Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: CEC109
Course Title: Digital Signal Processing

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P)= 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Core Course		

Prerequisites (if any): CEC102
Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
CO1	Describe the fundamental elements and significance of digital signal processing.
CO2	Apply the fundamentals of discrete-time signals and systems to analyze digital signal processing problems.
CO3	Apply transform-domain techniques to analyze digital signal processing systems.
CO4	Interpret the frequency-domain representation of discrete-time signals using DTFT and DFT concepts and apply FFT algorithms for efficient spectral analysis.
CO5	Design FIR and IIR digital filters using standard design methods and evaluate their performance under given specifications and constraints.
CO6	Analyze the architecture and applications of programmable digital signal processors.

Contents

Part-A

Unit-1 Introduction **3(L) hrs**

Basic elements of a Digital Signal Processing system, Advantages and disadvantages of DSP, Applications of DSP.

Unit-2 Discrete-Time Signal and Systems **13(L) hrs**

Representation of Discrete Time Signals, Elementary discrete-time signals, Basic Operations on Sequences, Classification of Discrete-time Signals, Classification of discrete-time systems, Impulse response and Convolution Sum, Discrete Convolution, Properties of Linear Convolution, Interconnection of LTI Systems, Analysis of LTI systems using difference equations, Discrete Correlation.

Part-B

Unit 3. Fourier Analysis of Discrete Time Signals **10(L) hrs**

Overview of Z-Transform, Discrete Fourier Transform (DFT), Relationship of DFT to other Transforms, Twiddle Factor, Cyclic Property of Twiddle Factor, Properties of DFT, Circular

Convolution and DFT, Fast Fourier Transform (FFT) Algorithms, Radix-2 Decimation-in-time (DIT) FFT, Radix-2 decimation-in-frequency (DIF) FFT.

Unit 4. Design of Digital Filters **13(L) hrs**

Types and realization of Digital Filters, Steps of Filter design, Linear Phase response filter, Design of FIR Filters using Fourier Series Method, Design of FIR Filters using Windows, Design of IIR Filter by Impulse Invariance Transformation, Design of IIR Filter by Bilinear Transformation Method, Analog and Digital Domain Frequency Transformation.

Unit 5. Digital Signal Processors **6(L)hrs**

Introduction to Programmable DSPs, Advantages of DSP Processors over Conventional Microprocessors, Architecture of TMS320C50, Selecting digital signal processors, Architecture of TMS320C5X processor by Texas Instruments.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	To develop elementary discrete time sequence: unit sample, unit step, exponential and unit ramp sequences.
2	To develop a program module to perform basic operations i.e. addition, multiplication, shifting, folding and scaling on sequences.
3	To develop a program to find linear convolution and circular convolution of two discrete time sequences.
4	To develop a program to find autocorrelation and cross correlation of two discrete time sequences.
5	To develop a program module to perform DFT and IDFT operation on discrete time sequences.
6	To develop a program for frequency analysis using DFT.
7	To develop a program to compute and verify the properties of DFT.
8	To develop a program to find circular convolution of two sequences using DFT and IDFT method.
9	To develop a program for implementation and comparison of FFT algorithms (DIT and DIF).
10	To develop program for finding magnitude and phase response of LTI system described by system function H(z).
11	To develop a program to design IIR filter with given specifications using Impulse invariance method.
12	To develop a program to design IIR filter with given specifications using bilinear transformation method.
13	To develop a program to design FIR filter with given specifications using Rectangular Window.

14	To develop a program to design FIR filter with given specifications using Hanning Window.
15	To develop a program to design FIR filter with given specifications using Kaiser window.

Text Books

1. A. Anand Kumar, "Digital Signal Processing",PHI Learning, 2ndEdition, 2024.

Reference Books

1. F. Husain, "Digital Signal Processing", Umesh Publications, New Delhi, India, 2011.
2. J.G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications",Pearson Education, 5th Edition, 2022.
3. Sanjit Kumar Mitra, "Digital Signal Processing- A Computer Based Approach",McGraw-Hill, 3rdEdition, 2011.
4. A.V. Oppenheim & R. W. Schafer, "Digital Signal Processing",Pearson Education, 9th Edition, 2017.
5. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, "Digital Signal Processing",Tata Mc-Graw Hill, 7th Edition, 2015.

Online Learning Materials

1. https://vemu.org/uploads/lecture_notes/20_12_2022_1745809354.pdf

   Accessed on 12/01/2026
2. https://www.rcet.org.in/uploads/academics/rohini_90925466680.pdf

   Accessed on 12/01/2026

Supplementary SWAYAM Course

Sr No.	Course Name	Instructor	Host Institute	URL
1	Digital Signal Processing	Prof. C. S. Ramalingam	IIT Madras	https://nptel.ac.in/courses/108106151
2	Digital Signal Processing and its Applications	Prof. V. M. Gadre	IIT Bombay	https://nptel.ac.in/courses/108101174

Experiments to be performed through Virtual Labs

Sr. No.	Experiment Name	Experiment Link(s)
1	Study of Discrete Fourier Transform (DFT) and its inverse	https://dsp-iitkgp.vlabs.ac.in/exp/fourier-transform/
2	Study of FIR filter design using window method: Lowpass and highpass filter	https://dsp-iitkgp.vlabs.ac.in/exp/fir-lowpass-highpass/
3	Study of FIR filter design using window method: Bandpass and Bandstop filter	https://dsp-iitkgp.vlabs.ac.in/exp/fir-bandpass-bandstop/
4	Study of Infinite Impulse Response (IIR) filter	https://dsp-iitkgp.vlabs.ac.in/exp/infinite-impulse-response/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rdYear (ECE)

Course Code: CEC110
Course Title: Microprocessor and Microcontroller

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Core Course		

Prerequisites (if any): ESC101, CEC103
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Recall and apply basic concepts of digital electronics to microprocessors and microcontrollers.
CO2	Describe and differentiate between the architecture, features of microprocessors and microcontrollers.
CO3	Apply the knowledge of instruction set for performing various operations on microprocessors and microcontrollers.
CO4	Describe the working of timer/counter, interrupts and serial communication in microcontrollers.
CO5	Illustrate programming concepts to interface devices with microcontroller.
CO6	Demonstrate various operations on microprocessors and microcontrollers using assembly language programming.

Contents

Part-A

Unit-1 Introduction to 8085 Microprocessor **11(L) hrs**

Architecture and pin configuration, Flags, Buses, Data transfer instructions, Arithmetic instructions, Logic instructions, Branch instructions, Conditional call and return instructions, Addressing modes, Assembly language programming, 8085 interrupts, Basic interrupt processing, RIM, SIM.

Unit-2 Introduction to 8051 Microcontroller **10(L) hrs**

Features and selection factors for Microcontroller, Comparison of microprocessor and microcontroller, architecture and pin configuration, PSW, Register banks, Internal memory organization, Types of Special Function Registers and their uses.

Part-B

Unit-3 8051 Programming **9(L) hrs**

Assembler, Compiler, Instruction set: Data Transfer, Arithmetic, Logical, Branching, Addressing

Modes: Immediate, Register, Direct, Indirect, Indexed, Assembler Directives, Assembly Language Programming (ALP): Data manipulation, Masking, Stack operation, Branch related programming.

Unit-4 Timer/Counter, Interrupts and Serial communication 8(L) hrs

Configuration and Programming of Timer/Counter using TMOD, TCON, THx, TLx, Programs to generate the time delays, Types of interrupts, Classification of interrupts, Interrupt Service Routine (ISR), Serial Communication, SCON, SBUF, PCON, Modes of serial communication, RS-232 standard, MAX-232 driver.

Unit-5 8051 Interfacing and Applications 7(L) hrs

I/O Interfacing: Relays, LED, LCD, Interfacing ADC 0808/09 with 8051, Memory Interfacing, Stepper Motor Interfacing to rotate in clockwise and anticlockwise direction.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	Introduction to the 8085 microprocessor and 8051 microcontroller kit.
2	Develop an Assembly Language Program (ALP) for addition and subtraction of two 8-bit numbers using 8085 microprocessor.
3	Develop an ALP for addition and subtraction of two 16-bit numbers using 8085 microprocessor.
4	Develop an ALP to perform multiplication of 8-bit data using 8085 microprocessor.
5	Develop an ALP to perform logical operations on 8-bit data using 8085 microprocessor.
6	Develop an ALP for addition and subtraction of two 8-bit numbers using 8051 microcontroller.
7	Develop an ALP to perform multiplication and division on 8-bit data using 8051 microcontroller.
8	Develop an ALP to perform logical operations on 8-bit data using 8051 microcontroller.
9	Develop an ALP for addition and subtraction of two 16-bit numbers using 8051 microcontroller.
10	Develop an ALP to perform masking of higher nibble on 8-bit data using 8051 microcontroller.
11	Develop an ALP for identifying smallest number from the three data bytes using 8051 microcontroller.
12	Develop an ALP for arranging numbers in ascending order using 8051 microcontroller.
13	Interface LED with 8051 microcontroller and turn it on/off.
14	Interface LCD with 8051 microcontroller to display the “ECE”.

15	Interface stepper motor to microcontroller and rotate in clockwise direction.

Text Books

1. R. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Prentice Hall, 2014.
2. Muhammed Ali Mazidi, Rolin McKinlay, Janice Gillispe "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2007.

Reference Books

1. K.J. Ayala,"The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Cengage Learning, 2010.
2. K. L. Short, "Microprocessors and Programmed Logic", 2nd Ed.,Pearson Education, 2008.
3. Subrata Ghoshal, "Microcontroller: Internals, Instructions, Programming and Interfacing", Pearson Education, 2010.

Online Learning Materials

1. https://www.scribd.com/document/362701400/8051-Notes Accessed on 14/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Microprocessors and Microcontrollers	Prof. Santanu Chattopadhyay	IIT, Kharagpur	https://onlinecourses.nptel.ac.in/noc26_ee58/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: CEC111
Course Title: Electromagnetics and Wave propagation

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)= 60 hrs.
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Core Course		

Prerequisites (if any): BSC101
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Apply Maxwell's equations to solve electromagnetic boundary-value problems in different media.
CO2	Analyze electromagnetic wave propagation and its sinusoidal behavior in different media.
CO3	Examine guided wave characteristics in parallel plane structures.
CO4	Interpret wave propagation mechanisms in rectangular and circular waveguides.
CO5	Assess parallel-plane transmission line performance using Smith charts.
CO6	Describe radio-wave characteristics and their propagation in the atmosphere.

Contents

Part-A

Unit-1 Time varying fields and Electromagnetic waves **10(L) hrs**

Maxwell's equations and boundary conditions, Wave equation and its solution in different media, plane wave, Sinusoidal time variations, polarisation, Reflection of waves by perfect dielectrics, perfect insulators, Surface impedance, Poynting theorem and Poynting vector.

Unit-2 Guided waves **9(L) hrs**

Waves between parallel planes, TE, TM waves and their characteristics, TEM waves, Attenuation in parallel plane guides, Wave impedance.

Unit-3 Waveguides **8(L) hrs**

Rectangular and circular wave guides, TE and TM waves in rectangular waveguides, Impossibility of TEM wave in wave guides.

Part-B

Unit-4 Transmission Lines **9(L) hrs**

Circuit representation of parallel plane transmission lines, Parallel plane transmission line with losses, Lossless line, Low loss RF and UHF transmission lines, Distortionless line, Transmission line charts-impedance matching.

Unit-5 Wave Propagation **9(L) hrs**

Free space equation, Ground Wave propagation, Surface and Space wave propagation, Range of space wave propagation, Structure of ionosphere, propagation of radio waves through ionosphere, Critical frequency, Maximum usable frequency, virtual height, Skip Distance.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. E. C. Jordan & K. G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd edition, PHI, 2011.
2. Collins R. E., "Antenna and radio wave propagation", McGraw Hill, 2001.

Reference Books

1. W. H. Hayt & J.A. Buck, Engineering Electromagnetics, 8th edition, TATA McGraw-Hill, 2014.
2. John Krauss, Electromagnetics and applications, 4th edition, Tata McGraw-Hill, 2010.
3. Matthew, N. O. Sadiku, Elements of Engineering Electromagnetics, 4th edition, Oxford University Press, 2007.
4. Prasad, K.D., "Antenna and Wave propagation", Satya Prakashan, 3rd edition, 2003.

Online Learning Materials

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/CE1%20BEC%20503%20%20-tln%20notes.pdf Accessed on 13/01/2026
2. https://ece.gecgudlavalleru.ac.in/images/admin/pdf/1594283629_2-2-TLW.pdf Accessed on 13/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Electromagnetic wave in guided and wireless media	Prof. Pradeep kumar K	IIT, Kanpur	https://nptel.ac.in/courses/108104130
2	Electromagnetic Theory	Prof. Pradeep kumar K	IIT, Kanpur	https://nptel.ac.in/courses/108104087

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: CEC112
Course Title: Analog and Digital Communication System

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Core Course		

Prerequisites (if any): CEC102
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Explain the fundamentals of communication systems and analog–digital modulation principles.
CO2	Analyze amplitude and angle modulation & demodulation techniques.
CO3	Understand the concept of super-heterodyne receiver and apply it to standard radio broadcasting.
CO4	Apply the knowledge of working principle of various signal processing operations for conversion of signal from analog to digital.
CO5	Evaluate digital modulation techniques and Analyze the impact of noise on communication systems.
CO6	Engage in self-learning of advanced concepts and application of digital communication.

Contents

Part-A

Unit-1 Introduction to the Communication Systems **5(L) hrs**

Block diagram of communication systems, Analog and Digital Messages, Modulation & Demodulation, Need and types of modulation, Advantages and disadvantages of Analog and digital Communication system, applications of Analog and digital Communication system.

Unit-2 Analog modulation and Demodulations **17 (L) hrs**

Amplitude modulation and demodulation, mathematical analysis and spectra of AM, AM power and current calculations, Types of Amplitude Modulation, AM generation methods; Square law modulation and Balanced modulator, angle modulation and demodulation, mathematical analysis and spectra of FM, Types of frequency modulation, FM generation methods; direct and indirect, Receiver parameters, super heterodyne AM and FM receivers, Envelope detector, Pre-emphasis & De-emphasis, Limiter circuit, Balanced Slope detector, Foster Seeley discriminator, Ratio detector.

Part-B

Unit-3 Digital Signal Conversion **9(L) hrs**

Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, Companding, Pulse code Modulation (PCM), Differential PCM, Delta modulation (DM), Adaptive delta modulation (ADM), quantization noise calculation, Line coding.

Unit-5 Digital Modulation and Demodulation Techniques **8(L) hrs**

Modulation and demodulation techniques for Amplitude shift Keying (ASK), Frequency Shift Keying (FSK), Minimum Shift Keying (MSK), Phase Shift Keying (PSK), Quadrature Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM).

Unit 6 Noise and System Performance **6(L) hrs**

Types and sources of noise in analog and digital communication systems, signal-to-noise ratio, noise figure, Output Signal to noise ratio in PCM and DM, inter-symbol interference, probability of error, basic error control concepts, Basic concepts of information theory.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	Create the DSB AM wave on a CRO and determine its modulation Index.
2	Demodulate DSB AM signal using Diode detector.
3	Generate FM signal using Varactor diode and Reactance modulator.
4	Detect FM signals using Foster- Seeley discriminator & Ratio detector.
5	Detect FM signals using PLL.
6	Sampling & Reconstruction of signal from its samples using Natural/ Flat- top sampling & Sample & Hold circuit.
7	To demonstrate Pulse Code Modulation and Demodulation.
8	To demonstrate Pulse data coding techniques for various formats.
9	To demonstrate Amplitude shift keying modulation and demodulation.
10	To demonstrate Amplitude shift keying modulation and demodulation.
11	To demonstrate frequency shift keying modulation and demodulation.
12	To demonstrate phase shift keying modulation and demodulation.
13	To simulate Amplitude Modulation and Demodulation using MATLAB SIMULINK.
14	To simulate Amplitude Shift Keying Modulation and Demodulation using MATLAB SIMULINK.
15	To simulate the following using MATLAB SIMULINK a) Frequency Modulation and Demodulation. b) Phase Modulation and Demodulation. c) Frequency Shift Keying Modulation and Demodulation. d) Quadrature Shift Keying Modulation and Demodulation.

Mini Project: Student has to do an experiment no. 15 independently as project.

Text Books

1. Advanced Electronic Communications Systems by Wayne Tomasi, Sixth Edition, Pearson Education Limited, 2014.
2. Kennedy G. & Davis B., "Electronic Communication Systems",McGraw-Hill Education Private Limited, 5th Edition, Glencoe Publishers, 2015.
3. Laboratory Manuals.

Reference Books

1. G.K., Mittal, R., "Radio Engineering", Khanna Publishers, Edition 15, 1990.
2. Roddy D. & Coolen, J., "Electronic Communications", Pearson Education, 4th edition, 2014.
3. Taub H. & Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill Education, 4th Edition, 2010.
4. J.G. Proakis, "Digital Communication", McGraw-Hill Education 4th edition, 2001.
5. Introduction to Analog & Digital Communications By Simon Haykin, Second Hand Book, VISIONIAS, Jan 2020.

Online Learning Materials

1. https://www.scribd.com/doc/267277936/Analog-Communication-Notes Accessed on 15/01/2026
2. https://www.scribd.com/document/668317450/Digital-Communications-Notes Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Analog Communication	Prof. Goutam Das	IIT, Kharagpur	https://nptel.ac.in/courses/117105143
2	Digital Communication	Prof. Bikash Kumar Dey	IIT, Bombay	https://nptel.ac.in/courses/117101051

Experiments to be performed through Virtual Labs

Sr. No.	Experiment Name	Experiment Link(s)
1	Study of Sampling theorem, effect of undersampling	https://dsp-iitkgp.vlabs.ac.in/exp/sampling-theorem/
2	Study of Quantization of continuous-amplitude, discrete-time analog signals	https://dsp-iitkgp.vlabs.ac.in/exp/quantization-continuous-amplitude/
3	Study of different types of companding techniques	https://dsp-iitkgp.vlabs.ac.in/exp/companding-techniques/

4	Study of modulation and demodulation techniques	https://vlab.amrita.edu/index.php?sub=59&brch=163

TRACK-I (Elective-I)
Communication, Signal Processing and Software Engineering

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: EEC101
Course Title: Wireless and Ad hoc networks

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): CEC111, CEC112
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Describe the operating principle, architecture along with Constraints and Challenges of wireless sensor networks.
CO2	Analyze topology control system.
CO3	Design basic transceiver model.
CO4	Explain different routing protocols used in WSN.
CO5	Demonstrate various Wireless Sensor Network platforms and tools.
CO6	Describe the concept and communication models in VANET.

Contents

Part-A

Unit-1 Introduction to Wireless Sensor Networks **10(L) hrs**

Constraints and Challenges of sensor networks, Emerging technologies for wireless sensor networks, Node architecture, Hardware components overview, Energy consumption of Sensor nodes, Dynamic energy and power management on System level, some examples of Sensor nodes, Optimization goals and figures of merit, QOS, Energy Efficiency, scalability, robustness. Advantages of sensor networks, Sensor network applications.

Unit-2 Topology Control **9(L) hrs**

Location driven, Geographic Adaptive Fidelity (GAF), Geographic Random Forwarding (GeRaF), Geographical and energy aware routing (GEAR), Connectivity driven, Adaptive self configuring sensor network topology (ASCENT).

Unit-3 WSN Sensors **9 (L) hrs**

Physical Layer Design, Transceiver Design, MAC Protocols for WSN, Low Duty Cycle Protocols &

Wakeup Concepts, S-MAC, Mediation Device Protocol, Wakeup Radio Concepts, Address & Name Management, Assignment of MAC Addresses, Routing Protocols, Energy Efficient Routing, Geographic Routing.

Part-B

Unit-4 WSN Platforms and Tools **9(L) hrs**

Sensor Node Hardware, Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Unit-5 VANET (Vehicular Ad hoc Networks) **8(L) hrs**

Introduction and Motivation, V2X Communication Scenarios and Requirement, Architecture of ITS station, Regional Regulation.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. Holger Karl & Andreas Willig, "Protocol and Architecture for wireless sensor networks, John Wiley 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless sensor Networks-An Information Processing Approach", Elesevier,2007.
3. Riccardo Scopigno, Antonella Molinaro, Claudia Campolo, "Vehicular ad hoc Networks: Standards, Solutions, and Research", Springer, 2015.

Reference Books

1. WaltenegusDargie and Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons,first edition,2010.
2. Holger Karl & Andreas Willig, "Protocol and Architecture for wireless sensor networks, John Wiley 2007.

Online Learning Materials

1. https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/Adhoc%20Sensor%20Networks.pdf Accessed on 19/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Wireless Adhoc Sensor Networks	Prof. Sudip Misra	IIT Kharagpur	https://nptel.ac.in/courses/106105160

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC102
Course Title: Image Processing and Computer Vision

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Comprehend the need of image processing and computer vision techniques and its features.
CO2	Classify Image enhancement and restoration techniques.
CO3	Incorporate various techniques for image segmentation.
CO4	Analyze and select appropriate feature extraction methods.
CO5	Categorize and estimate various Object Recognition, Motion estimation techniques and their applications.
CO6	Make use of various Image processing and Computer vision techniques to develop problem solving skills for real time applications.

Contents

Part-A

Unit-1 Introduction **5(L) hrs**

Fundamental steps in digital image processing, Image sensing and acquisition, Sampling and Quantization, Image formation models, Quality metrics for image processing, Overview of Computer Vision, Applications of Image processing and Computer Vision.

Unit-2 Image Enhancement and Restoration **10(L) hrs**

Image enhancement in spatial domain and frequency, Basic gray level transformations, Histogram equalization, Image restoration, Types of noises corrupting the images, Denoising methods, Median filtering, Wiener filtering.

Unit-3 Image Segmentation **7(L) hrs**

Point, line, corner and edge detection, Thresholding, Region Based segmentation, Edge linking and boundary detection.

Part-B

Unit-4 Feature Extraction **8(L) hrs**

Importance of Features, Feature extraction techniques, Histogram of Oriented Gradient (HOG), Scale Invariant Feature Transform (SIFT), Background subtraction techniques, Image Matching, Principal Component Analysis (PCA).

Unit-5 Object Recognition and Motion Estimation **10(L) hrs**

Intro to CNNs: 1-D & 2-D Convolution, Pooling. Performance Metrics: Confusion Matrix, Precision, Recall, F1 Score, Intersection over Union (IoU), Precision-Recall curves and Mean Average Precision (mAP). Object Detection Frameworks: Region-Based Detectors (R-CNN, Fast R-CNN, Faster R-CNN) and Single-Shot Detectors (YOLO). Motion Estimation: Optical Flow.

Unit-6 Applications of Image Processing and Computer vision **5(L) hrs**

Face Recognition, Facial Expression Recognition, Object Detection, Automated Video Surveillance.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. R.C. Gonzalez and R.E. Woods, “Digital Image Processing”, Pearson Education, 2018.
2. D.A. Forsyth and J. Ponce, “Computer Vision - A modern approach”, Prentice Hall, 2011.

Reference Books

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Nature Switzerland AG, 2nd Edition, 2022.
2. E. R. Davies, “Computer Vision: Principles, Algorithms, Applications, Learning”, Academic Press, 5th edition, 2017.
3. D. H. Ballard and C. M. Brown, “Computer Vision”, Prentice-Hall, Englewood Cliffs, 1982.

Online Learning Materials

1. https://www.cl72.org/090imagePLib/books/Gonzales,WoodsDigital.Image.Processing.4th.Edition.pdf Accessed on 23/01/2026
2. https://www.scribd.com/document/953223308/Object-Tracking-and-Motion-Estimation Accessed on 23/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Digital Image Processing	Prof. Prabir Kumar Biswas	IIT, Kharagpur	https://nptel.ac.in/courses/117105135
2	Computer Vision	Prof. Jayanta Mukhopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_cs143/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC103
Course Title: Software Design and Development

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NIL

On completion of the course, the student will be able to:

CO#	Course Outcomes
CO1	Understand basic concepts of software, software development life cycle, and problem-solving techniques.
CO2	Analyze problems and develop simple algorithms using flowcharts and pseudocode.
CO3	Apply fundamental programming concepts to develop simple software solutions.
CO4	Use control structures and data handling techniques effectively in program development.
CO5	Understand basic data storage techniques including files and simple data structures.
CO6	Design, implement, test, and document a small software project using structured methods.

Contents

Part-A

Unit–1 Introduction to Software Development **7(L) hrs**

Definition of software, Types of software (system and application), Software in real-life applications, Introduction to software development, Overview of Software Development Life Cycle (SDLC), Roles in a software development team, Ethical issues in software development.

Unit–2 Software Architecture **8(L) hrs**

Definition of software architecture, Importance of software architecture, Architectural genres, Architectural styles, C4 model, Architectural representation techniques.

Unit–3 Architecture Design Patterns **10(L) hrs**

Layered architecture, Client–server architecture, Model–View–Controller (MVC), Microservices architecture, Event-driven architecture, Hybrid and modern architectural patterns.

Part–B

Unit–4 Architecture Blueprints **10(L) hrs**

Fundamentals of architecture blueprints, Architecture pattern usage, Blueprint elements and notations, Blueprint creation process, Architecture blueprint templates.

Unit–5 Blueprint Validation **5(L) hrs**

Validation theory and principles, Manual validation techniques, Automated validation tools, Blueprint to code transition, Common pitfalls in validation.

Unit–6 Applications and Future Scope **5(L) hrs**

Industry applications of software architecture, DevOps and CI/CD integration, AI-augmented blueprinting, Future scope and challenges in software architecture.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. Rajib Mall, Fundamentals of Software Engineering, PHI Learning.
2. E. Balagurusamy, Programming Fundamentals, McGraw Hill.

Reference Books

1. Ian Sommerville, Software Engineering, Pearson Education.
2. Herbert Schildt, Programming Using C / Java / Python, McGraw Hill.
3. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill.

Online Learning Material

1. https://www.coursera.org/learn/introduction-to-software-engineering Accessed on 23/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Software Engineering	Prof. Rajib Mall	IIT, Kharagpur	https://nptel.ac.in/courses/106105182
2	Software Engineering	Prof. Rushikesh K Joshi, Prof. Umesh Bellur, Prof. N.L. Sarda	IIT, Bombay	https://nptel.ac.in/courses/106101061

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

TRACK-II (Elective-I)
Embedded System and VLSI Design

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC104
Course Title: Embedded system Design using ARM

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)= 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): CEC103, CEC110
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Develop the ability to understand the role of Embedded systems in industry.
CO2	To understand the fundamentals of ARM-based systems.
CO3	Apply the knowledge of instruction set for performing various operations on ARM.
CO4	Illustrate programming concepts to interface peripheral devices with ARM.
CO5	Use the various instructions to program the ARM controller.
CO6	Understand the embedded system's real-time operating system.

Contents

Part-A

Unit-1 Introduction to Embedded Systems **8(L) hrs**

Embedded Systems overview, Embedded systems vs General Computing systems, Characteristics and quality attributes of Embedded systems, Embedded hardware units and devices, design parameters of an Embedded system, Present trends and applications of Embedded systems.

Unit-2 ARM Embedded Systems **9(L) hrs**

Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware -AMBA bus protocol, ARM bus technology, ARM data flow architecture Registers Interrupts and vector table.

Unit-3 Introduction to the ARM Instruction set **12(L) hrs**

Introduction, Data processing instructions, Load-Store instruction, Software interrupt instructions, Program status register instructions, Conditional Execution.

Part-B

Unit-4 Embedded Systems Interfacing **8(L) hrs**

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

Unit-5 RTOS for Embedded System Design **8(L) hrs**

Real time Embedded systems, Real Time operating Systems- Key characteristics, Scheduler, Tasks, Semaphores, Message queues, Overview of Firmware in ARM Embedded Systems.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

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

1. T. Martin, "The Insider's Guide to The Philips ARM7-Based Microcontrollers, An Engineer's Introduction to The LPC2100", Hitex, 2005.
2. Q. Li, "Real Time Concepts for Embedded Systems", CMP Books, 2003.

Online Learning Materials

1. https://ebooks.inflibnet.ac.in/csp13/chapter/introduction-to-arm processor/ Accessed on 14/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Embedded System Design with ARM	Prof. Indranil Sengupta, Prof. Kamalika Dutta	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: EEC105
Course Title: VLSI Design Concepts

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 5	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): CEC103
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Understand the VLSI design flow, CMOS fabrication, and technology scaling trends.
CO2	Analyze MOSFET characteristics, capacitance models, and CMOS logic gate behavior.
CO3	Apply CMOS processing concepts to layout design using rules and stick diagrams.
CO4	Evaluate static CMOS inverter performance and design circuits using pass logic.
CO5	Design basic sequential MOS circuits including latches and flip-flops.
CO6	Understand the architecture and operation of SRAM and DRAM memory subsystems.

Contents

Part-A

Unit-1 Introduction to VLSI Systems **8(L) hrs**

Evolution of VLSI technology; VLSI design flow; front-end and back-end design; CMOS fabrication overview; scaling trends; Moore's law and technology nodes.

Unit–2: MOS Transistor Fundamentals **8(L) hrs**

MOSFET structure and operation; I-V characteristics; threshold voltage; short-channel effects; Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, CMOS Logic: Inverter, NAND Gate, NOR Gate, CMOS inverter characteristics; noise margins and switching behavior.

Unit-3 CMOS Processing Technology **8(L) hrs**

CMOS Technologies, CMOS Inverter Fabrication and Layout, Layout Design Rules, Gate Layouts and Stick Diagrams, CMOS Process enhancements, Manufacturing Issues.

Part-B

Unit-4 Static CMOS Inverter **8(L) hrs**

Static CMOS Inverter: DC Characteristics, Noise Margin, Pass Transistor DC Characteristics, Circuit design using Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers.

Unit-5 Sequential MOS Logic Circuitry **7(L) hrs**

SR Latch Circuitry, Clocked latch and Flip Flop Circuitry (SR and JK), CMOS D-Latch and Edge Triggered Flip-Flop.

Unit-6 Array Sub-system **6(L) hrs**

SRAM: SRAM Cells, Row Circuitry, Column Circuitry, DRAM: Subarray Architectures, Column Circuitry, Embedded DRAM.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. Neil H. E. Weste and David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 4th Edition, 2011, ISBN: 0-321-54774-8.
2. Neil H. E. Weste and Kamaran Eshraghian, "Principles of CMOS VLSI Design: A Systems Perspective", Pearson Education, 2nd Edition, 2010, ISBN: 978-81-317-1942-8.
3. Douglas. A. Pucknell and Kamaran Eshraghian, Basic VLSI Design", PHI, 3rd Edition 2010, ISBN: 0-321-26977-2.

Reference Books

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata McGrawHill, 3rd Edition, ISBN: 0-7923-7246-8.
2. John P. Uyemura "Introduction to VLSI Circuits & Systems", Wiley India Edition.
3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic "Digital Integrated Circuits- A Design Perspective", Prentice Hall, 2nd edition, 2003.

Online Learning Materials

1. https://www.slideshare.net/slideshow/fundamentals-of-cmos-vlsi-design-and-mos-transistors/86500500 Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	VLSI Circuits	Prof. S.Srinivasan	IIT, Madras	https://nptel.ac.in/courses/117106092

2	CMOS Digital VLSI Design	Prof. Sudeb Dasgupta	IIT, Roorkee	https://nptel.ac.in/courses/108107129

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: ESEC102
Course Title: Design Thinking

Programme: B.Tech.	**L: 0 T:** 0 **P:** 2	**Credits:** 1
Semester: 5	**Theory/Practical:** Practical	**Teaching Hours:** 30(P) = 30hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks: -**
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): NIL		
Course Type: Engineering Science Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Comprehend the basics of design thinking.
CO2	Identify the problems in existing design.
CO3	Exhibit the use of empathy tools in the problem definition phase.
CO4	Understand creative thinking methods used in engineering solutions.
CO5	Develop the culture of making prototype and testing the design.
CO6	Create innovative solutions for problem faced by the society

Introduction to Design Thinking **6(L) hrs**

Origin and relevance of design thinking, Importance of design in engineering, Stages of design thinking, Customer centric design, Opportunity and problem identification.

Problem Definition **6(L) hrs**

Empathy: Tools and methods, empathy map, define: Tools used in define phase, 5-WHY method, fish bone diagram, importance of problem framing, Point of View (POV) statement. Case studies for empathy and problem definition.

Ideation **6(L) hrs**

Idea generation: Tools and methods, Bench marking, Brainstorming, 6-3-5 method, Co-design, Case studies on ideation.

Prototyping **6(L) hrs**

Types of prototypes, Minimum Viable Prototype, Digital prototypes, working prototypes, 3D printed prototypes.

Testing **6(L) hrs**

Test the design feasibility, capability and usability.

Activity: Build and test a functional prototype.

Reference Books

1. E BalaGurusamy & Bindu Vijaya Kumar, Design Thinking: A beginner's perspective, 1st edition, Mc-Graw Hill publication, 2024.