "MOSFET Modeling for VLSI simulation: Theory and Practice", World Scientific, 2007.
5. B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", Pearson Prentice Hall, 2006.
6. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, 2003.

Online Courses and Video Lectures:

1. NPTEL MOOCS video courses.
2. Related IEEE Publications

Student has to complete one project based on lab experiments.

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-113
Subject Name: IoT using Raspberry Pi

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** NA
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Basic programming skills
Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	PO	PSO
CO1	Create a fully functional computer using Respberry Pi.	1(3)	1(2)
CO2	Use Python based IDE and trace and debug Python code on the device.	1(1)	1(1)
CO3	Implement various communication protocols for wired and wireless communication.	3(2)	2(3)
CO4	Understanding the concept of Internet of Things.	2(2)	2(3)
CO5	Elucidate sensor technology for sensing the real world using analog and digital sensors	3(3)	2(2)
CO6	Design real time IoT Devices	3(2)	1(2)

Detailed Contents:

Part A

Introduction to Raspberry Pi **4+2(T)=6 hours**

Basic functionality of the Raspberry Pi board and its Processor, setting and configuring the board, Differentiating Raspberry Pi from other platforms like Arduino, asus thinker etc, Component overview.

Programming the Raspberry Pi **7+3(T)=10 hours**

Python: Introduction to python programming language, Python programming environment, Python expressions, Strings, Functions, Function arguments, List methods, Control flow, Numpy, PIP(Python installation package) and customized libraries.

Controlling Hardware **6+2(T)=8 hours**

Connecting an LED, Controlling the brightness of an LED, Make a Buzzing sound, Switching a high power DC device using a Transistor, Switching a high power device using Relay, Changing the color of RGB LED.

Part-B

Overview of IoT **6+2(T)=8 hours**

Understanding IoT fundamentals, IOT Architecture, protocols, Various Platforms for IoT, Real time Examples of IoT, Overview of IoT components and IoT Communication Technologies.

Sensors and Networks **10+2(T)=12 hours**

Sensing the real world, Example of Sensors, Industrial IoT, Automotive IoT, Actuator, Sensor Data, Communication Protocols, Radio Frequency Identification Technology (RFID) IoT Systems, Electronic Product Code Global Architecture Framework, Web of Things of RFIDs, WSN Concepts, WSN Architecture, WSN Protocols, WSN Infrastructure Establishment, WSN Nodes Secure Communication, WSN IoT Applications.

IoT Design **6+2(T)=8 hours**

IoT Applications based on Pi, LAMP Web-server, GPIO Control over Web Browser, Creating Custom Web Page for LAMP, Communicating data using on-board module, Home automation using Pi, Node-RED, MQTT Protocol, Using Node-RED Visual Editor on Rpi.

Text Books:

1. Simon Monk, "Programming the Raspberry Pi, Second Edition: Getting Started with Python", McGraw-Hill Education, 2nd edition, 2015
2. Tim Cox, "Raspberry Pi Cookbook for Python Programmers", Packt Publishing Limited, 1st, 2014
3. Raj Kamal, "Internet of Things – Architecture and Design Principles", 5th Reprint Edition, McGraw -Hill Education, 2019

Reference books and other resources:

1. Ebem Upton, "Raspberry Pi user guide", John Wiley & Sons, 2016
2. Mayur Ramgir, "Internet of Things – Architecture, Implementation and Security", 1st Impression, Pearson India, 2020

E books and online learning materials:

1. http://www.stilson.net/documentation/raspberrypi/Raspberry%20Pi%20Cookbook.pdf
2. https://www.raspberrypi.org/magpi-issues/Projects_Book_v1.pdf

MOOCS and Video Course:

1. https://www.youtube.com/watch?v=RpseX2ylEuw&list=PLQVvvaa0QuDesV8WWHLLXW_avmTzHmJLv
2. https://www.udemy.com/course/getting-started-with-raspberry-pi/

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-114
Subject Name: VLSI Design with HDL

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Digital Electronics, Basics of MOS.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the need of hardware description language and its features.	1(2)	3(1)
CO2	Make use of hardware description language VHDL and Verilog to represent digital circuits.	5(3)	3(1)
CO3	Demonstrate the use of various architecture modeling styles of VHDL to design digital circuits.	5(3)	3(2)
CO4	Create digital circuit design at various levels of abstraction in Verilog.	5(3)	3(3)
CO5	Categorize and estimate various types of delays in the design of digital circuits.	1(2), 3(2)	3(1)
CO6	Design combinational and sequential circuits for various applications using VHDL and Verilog.	1(3), 3(3), 5(3), 12(1)	3(3)

Detailed Contents:

Part A

Introduction to VHDL: 7+2(T)=9 hours

Evolution of Computer-aided Digital Design, Emergence of HDLs, Typical VLSI design flow, Design Methodologies, Importance of Hardware description languages, VHDL, Features, Primary constructs, Identifiers, Data objects, Data classes, Data types, Operators.

Architecture Modeling Styles: 7+3(T)=10 hours

Behavioral style of modeling: Process, if-else, Case, Null, Loops, Next, Exit, Assert, Report; Structural style: Component declaration and instantiation; Data flow style of modeling: Conditional and selected signal assignment statement, unaffected.

Applications of VHDL: 5+3(T)=8 hours

Design of gates, Combinational Circuit Design such as Adders, Subtractors, Multiplexers, Encoders, Decoders, Code Converters, Comparators, Sequential Circuit Design such as Flip-flops, Counters, Shift registers etc.

Part-B

Basic Concepts of Verilog: 7+2(T)=9 hours

Modules, Ports, Instances, Components of simulation, Lexical Conventions: Operators, strings, Identifiers and Keywords; Data types, Nets, Registers, Vectors, Arrays, System Tasks and Compiler Directives.

Abstraction Levels in Verilog: 13+3(T)=16 hours

Behavioural Modeling: Conditional Statements, case, loops; Data flow Modeling: Continuous Assignment, Delays, Operator Types; Gate-level Modeling: Gate types, Gate Delays; Switch-level Modeling: MOS switches, CMOS Switches. Design Examples such as Multiplexer, 4-Bit Counter, 4-Bit Full adder, Flip-flops etc.

Text Books:

1. J. Bhasker, A VHDL Primer, Prentice Hall PTR, 1999.
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall, Second Edition, 2003.

Reference books and other resources:

1. D. L. Perry, VHDL: Programming by Example, Tata McGraw-Hill, 2002.
2. S. Brown and Z. Vranesic, Fundamentals of Digital Logic with VHDL Design, McGraw-Hill Education, 2008.
3. T.R.Padmanabhan and B.T.Sundari, Design through Verilog HDL, John Wiley & Sons, 2004.

E books and online learning materials:

1. https://www.tutorialspoint.com/vlsi_design/vlsi_design_tutorial.pdf
2. https://www.eng.auburn.edu/~strouce/elec4200.html
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-884-complex-digital-systems-spring-2005/lecture-notes/

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/101/117101004/
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs72/

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-115

Subject Name: Introduction to MEMS and Nanotechnology

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** NIL
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Semiconductors and Physics.
Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic concepts of Microsystems and their applications in various fields.	1(3), 3(1), 7(1)	3(1)
CO2	Assess the properties of different materials and working of sensors for creating MEMS.	2(2)	3(2)
CO3	Explain the stages of fabrication process involved in MEMS.	1(2)	3(1)
CO4	Comprehend the fundamentals and physics behind nanotechnology.	1(3)	3(1)
CO5	Illustrate characteristics of materials and devices at nanoscale.	1(3), 2(2)	3(2)
CO6	Analyze the impact of nanotechnology in various fields.	1(3), 3(1), 7(3)	3(2)

Detailed Contents:

Part A

Introduction: 4+1(T)=5 hours

Introduction to MEMS and Microsystems, MEMS Products, Miniaturization, Applications of Microsystems in Telecommunications, automotive Industry, Consumer Products.

Materials for MEMS and Sensors: 7+3(T)=10 hours

Materials: Substrates and wafers, Silicon as Substrate Material, Silicon Compounds, Gallium Arsenide, Piezoelectric Crystals, Polymers; Sensors: Microsensors- Acoustic wave, biosensors, Chemical Sensors, Optical Sensors, Pressure sensors, Thermal Sensors; Micro actuators.

Micromanufacturing: 8+2(T)=10 hours

Photolithography, structural and sacrificial materials, Thin Film deposition: LPCVD, Sputtering; Impurity Doping: Diffusion, Ion Implantation, Etching: Wet Etching, dry etching; Bulk and Surface micromachining, Wafer Bonding, LIGA.

Part-B

Nanotechnology: 8+3(T)=11 hours

Brief History of Nanotechnology, Nanotechnology as an Emerging Technology, Introduction to Quantum Mechanics: Matter Waves, Heisenberg's uncertainty Principle, Schrodinger Equation, Electron Confinement, Tunneling of a Particle through Potential Barrier, Structure and Bonding: Arrangement of Atoms, Bonding in Solids, Electronic Structure of Solids.

Nanomaterials and Nanodevices: 7+3(T)=10 hours

Nanomaterials: Carbon Nanoparticles, Carbon Nanotubes, Nanofibres, Graphene. Nanodevices: Device Miniaturization and Issues, Quantum Computing, Electron Devices: Ballistic Transport, Single Electron Devices, Spintronics, Storage Class Memory, Photonic Devices.

Applications and Impact of Nanotechnology: 5+1(T)=6 hours

Energy: Dye-Sensitized Photovoltaic Solar cell, Fuel Cell, Medical Field; Domestic Appliances; Space, Defense and Engineering, Environmental Impact.

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Text Books:

1. Tai Ran-hsu, "MEMS and Microsystems Design and manufacture", Tata McGraw Hill, 8th Edition, 2002.
2. Sulabha K. Kulkarni, "Nanotechnology: Principles and Practices", Springer, 3rd Edition, 2011
3. Jeremy J. Ramsden, "Nanotechnology: An Introduction", Elsevier, 2nd Edition, 2016.

Reference Books:

1. N. P. Mahalik, "MEMS", Tata McGraw Hill, 2008.
2. Nitaigour P. Mahalik, "Micromanufacturing and Nanotechnology", Physica-Verlag, Springer, 2006.
3. Stephen D. Senturia, "Microsystem Design", Kluwer academic Publishers, 2001.
4. Bijoy Bhattacharyya, "Electrochemical Micromachining for Nanofabrication, MEMS and Nanotechnology", Elsevier, 2015.
5. A. Luque, S Nihtianov, "Smart Sensors and MEMS Intelligent Sensing Devices and Microsystems for Industrial Applications", Elsevier, 2018.
6. Zhaoying Zhou, "Microsystems and Nanotechnology", Tsinghua University Press, 2012.

E books and online learning materials:

1. https://www.academia.edu/1455218/MEMS_and_microsystems_design_manufacture_and_nanoscale_engineering
2. https://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_review/an-introduction-to-mems.pdf
3. https://www.phys.sinica.edu.tw/TIGP-NANO/
4. https://lecturenotes.in/subject/563/introduction-to-nanotechnology-in

5. https://nptel.ac.in/content/storage2/courses/112108092/module1/lec01.pdf
6. https://drive.google.com/file/d/1mY7qbe4yUg9O02Q5yML9m_soy1OlCmIK/view

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/112/108/112108092/
3. https://nptel.ac.in/courses/118/104/118104008/
4. https://nptel.ac.in/courses/108/108/108108113/
5. https://nptel.ac.in/courses/113/106/113106093/
6. https://nptel.ac.in/courses/118/102/118102003/

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PEEC-116
Subject Name: Modern and Future Memories

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 8	**Teaching Hours:** 39+13(T)= 52 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fundamentals of Memories.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	PO	PSO
CO1	Explain the fundamentals of MOS Transistors.	1(3)	3(1)
CO2	Analyze the behavior of MOS Inverters and their applications in memories.	2(3), 3(1)	3(2)
CO3	Illustrate the design functionality of SRAM and DRAM with its performance specifications.	2(3), 3(2)	3(2)
CO4	Classify different SRAM and DRAM structures.	1(3), 2(2)	3(2)
CO5	Describe NOR and NAND based flash memories.	3(2), 7(1)	3(3)
CO6	Compare magnetic, resistive and phase change non-volatile memories.	3(1)	3(2)

Detailed Contents:

Part A

Introduction **6+2(T)= 8 hours**

Review of MOS based devices, MOS transistor: threshold voltage, drain and transfer characteristics, subthreshold slope, Hot electron effect, various leakages in MOSFET, SOI MOSFET, MOS Inverter and characteristics, Classification of memories.

Static Random Access Memory **14+4(T)= 18 hours**

Basic SRAM Architecture and Cell Structures: Performance and Timing Specifications, SRAM Read and Write Operations, SRAM Selection Considerations, High Performance SRAMs: Double and Quad Data Rate SRAM, Low-Voltage SRAMs, SOI SRAMs, Content Addressable Memories (CAMs).

Part-B

Dynamic Random Access Memory **7+3(T)=10 hours**

DRAM Technology Evolution and Trends: Timing Specifications and Operations, Memory Read-Write and Refresh Operation, Enhanced DRAM (EDRAM), Cache DRAM (CDRAM), SOI DRAMs.

Non-Volatile Memories **12+4(T) = 16 hours**

Floating Gate Cell Theory and Operations: Fowler-Nordheim Tunneling, Nonvolatile Memory Cell and Array Designs: UV-EPROM Cells , Flash Memory Architectures: NOR Flash Memories: AMD NOR Architecture Flash Memories, Intel Flash Memories, NAND Flash Memories: AMD NAND Architecture Flash Memories, Samsung 32M x 8-bit NAND Architecture Flash Memory, Flash Memory Reliability Issues, Ferroelectric Memories, Phase-Change Nonvolatile Memories, Protonic Nonvolatile Memories, magnetic random-access memory (MRAM) and RRAM

Text Books:

1. Ashok K. Sharma, "Advanced Semiconductor Memories: Architectures, Design and Applications," Wiley-IEEE Press, 2002.

Reference books and other resources:

1. A. Bhattacharya, "Silicon Based Unified Memory Devices and Technology," CRC Press, 2017.
2. Ashok K. Sharma, "Semiconductor Memories: Technology, Testing and Reliability," Wiley IEEE Press, 1997.
3. Jean-Pierre Colinge, FinFETs and Other Multi-Gate Transistors, Springer, 2008.

E books and online learning materials:

1. https://nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-28.pdf
2. https:// nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-30.pdf
3. https://nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-27.pdf
4. https://nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-32.pdf
5. https://nanoscalereslett.springeropen.com/track/pdf/10.1186/1556-276X-9-526.pdf

MOOCS and Video Course:

1. https://www.youtube.com/watch?v=jK6xr4r06tU
2. https://www.youtube.com/watch?v=5zfs8IGU16o

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-106
Subject Name: IoT using Raspberry Pi Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Python Programming.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the principles Raspberry Pi programming	5(2)	2(2)
CO2	Develop clear and effective Raspberry Pi code	5(2)	2(2)
CO3	Create applications using Raspberry Pi	3(1), 5(2)	2(2)
CO4	Develop and use Convertors using Raspberry Pi	3(1), 5(2)	2(2)
CO5	Analyze and evaluate the data received through sensors in IoT	1(2), 5(2)	2(2)
CO6	Design their own IoT system using Raspberry Pi through wireless technologies.	3(1), 5(2)	2(2)

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Detailed Contents:

Experiment 1. To Study the architecture of Raspberry Pi.
Experiment 2. Write a program to interface raspberry pi with your computer.
Experiment 3. Write a program to install Wi-Fi module on raspberry pi.
Experiment 4. Write a program to connect and install Camera on raspberry pi.
Experiment 5. Write a program to operate stepper motor with raspberry pi
Experiment 6. Write a program to operate LED's with raspberry pi.
Experiment 7. Write a program to connect and install biometrics with raspberry pi.
Experiment 8. Write a program to install android on raspberry pi.
Experiment 9. Write a program to install operating system on raspberry pi.
Experiment 10. Write a program to use raspberry pi as an analog to digital convertor.
Experiment 11. Setting up of Raspberry Pi and connect to a network.
Experiment 12. Connect IOT devices through cloud using IoT protocol such as MQTT.
Experiment 13. To demonstrate the communication modules like BLE, WIFI, XBEE.

Reference material: Lab Manual
Student has to complete one project based on lab experiments.

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: LPEEC-107

Subject Name: VLSI Design with HDL Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** NA
External Marks: 20	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Professional Elective Course

Prerequisites: Digital Circuits

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of HDL tools for modeling and functional verification of digital circuits.	1(3), 5(3)	3(3)
CO2	Develop VHDL and Verilog codes for combinational and sequential circuits under given specifications.	1(3)	3(2)
CO3	Examine the simulated waveforms for different inputs to digital circuits.	1(3), 2(2)	3(1)
CO4	Design digital circuits for given specifications using HDL tools.	1(3), 3(3), 5(3)	3(3)
CO5	Demonstrate the operation of digital circuits on FPGA board.	1(3), 5(3)	3(3)
CO6	Work in a team to construct program for given engineering problem and test it on kits for enhanced learning.	1(3), 2(3), 4(3), 5(3), 9(2), 12(3)	3(3)

Detailed Contents:

Perform the following experiments using VHDL and Verilog on Xilinx Design Tools:

Experiment 1. Design of gates: AND, OR, NOT, NAND and NOR.

Experiment 2. (a) Design of Half-Adder and Full Adder.
(b) Design of Half Subtractor and Full Subtractor.

Experiment 3. (a) Design of 4:1 MUX.
(b) Design of 1:8 DEMUX.

Experiment 4. (a) Design of 3:8 Decoder.
(b) Design of 8:3 Encoder.

Experiment 5. (a) Design of 4 Bit Binary to Grey code Converter.
(b) Design of 4 Bit Binary to BCD Converter.

Experiment 6. Design of 4-Bit Binary to Excess-3 converter using sequential statement.

Experiment 7. Design of 8:3 Priority Encoder using if-else.

Experiment 8. Design of 9-Bit parity generator using structural style.

Experiment 9. Design of all type of Flip-Flops using sequential statements.

Experiment 10. Design of counters: MOD 5, MOD 16.
Experiment 11. Design of Ring Counter and Johnson Counter.
Experiment 12. Design of Synchronous 8-Bit universal shift register.
Experiment 13. (a) Study and Implementation of basic gates on FPGA board.
(b) Implementation of MUX and DEMUX on FPGA board.

Reference Books and Other Resources:

1. Lab manuals available in lab.
2. J. Bhasker, A VHDL Primer, Prentice Hall PTR, 1999.
3. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall, Second Edition, 2003.
4. D. L. Perry, VHDL: Programming by Example, Tata McGraw-Hill, 2002.

MOOCS and Video Course:

1. https://nptel.ac.in/courses/106/102/106102181/
2. https://nptel.ac.in/courses/117/108/117108040/

Student has to complete one project based on lab experiments.

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OPEN ELECTIVE COURSES

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-101
Subject Name: Signals and Systems

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Mathematics, Function Plotting.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply various operations on the signals and classify signals and systems on the basis of characteristics.	1(2)	1(1)
CO2	Make use of various tools like Fourier series, Fourier transform and Z-transform for the analysis of continuous and discrete time signals.	1(3),2(2)	1(2)
CO3	Analyze the response of LTI systems and solve difference and differential equations used for the mathematical representation of systems.	2(3),3(2)	1(3)
CO4	Predict the behavior of random signals using probability theory.	2(3)	1(2)
CO5	Examine the effect of noise sources on system performance.	2(3)	1(2)
CO6	Test real-time systems using self-study and engage in life-long learning.	2(3), 12(1)	1(2)

Detailed Contents:

Part -A

Classification of Signals and Systems: 8 hours

Introduction to Signals in engineering, Elementary signals in continuous and discrete domain, Operations on dependent and Independent variables, Role of Sampling, Classification of Continuous-time and Discrete-time signals, Overview of systems in engineering, Classification of Continuous-time and Discrete-time systems, Interconnection of systems.

Analysis of Continuous-time and Discrete-time signals: 11 hours

Representation of Continuous-time and discrete-time signals using Fourier series, Properties of Fourier Series, Aperiodic Continuous-time and discrete-time signal representation using Fourier Transform, Properties of Fourier Transform, Fourier Transform of Periodic Power Signals, Spectral Density, Parseval's Theorem and correlation,

Introduction to z-transform, Properties and Region of Convergence.

Part-B

Linear Time Invariant Systems: 7 hours

Definitions and Properties of LTI Systems, Causality and stability, Impulse and step response, Convolution integral, Transfer function, Differential equations for continuous-time systems, Impulse Response of Discrete-Time Systems, Convolution sum, Difference equations and analysis.

Probability Theory: 7 hours

Definitions related to Probability of Random Experiments, Properties of Probability, Joint and Conditional Probability, Random Variable, Cumulative distribution Function, Probability Density Function, Statistical Averages of Random Variable, Examples of Probability Density Functions, Random Process.

Noise Impact on Communication Systems: 6 hours

External sources of noise, Internal sources of noise, White Gaussian noise, Equivalent input noise, Signal to Noise Ratio (SNR), Noise Temperature, Noise equivalent Bandwidth, Noise Factor and noise figure, Determination of Noise Figure, Spectral components of noise.

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Text Books:

1. Haykins S. & Veen B. V., "Signals and Systems", John Wiley & Sons, 2nd Edition, 2008.
2. Oppenheim A. V., Wilsky S. & Nawab S. H., "Signals and Systems", Pearson Education, 2007.
3. Haykin S., "Communication Systems", John Wiley & Sons, 3rd Edition, 2008.

Reference books and other resources:

1. Hsu H. P., "Signals and Systems", McGraw Hill Education Pvt. Ltd., 2nd Edition, 2008.
2. Ramesh P. & Anandanatarajan R., "Signals and Systems", Scitech publishers, 4th Edition.
3. Roberts M. J., "Signals and Systems: Analysis using Transform Methods and MATLAB", Tata McGraw-Hill, 2nd Edition, 2012.
4. Sundararajan D., "A Practical Approach to Signals and Systems", John Wiley & Sons, 2008.
5. Ghosh S., "Signals and Systems", Pearson Education, 2006.
6. Etten W.V., "Introduction to Random Signals and Noise", John Wiley & Sons, 2005.
7. Kani N., "Signals and Systems", Tata McGraw-Hill, 2010.

E books and online learning materials:

1. http://www.di.univr.it/documenti/OccorrenzaIns/matdid/matdid744681.pdf
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-notes/

MOOCS and Video Course:

1. http://nptel.ac.in/courses/117104074/1
2. https://www.edx.org/course/signals-and-systems-part-1

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-102

Subject Name: Basics of Electronics and Communication

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Fundamentals of electronic devices
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of working principle of diode for utilization in different applications.	1(2)	1 (3)
CO2	Apply the knowledge of working principle of transistor for utilization in different applications.	1(3)	1(3)
CO3	Understand the basic concept of feedback in amplifiers and applying for designing LC and RC oscillators.	1(1)	1(2)
CO4	Comprehend the basic concept of Binary Number System and apply for Boolean problems.	2(2)	1(2)
CO5	Analyze performance of different types of analog modulation techniques.	2(3)	1(3)
CO6	Demonstrate the concepts of digital modulation techniques.	3(2)	1(3)

Detailed Contents:

Part -A

Introduction to Electronics: 8 hours

Semiconductors, Intrinsic Semiconductors, Extrinsic Semiconductor, P-N Junction Diode Operation, Junction Theory, V-I Characteristics of P-N Junction Diode, Ideal Diode, Diode Applications, Special Diodes- Zener diode as a voltage regulator, Light Emitting Diode, Photodiode.

Transistors and its applications: 7 hours

Introduction to Transistors, Construction and Working of a Transistor, Transistor as an amplifier, Basic configurations - Common Emitter, Common Base, Common Collector: characteristics and comparison, Need for Biasing, Operating point, Need for Bias Stabilization,

Oscillators: 4 hours

Feedback in Amplifiers, Types of Feedback, Principle of Oscillators, LC and RC oscillators

Part -B

Fundamentals of Digital Electronics: 7 hours

Logic Gates: AND, OR, NOT, Universal Gates, Exclusive Gates, Boolean algebra, Binary Number System- Binary, Decimal, Octal, Hexadecimal, Number System Conversions, Binary Addition, Binary Subtraction-1's and 2's compliment, 7-Segment LCD Display.

Analog Communication: 8 hours

Elements of a communication system, Introduction to Modulation and Demodulation, Need of Modulation, Types of Modulation – Amplitude Modulation: Mathematical analysis, Modulation index; Frequency Modulation: Mathematical analysis, Frequency spectra, Modulation Index; Phase Modulation: Mathematical analysis, Applications in Engineering.

Digital Communication: 5 hours

Advantages of Digital Communication, Digital Modulation techniques – ASK, FSK, and PSK. Applications of Digital Modulation. M-ary modulation.

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Text Books:

1. Jacob Milliman, Christos Halkias, Chetan Parikh, "Milliman's Integrated Electronics" Paperback, 2nd Edition.
2. Donald P. Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Applications". McGraw Hill Education; Eighth Edition.
3. Kennedy Davis,"Electronics Communication Systems" Paperback, 4th Edition.

Reference books and other resources:

1. N.N Bhargava, S.C. Gupta, D.C. Kulshreshtha " Basic Electronics and Linear Circuits", Tata McGraw-Hill Education.
2. R.P Jain, " Modern Digital Electronics", Tata McGraw Hill Publications, 4th edition.

E books and online learning materials:

1. http://web.eecs.utk.edu/~roberts/ECE342/AnalogCommunicationSystems.pdf
2. https://inst.eecs.berkeley.edu/~ee100/su07/handouts/DiodeTransistorNotes.pdf

MOOCS and Video Course:

1. NPTEL Course on: Basic Electronics and Lab
2. http:// nptel.ac.in/courses/122106025/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-103
Subject Name: Consumer Electronics

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours: 39**
Theory/Practical: Theory	**Credits:**
Internal Marks: 40	**Percentage of Numerical/Design Problems:** NA
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Basics of Electronics
Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify various types of analog and digital signals	1(2)	1(2)
CO2	Troubleshoot audio systems	2(2),4(2)	1(2)
CO3	Analyse the composite signal used in various power supplies and video systems	2(3)	1(3)
CO4	Identify & troubleshoot colour TV receivers	3(3)	1(3),3(2)
CO5	Maintain compliance with various electronic appliances	3(2)	1(2)
CO6	Troubleshoot different types of microphones	4(2)	1(3)

Detailed Contents:

Part A

Audio Video Fundamentals **7 hours**

Microphones: Characteristics of microphones; types of microphones (Carbon, crystal, dynamic,velocity); types of headphones(crystal, moving iron, electrostatic, dynamic);Hearing impairments; Audiometry; Hearing Aids; Inside a hearing aid; Distortion in tape equipment; Noise reduction: Pre emphasis and De-emphasis , Companders, Noise Reduction systems

Controlling and Troubleshooting Systems **8 hours**

Power Supplies: Voltage Regulation, Zener DiodeShunt Stabiliser, Transistor Shunt Stabiliser, UPS,Troubleshooting in Audio systems, troubleshooting in Video Systems

Television Practices **8 hours**

Colour TV standards and systems : Dispersion and recombination of light , Primary and secondary colours, Attributes of colour, Luminance signal, Chrominance Signal ,Colour picture tube, Difference between colour picture tube and monochrome; Colour TV systems, Compatibility Considerations.

Part-B

Consumer Applications and Electronic Devices **8 hours**

Calculators: Structure and Internal Organisation of Calculator, Servicing Electronic Calculators, Digital Clocks, LSI Digital clocks; In-Car Computers : Applications, Electronic Ignition, Antilock Braking system, Instrument panel Displays;Microwave Ovens: Transit time, Waveguides, types of microwave ovens, microwave cooking, wiring and safety Instructions, Air Conditioners : components of air conditioning system, remote control buttons; Refrigeration: Refrigerants, Refrigeration system, Domestic Refrigerators.

Product Compliance **8 hours**

Product safety and liability issues; standards related to electrical safety and fire hazards, EMI/EMC requirements, design techniques for ESD, RF interference and immunity,line current harmonics and mains voltage surge.

Text Books:

1. Bali, S.P., "Consumer Electronic", Pearson,2007.
2. Gupta, R.G., "Audio Video System principles, maintenance and troubleshooting" , McGraw Hill,2010.

Reference books and other resources:

1. Dhake,A.M. "Television and Video Engineering",McGraw Hill,2006.

E Books Online Learning Material:

1. Microphone-https://www.coursehero.com/file/18404103/7- microphonesppt/
2. CD player: www.tclauset.org/cpg132/albums/FTPuploads/ppt_05/CDs_SperoS.ppt
3. Television: https://www.slideshare.net/Pravinshirek07/colour-television

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-104
Subject Name: Wireless Communication

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 7	**Teaching Hours:** 39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10-20 %
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Fundamentals of Analog and Digital Communication.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic elements of Cellular Radio Systems and its design.	1(3)	1(3)
CO2	Describe different types of interferences.	2(2)	1(2)
CO3	Identify the requirements of Multiple Access techniques for Wireless communication.	1(2)	1(2)
CO4	Explain the functioning of packet radio protocols.	1(3)	1(2)
CO5	Distinguish different wireless communication systems and standards.	1(2)	1(2)
CO6	Summarize features of various intelligent networks.	5(3)	1(3)

Detailed Contents:

Part-A

Basic Cellular System: 10 hours

Basic cellular system, Performance criteria, Components and Operation of cellular systems, Planning a cellular system, Analog & Digital cellular systems, Concept of frequency reuse channels, Co-channel interference, Reduction factor, Handoff, Cell splitting.

Multiple Access Techniques for Wireless Communications: 8 hours

Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Packet Radio Protocols; Pure ALOHA, Slotted ALOHA.

Part-B

Wireless Systems & Standards: 12 hours

AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), Global system for Mobile (GSM): Services, Features, System Architecture and Channel Types, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications, overview of 4G and 5G.

Intelligent Networks for wireless communication: 9 hours

Introduction to Bluetooth, RFID technology, Advanced Intelligent Network (AIN), SS7 network and ISDN for AIN, AIN for mobile communication, Asynchronous Transfer Mode (ATM) technology.

Text Books:

1. T. L. Singal, Wireless Communications, McGraw Hill Education (India), 2010
2. C Y Lee, Mobile Cellular Telecommunications, 2nd Edition, MGH, 2004.

Reference books and other resources:

1. Raj Pandya, ―Mobile and Personal Communication systems and services‖, Prentice Hall of India, 2001.
2. Wireless and Digital Communications; Dr. Kamilo Feher (PHI), 1998.
3. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.
4. Jochen H. Schiller, "Mobile Communications", Second Edition, Pearson Education.

E books and online learning materials:

1. http://ee.sharif.edu/~pr.wireless.comm/references/Schwartz.pdf
2. http://www.egr.msu.edu/~tongli/Introduction-WCN.pdf

MOOCS and Video Course:

1. http://nptel.ac.in/courses/114102062/3
2. http://nptel.ac.in/courses/114102062/6

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-105
Subject Name: Embedded Systems

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 7	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Digital Electronics, Knowledge of Microprocessor and microcontroller.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Develop the ability to understand the role of embedded system in industry.	3(2)	3(2)
CO2	Explain the internal architecture of ARM.	1(3)	3(1)
CO3	Illustrate the programming concepts to interface devices with ARM.	3(3), 9(2)	3(3)
CO4	Comprehend bus and protocol concepts.	2(2)	3(1)
CO5	Extend and apply the acquired knowledge to the embedded application development platform	3(2), 5(1)	3(1)
CO6	Apply the knowledge of microcontrollers and embedded systems for advanced applications.	1(3)	3(3)

Detailed Contents:

Part A

Introduction to Embedded Systems: 7 hours

Embedded systems vs. General computing systems, Categories of Embedded systems, Embedded Processors, Embedded hardware units and devices, Design parameters of embedded systems.

ARM Processor Architecture and Programming: 10 hours

The ARM design philosophy, ARM data flow architecture, Registers, Interrupts & vector table, ARM 32-bit instruction set: Data processing instructions and Load-store instructions and interfacing of LED, relay modules with ARM7.

Buses and Protocols: 8 hours

Serial Bus communication protocols: I2C, USB, Parallel Bus device protocols: ISA, ARM Bus. Network Protocols: HTTP, TCP/IP.

Part-B

Embedded Application development platforms: 6 hours

Basic features and architecture of development platforms such as Arduino, Raspberry Pie, TIVA C Series and MSP430.

Embedded control applications: 8 hours

Embedded Program Development tools, Application examples: Washing Machine, Automotive systems, Auto-focusing Digital Camera, Air Conditioner.

Text Books:

1. Lyla B Das, "Embedded Systems- An Integrated Approach", 1st Edition Pearson,2013
2. N. Sloss, D. Symes and C. Wright, "ARM system developer's guide", Elsevier/ Morgan Kaufman, 1st Edition, 2004
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", 2/e TMH, 2012

Reference books and other resources:

1. Shibu KV, "Introduction to Embedded Systems", 1/e McGraw Hill Education, 2009
2. David E. Simon "An embedded software primer," Pearson Education, 1995.

MOOCS and Video Course:

1. https://nptel.ac.in/content/syllabus_pdf/108102045.pdf

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-106
Subject Name: Network Security

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 7	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Basic understanding of computers and networks
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the security requirements, threats and design principles for network security.	2(2)	2(3)
CO2	Discuss the various algorithms of public- and private-key cryptography.	3(2), 2(2)	2(2)
CO3	Develop hash functions for message authentication codes.	3(1), 5(3)	2(2)
CO4	Assess the degree of protection at different layers of TCP/IP architecture and illustrate some network security protocols.	2(1), 6(2)	2(3)
CO5	Summarise application-layer security protocols and methods to authenticate users across networks.	3(2), 5(2)	2(2)
CO6	Analyze the techniques and infrastructures to develop secure wireless communication network.	3(2), 7(2)	1(3)

Detailed Contents:

Part A

Computer and Network Security Concepts: 7 hours

Computer Security – Definition, Requirements, Challenges; X.800 – Security architecture for OSI, Active and passive attacks, Security services, Security mechanisms, Model for network security.

Cryptographic Algorithms: 8 hours

Symmetric and Asymmetric cipher model, Substitution and Transposition techniques, Stream cipher vs. Block cipher, Internal structure and key schedule of DES, Principles of public-key cryptosystems, RSA algorithm.

Authentication Schemes: 4 hours

MD4 Family, Hash functions from block ciphers, Secure Hash Algorithm-1, Message authentication codes.

Part-B

Network Security Protocols in Practice: 6 hours

Understanding security using the OSI and TCP/IP architectures, Crypto placement in different layers of TCP/IP, X.509 Public-key infrastructure, IPSec and its security association, Secure socket layer protocol.

Email security and authentication protocols: 5 hours

Basic email security mechanism, Pretty good privacy, Secure/Multipurpose internet mail extension protocol, Basic Idea of Kerberos, Secure Shell.

Wireless Network Security: 9 hours

Wireless local-area networks, Wireless security vulnerabilities, Common wireless security protocols, Wired-equivalent privacy protocol, Wi-Fi Protected Access (WPA) protocol, WPA-2.

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, 7th Edition, 2017.
2. Jie Wang and Zachary Kissel, "Introduction to Network Security: Theory and Practice", John Wiley & Sons, 2015.

Reference books and other resources:

1. Charlie Kaufman, Radia Perlman, and Mike Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2017.
2. Behrouz A. Forouzan, "Introduction to Cryptography and Network Security", McGraw Hill, 2008.
3. André Perez, "Network Security", ISTE and John Wiley & Sons, 2014.
4. Christos Douligeris and Dimitrios N. Serpanos, "Network Security: Current Status and Future Directions", John Wiley & Sons, 2007

E books and online learning materials:

1. https://crypto.stanford.edu/cs155old/cs155-spring11/lectures/01-intro-thompson.pdf
2. https://cseweb.ucsd.edu/~mihir/papers/gb.pdf
3. http://index-of.es/Hack/Introduction_to_Network_Security.pdf
4. https://web.cs.ucdavis.edu/~rogaway/classes/227/winter00/
5. https://courses.cs.washington.edu/courses/csep590/06wi/

MOOCS and Video Course:

1. https://nptel.ac.in/courses/106/105/106105162/
2. https://www.udemy.com/course/network-security-course/
3. https://www.coursera.org/specializations/computer-network-security

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Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-107
Subject Name: Fundamentals of Mechatronics

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Basics of measurement and control systems.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Discuss the components and applications of a mechatronics system.	1(2)	1(1), 3(1)
CO2	Explain the operational principle of various sensors and transducers and decide their role in various applications.	1(3), 2(2)	1(1)
CO3	Examine the role of pneumatic, hydraulic and electrical actuating systems in controlling various applications.	1(3), 2(3)	1(1)
CO4	Illustrate the functioning and applications of microcontrollers in mechatronic design.	1(3), 2(2)	1(1),3(2)
CO5	Develop ladder programs for a PLC involving logic functions, latching, internal relays and sequencing.	2(3), 3(1)	1(3)
CO6	Apply the concepts of Mechatronics in real world applications and engage in life-long learning.	1(3), 2(3), 3(3), 12(2)	1(2),3(3)

Detailed Contents:

Part A

Introduction: **4 hours**

Basic elements of Mechatronics system, Design Process, Traditional versus Mechatronics approach, Measurement systems, Overview of Control Systems, Applications of mechatronics systems.

Sensors and Transducers: **8 hours**

Performance Terminology, Displacement, Position and Proximity Sensors: Potentiometer, strain-gauge, capacitive, differential transformers, optical encoders, Pneumatic sensors, Proximity switches, and Hall-effect sensors. Velocity and motion sensors, Fluid pressure sensors, Temperature sensors, Light Sensors.

Actuators: **7 hours**

Pneumatic and Hydraulic systems, Directional Control Valves, Pressure control valves, Rotary actuator. Electrical Actuation systems: Solid-State Switches, Solenoids, Stepper Motors.

Part-B

Microcontrollers: **7 hours**

Numbering Systems, Microcontrollers: Block diagram and functioning, PIC Microcontroller, Applications: Temperature Measurement System, Domestic Washing Machine.

Programmable Logic Controllers: **7 hours**

Basic PLC structure, Input/Output Processing, Ladder Programming, Instruction Lists, Latching and Internal relays, Sequencing, Timers and Counters.

Mechatronic Systems: **6 hours**

Mechatronic Designs, Case studies of mechatronic systems-A Pick-and-Place Robot, Car Park Barriers, Digital Camera, Bar Code Reader.

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Text Books:

1. William Bolton, "Mechatronics", Pearson Education, Sixth Edition, 2015.
2. Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier, First Edition, 2005.

Reference books and other resources:

1. David G. Alciatore, Michael B. Histand, "Introduction to Mechatronics and Measurement Systems", McGraw Hill, Fourth Edition, 2012.
2. K.P. Ramachandran, G.K.Vijayaraghavan, M.S. Balasundaram, "Mechatronics", John Wiley & Sons, First Edition, 2008.
3. Devdas Shetty, Richard A. Kolk, "Mechatronics System Design", Cengage Learning, Second Edition, 2011.
4. Musa Jouaneh, "Fundamentals of Mechatronics", Cengage Learning, 2013.

E books and online learning materials:

1. https://ieeexplore.ieee.org/abstract/document/7827930
2. https://www.sciencedirect.com/science/article/abs/pii/S0967066102000163

MOOCS and Video Course:

1. https://nptel.ac.in/courses/112/103/112103174/
2. https://nptel.ac.in/courses/112/107/112107298/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-108

Subject Name: Information and Communication Technologies in Rural Sector

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10-20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: Knowledge of Electronic Communication to develop the rural sector.
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the various issues in Rural area.	1(2)	1(1)
CO2	Analyze the scope of communication technologies in rural area.	2(3)	1(3)
CO3	Significance of Computer networks in rural area.	2(3)	2(3)
CO4	Development of rural area using smart facilities.	3(2)	1(2)
CO5	Develop automation in the rural agriculture.	3(2)	1(3)
CO6	Understand the various Information technology strategies for rural development.	1(2)	1(2)

Detailed Contents:

Part A

Study of Rural Areas **6 hours**

Problems in Rural Areas (Infrastructure, Population, Communication and social problems, Need of rural development, need of present world, the role of Electronic and Communication in the rural sector, Basic communication model, Line telephony, Line telegraphy, Facsimile exchange, Development of electronic telephone, Caller ID, WLL.

Communication Technologies **7 hours**

Cellular Telephone systems: Digital cellular telephone, Second generation cellular systems: GSM specifications and Air Interface - specifications of various units, 2.5 G systems: GPRS/EDGE specifications and features, 3G systems: UMTS & CDMA 2000 standards and specifications

Computer Networks **7 hours**

Computer communication network: Introduction to Classification of computer N/W's- LAN, MAN, WAN, Intranet, Internet system & Extranet SYSTEM, Role of Computer networks, broadband, ISDN, VSAT.

Part-B

Facilities in Rural Area **6 hours**

Building infrastructures: Smart schools, Hospitals, Public Distribution System (PDS), ATM Systems, Smart Transport System, Geographic information system (GIS).

Automation Facilities **6 hours**

Agricultural infrastructure: Solar Pump Systems, Google earth mechanism, Digital surveillance system, Soil health testing, Weather report, Radio & Television Broadcasting, Unmanned Arial Vehicles (UAV).

Rural Development Strategies **7 hours**

Information Technology (IT): e-Seva, eNAM (National Agriculture Market), Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Digital India Land Records Modernization Program (DILRMP), BHARATNET – The world's largest rural broadband project.

Text Books:

1. Telecommunication Switching systems & Networks: Vishwanathan, 3rd Edition, PHI.
2. Wireless Communication – Principles and practice: T S. Rappaport**,** Prentice Hall PTR, 2nd Edition, 2007.
3. Computer Networks: Andrew Tanenbaum, 4th Edition, PHI.

Reference books and other resources:

1. J. E. Flood, "Telecommunications Switching, Traffic and Networks", Pearson Education
2. John C. Bellamy, "Digital Telephony", Third Edition; Wiley Publications
3. Computer Communication Networks: Frouzan, 4th Edition, Tata Mc-Graw Hill.

E books and online learning materials:

1. https://store.pothi.com/book/ebook-dr-satish-patel-information-communication-technology-rural-perspective/
2. https://www.routledge.com/Information-and-Communication-Technologies-in-Rural-Society/Rusten-Skerratt/p/book/9780415411165
3. https://www.pashudhanpraharee.com/role-of-e-nam-e-pashuhaat-aplm-act-in-doubling-livestock-farmers-income/
4. https://www.digi.com/blog/post/introduction-to-smart-transportation-benefits
5. https://dolr.gov.in/en/programme-schemes/dilrmp/best-practices-dilrmp
6. https://www.ctc-n.org/technologies/solar-water-pumps
7. https://researchguides.library.wisc.edu/GIS#:~:text=Mapping%20and%20Geographic%20Information%20Systems%20%28GIS%29%20%3A%20What,Finding%20what%20is%20inside.%20...%20More%20items...%20
8. https://www.geeksforgeeks.org/asynchronous-transfer-mode-atm-in-computer-network/
9. https://informatics.nic.in/uploads/pdfs/1c9eb0a8_Punjab_state_in_focus.pdf

MOOCS and Video Course:

1. https://onlinecourses.nptel.ac.in/noc19_ee48/preview
2. https://nptel.ac.in/courses/105/106/105106115/

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: OEEC-109
Subject Name: Neural Networks and Fuzzy Logic

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** L:39
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Open Elective Course

Prerequisites: NIL
Additional Material Allowed in ESE: Scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Examine the fundamental concepts of biological neuro-system and evolution of artificial neural networks.	1(3), 2(3)	1(3)
CO2	Identify the various types of learning techniques developed to train artificial neural network.	2(3), 3(3)	2(3)
CO3	Demonstrate the feedforward architecture of neural network.	2(3), 3(2)	1(2)
CO4	Explain the functioning of feedback neural networks architectures.	3(2)	1(2)
CO5	Formulate the complex neural network to model and solve complicated practical problems.	3(3), 4(2), 5(3)	1(3), 2(2)
CO6	Summarize the concepts of fuzzy logic and its applications.	1(2), 3(3)	1(3)

Detailed Contents:

Part A

Introduction: **10 hours**

Neural Networks: History, Overview of Biological Neuro-System, Terminology of Artificial Neural Network, Comparison of Biological Neural Networks and Artificial Neural Networks, Mathematical Models of Neuron, ANN Architecture, Topology, Fundamental Learning Laws, Learning Paradigms – Supervised, Unsupervised and reinforcement Learning.

Artificial Neural Networks: **10 hours**

Perceptron Architecture, Single layer perceptron, Perceptron Learning Rules, Multi-layer perceptron, Back Propagation Algorithm, Associative Memories, Hopfield Networks, Competitive Learning, Self-organizing Maps.

Part-B

Applications of Neural Networks: **8 hours**

Applications of neural nets such as pattern classification, optimization, associative memories, vector quantization and decision-making.

Fuzzy Logic **11 hours**

Introduction, Classical and Fuzzy Sets: Overview of Classical Sets, Linguistic Variables, Membership Function, Fuzzification, De-Fuzzification to Crisp Sets, Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations, Fuzzy rule generation (IF-THEN), Applications of Fuzzy Logic – Biomedicine, Anti Brake system.

Text Books:

1. Yegnanarayana, B., "Artificial Neural Networks", Wiley India, 2nd edition, 2009.
2. Ross, T. J., "Fuzzy Logic with Engineering Applications", John Wiley & Sons, 2009.

Reference books and other resources:

1. Fausett, L. "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson, 2008.
2. Rajasekaran, S., and Vijayalakshmi, G.A., "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2011.
3. G. J. Klir, "Fuzzy sets and fuzzy logic: Theory and Applications", PHI Learning, 2009.
4. S. K. Valluru and T. N. Rao, "Introduction to Neural Networks, Fuzzy Logic & Genetic Algorithms", Jaico, 1st edition, 2010.
5. Sivanandam, S.N., Sumathi, S., and Deepa, S. N., "Introduction to Fuzzy Logic using MATLAB", Springer, 2007
6. Related IEEE/IEE/ Science Direct publications.

E books and online learning materials:

1. http://users.monash.edu/~app/CSE5301/Lnts/LaD.pdf
2. https://www.site.uottawa.ca/~petriu/ELG5196-SoftComputing-NN_FL.pdf

MOOCS and Video Course:

1. https://nptel.ac.in/courses/117/105/117105084/
2. https://nptel.ac.in/courses/127/105/127105006/
3. https://www.coursera.org/learn/neural-networks-deep-learning
4. https://www.udemy.com/course/introduction-to-artificial-neural-network-and-deep-learning/

GNDEC

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PREC-102
Subject Name: Minor Project

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 6	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 60	**Percentage of Numerical/Design Problems:** NA
External Marks: 40	**Duration of End Semester Exam (ESE):** NA
Total Marks: 100	**Elective Status:** Project

Prerequisites: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of electronics and communication field to identify, collect relevant literature and analyze the information to formulate the problem definition for project	1(3), 2(3), 4(3)	-
CO2	Demonstrate ethical principles in project planning, execution and documentation.	8(3), 11(3)	-
CO3	Select and utilize appropriate tools to implement and demonstrate the proposed project.	5(3)	-
CO4	Design and develop sustainable solution/system for the improvement of environment conditions and betterment of the society.	3(3), 6(3), 7(3)	-
CO5	Communicate effectively on developed solution/system with engineering community as individual or team through effective presentation and report writing.	9(3),10(3), 11(3)	-
CO6	Develop sustainable system with scope for enhancement and the aspect of life-long learning.	12(3)	-

Syllabus: Students may choose a project based on any subject of Electronics and Communication Engineering and can also make it interdisciplinary for societal benefit. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports. Evaluation of the project work shall be done as per the approved Rubrics.

Reference Books and Other Resources:
Various project-based magazines available in the college/department library.

MOOCS and Video Course:
Various courses provided at https://swayam.gov.in/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PREC-103 / PREC-104/PREC-105
Subject Name: Project-I / Project-II/ Major Project

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 6
Semester: 7/ 8	**Teaching Hours:** 78 Hours
Theory/Practical: Practical	**Credits:** 3
Internal Marks: 120	**Percentage of Numerical/Design Problems:** NA
External Marks: 80	**Duration of End Semester Exam (ESE):** NA
Total Marks: 200	**Elective Status:** Project

Prerequisites: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify and formulate open ended problems in the field of electronics and communication which requires further investigation.	1(3), 2(3), 4(2)	-
CO2	Demonstrate ethics in planning, execution and documentation of the project.	8(3), 11(2)	-
CO3	Identify and utilize relevant tools to implement and demonstrate the proposed project idea.	5(3)	-
CO4	Design and develop sustainable solution/system for the betterment of environment and the society.	3(3), 6(3), 7(3)	-
CO5	Implement effectively the developed innovative solutions by effective presentation and report writing individually or in a team.	9(3),10(3), 11(2)	-
CO6	Develop sustainable system with scope for enhancement and continue life-long learning	12(3)	-

Syllabus:

Students may choose a project based on any subject of Electronics and Communication Engineering. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through presentations and progress reports. Evaluation of the project work shall be done as per the approved Rubrics.

Reference Books and Other Resources:

Various projects based magazines available in the college/department library.

MOOCS and Video Course:

1. http://nptel.ac.in/courses/117101105/
2. http://nptel.ac.in/courses/117101002/

Guru Nanak Dev Engineering College, Ludhiana

Department of Electronics and Communication Engineering

B. Tech. (Electronics and Communication Engineering)

Subject Code: PREC-106

Subject Name: Seminar on Recent Trends in Electronics and Communication

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7/8	**Teaching Hours:** 26 Hours
Theory/Practical: Practical	**Credits:** S/US
Internal Marks: 50	**Percentage of Numerical/Design Problems:** NA
External Marks: 0	**Duration of End Semester Exam (ESE):** NA
Total Marks: 50	**Elective Status:** Seminar (Non-Credit)

Prerequisites: NA

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes	POs	PSOs
1.	Pursue new and enriched understandings of the recent topics through sustained collaborative endeavor.	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)
2.	Recognize and formulate effective technical writing and oral communication	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)
3.	Analyze arguments so as to frame ones that are quite agreeable.	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)
4.	Develop, focus and organize ideas about a technical topic.	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)
5.	Identify a research problem and locate, outline and check out research resources to develop a thorough understanding.	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)
6.	Formatting the text properly to write a good technical report.	6(1), 9(2), 10(3), 12(3)	1(2), 2(2), 3(2)

Detailed Contents:

In this course, students are required to present a seminar on a recent topic in the field of Electronics and Communication Engineering. Students will be searching a suitable topic from the literature and then collect all related facts and then present it in the seminar. They will be required to submit a Seminar Report as well.