Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: CEC113
Course Title: Mobile Communication and Networks

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 6	**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 Core Course		

Prerequisites (if any): CEC112
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 and parameters of cellular systems.
CO2	Describe different types of interferences.
CO3	Analyze handoffs and dropped calls
CO4	Explain the functioning of the wireless communication system and the evolution of different wireless communication systems and standards.
CO5	Describe the working of various intelligent networks
CO6	Identify the requirements of mobile communication as compared to static communication

Contents

Part-A

Unit-1 Cellular Systems **8(L) hrs**

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, and consideration of the components of cellular systems

Unit-2 Interference in Mobile Systems **10 (L) hrs**

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

Unit-3 Handoffs and dropped calls **9(L) hrs**

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

Unit-4 Generations of mobile communication system **9(L) hrs**

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, introduction to 5G and 6G.

Unit-5 Intelligent Network for wireless communication **9(L) hrs**

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**,** Software-Defined Networking (SDN) and Network Function Virtualization (NFV).

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

Textbooks

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. T L Singal, Wireless Communications, McGraw-Hill Education.

Reference Books

1. Jochen H. Schiller, “Mobile Communications”, Second Edition, Pearson Education.
2. A. Molisch, "Wireless Communications," Wiley, 2005. Haykin & Moher, "Modern Wireless Communications," Pearson, 2011 (Indian Edition)
3. J. G. Proakis, "Digital Communications," McGraw-Hill
4. A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
5. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

Online Learning Materials

1. https://www.jbiet.edu.in/pdffls/ECE-Coursematerial/3/Mobile-Communications-and-Networks.pdf Accessed on 14/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to Wireless and Cellular Communications	Prof. R. David Koilpillai	IIT Madras	https://onlinecourses.nptel.ac.in/noc20_ee61/preview

2	Mobile and Wireless Communication	Dr. Garima Saini	NITTTR, Chandigarh	https://onlinecourses.swayam2.ac.in/ntr26_ed25/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: CEC114

Course Title: Antenna Theory and Microwave Communication

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 6	**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: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Core Course		

Prerequisites (if any): CEC111

Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Explain the fundamental principles of antenna theory and electromagnetic radiation.
CO2	Apply electromagnetic concepts and wave-propagation principles to determine antenna and propagation parameters.
CO3	Design and evaluate different types of antenna arrays based on their properties and performance characteristics.
CO4	Explain the principles and applications of microwave sources and solid-state devices.
CO5	Analyze and compare the performance characteristics of microwave tubes and semiconductor devices for high-frequency applications.
CO6	Design and assess microwave passive networks and measurement systems using scattering-matrix techniques.

Contents

Part-A

Unit-1 Radiating Systems: Fundamentals and Antenna Parameters **9(L) hrs**

Types of Antennas, Radiation Mechanism in dipole, Radiation Pattern, Radiation Power Density, Radiation intensity, Directivity, Gain, Antenna efficiency, Bandwidth, Polarisation, Antenna Input Impedance, Antenna Effective length, Maximum Directivity and Maximum Effective Area, Return Loss, Effective aperture, Antenna Temperature, Microstrip antennas and its feed networks.

Unit-2 Linear Wire Antennas **9(L) hrs**

Retarded potential, Infinitesimal dipole, Far-field, Radiating near-field and reactive near-field region, Monopole and Half-wave dipole.

Unit-3 Antenna Arrays **9(L) hrs**

Array of two point sources, Array factor, n-element linear array with uniform amplitude and spacing, Analysis of Broadside array, Ordinary end-fire array, Hansen-woodyard end-fire array, Analysis of

Binomial array.

Part-B

Unit-4 Microwave Sources and Solid-State Devices **9(L) hrs**

Characteristic features of microwaves, advantages and applications, Limitations of conventional tubes, Frequency allocations, Construction, operation, and properties of Klystron Amplifier, Reflex Klystron, Magnetron, Gunn Diode.

Unit-5 Microwave Passive Devices and Measurements **9(L) hrs**

Scattering matrix, Properties, S matrix formulation of two-port junction. Passive microwave devices S-matrix and properties (T junctions- H plane, E plane, and E-H plane), Directional coupler, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator), Matched termination, Microwave power measurement (calorimeter, bolometer), Measurement of Standing Wave Ratio (SWR), Frequency and wavelength.

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 study microwave components and instruments.
2	To measure crystal characteristics and establish the square law characteristics of the diode.
3	To measure klystron characteristics.
4	To measure the standing wave ratio VSWR.
5	To measure the directivity and coupling coefficient of a directional coupler.
6	To study the characteristics of a circulator.
7	To study the calibration of the attenuation constant of an attenuator.
8	To determine the phase shift of a phase shifter.
9	To determine the radiation characteristics of the Horn antenna.
10	To study the antenna simulating tool IE3D.
11	To design and simulate a microstrip patch antenna using the antenna simulation tool IE3D.
12	To study the measurement of antenna parameters using a Vector Network Analyser.
13	To measure the return loss of a microstrip patch antenna using a Vector Network Analyzer.
14	To measure the impedance of a microstrip patch antenna using the Smith chart and the Vector Network Analyzer.
15	To fabricate a microstrip patch antenna for a given frequency and verify it on a Vector Network Analyzer.

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

Textbooks

1. Balanis C.A, “Antenna Theory”, John Wiley & Sons, 3rd edition, 2005.
2. Krauss J.D, “Antenna Theory”, McGraw-Hill, 1985.

3. S.Liao, "Microwavedevicesandcircuits",3rd edition, PHI.
4. R.E.Collin , "FoundationofMicrowaveEngg",2nd edition McGraw Hill, 1992.
5. Laboratory Manuals

Reference Books

1. Jordan E. C, "Electromagnetics and radiating systems", PHI, 2007
2. Collins R. E., "Antenna and radio wave propagation", McGraw-Hill,2001.
3. Kennedy, G. "Electronic Communication Systems", TMH, Fifth Edition,2015.
4. Prasad,K.D., " Antenna and Wave propagation", Satya Prakashan, 3rd edition, 2003.
5. M.Kulkarni, "Microwave devices and Radar Engg", Umesh Publications.
6. K.CGupta,"MicrowaveEngg", Tata McGraw-Hill, 7th Edition,2007.
7. D.Pozar,"Microwave Engineering", JohnWiley&Sons, NewYork,1998.

Online Learning Materials

1. https://www.scribd.com/document/165938178/Chapter-Two-Fundamental-Parameters-of-Antenna-pdf Accessed on 14/01/2026
2. https://www.slideshare.net/slideshow/microwave-engineering-solid-state-devices/273930907 Accessed on 14/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Advanced Antenna Theory	Dr. Amalendu Pattnaik	IIT, Roorkee	https://nptel.ac.in/courses/117107035
2	Microwave Engineering	Prof. Ratnajit Bhattacharjee	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc20_ee91/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: CEC115
Course Title: Artificial Intelligence and Machine Learning

Programme: B.Tech.	**L:** 3 **T:** 0 **P:**2	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P)= 75hrs
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: BSEC101, ESC105.
Additional Material Allowed in ESE: NA

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

CO#	Course Outcomes
CO1	Describe the scope and significance of artificial intelligence and machine learning.
CO2	Apply data preprocessing and exploratory data analysis techniques for machine learning.
CO3	Analyze supervised learning algorithms for regression and classification problems.
CO4	Evaluate machine learning models using appropriate performance metrics.
CO5	Apply unsupervised learning techniques for pattern discovery and dimensionality reduction.
CO6	Perform data preprocessing using Python-based tools.

Contents

Part-A

Unit-1 Introduction & Python for Data Science **6(L) hrs**

Introduction to Artificial Intelligence, Machine Learning and Deep Learning, Types of Machine Learning, Python Basics for ML: NumPy, Pandas, matplotlib.

Unit-2 Data Preprocessing **8(L) hrs**

Feature Scaling, Handling Categorical Data, Column Transformer, Handling Missing Values, Handling Outliers.

Unit-3 Feature Engineering **9(L) hrs**

Feature Construction, Feature Splitting, Mathematical Transforms, Dimensionality Reduction: Principal Component Analysis (PCA).

Part-B

Unit-4 Supervised Learning –Regression **10(L) hrs**

Simple Linear Regression, Ordinary Least Squares, Gradient Descent: Batch GD, Stochastic GD, Mini-batch GD, Model Evaluation: Regression Metrics, Regularization Techniques: Lasso Regression (L1), Ridge Regression (L2).

Unit-5 Supervised Learning - Classification **12(L) hrs**

Logistic Regression, Classification Metrics: Accuracy, Confusion Matrix, Precision, Recall, F1-Score, ROC Curve, AUC, K-Nearest Neighbors, Decision Trees: Entropy, Information Gain, Gini Impurity, Pruning, Support Vector Machines, Naive Bayes Classifier.

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 familiarize students with the Jupyter Notebook environment and implement basic NumPy array operations and Pandas dataframe manipulations.
2	To perform univariate and bivariate analysis using statistical plots to understand data distribution and class separability.
3	To handle missing values and categorical variables using appropriate imputation and encoding techniques.
4	To study the effect of feature scaling on model performance and implement preprocessing pipelines using Scikit-Learn.
5	To implement simple linear regression from scratch using NumPy and analyze convergence behavior.
6	To develop regression models for multivariate data and study non-linear relationships using polynomial features.
7	To analyze the effect of regularization on model complexity and feature selection.
8	To develop a binary classification model and evaluate performance using confusion matrix and classification metrics.
9	To implement SVM classifiers using linear, polynomial, and RBF kernels and visualize decision boundaries.
10	To train decision tree models and study overfitting by varying tree depth and splitting criteria.
11	To implement KNN classification and determine the optimal value of K using cross-validation.
12	To compare the performance of Decision Trees, Random Forests, and AdaBoost classifiers on a given dataset.
13	To perform clustering on unlabeled data and determine the optimal number of clusters using evaluation techniques.
14	To apply PCA for dimensionality reduction and visualize data reconstruction with reduced components.
15	To design and implement a complete machine learning solution involving data collection, preprocessing, model selection, tuning, and evaluation on a real-world dataset.

Text Books

1. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools and Techniques to Build Intelligent Systems”, O'Reilly Media, 3rd Edition, 2023.
2. Andreas C. Muller and Sarah Guido, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly Media, 2016.

Reference Books

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, “An Introduction to Statistical Learning with Applications in Python (ISLP)”, Springer, 2nd Edition, 2023.
2. Andriy Burkov, "The Hundred-Page Machine Learning Book", Andriy Burkov, 2019.
3. Sebastian Raschka and Vahid Mirjalili, “Python Machine Learning”, Packt Publishing, 3rd Edition, 2019.
4. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

Online Learning Materials

1. https://www.cs.cmu.edu/~tom/10701_sp11/lectures.shtml Accessed on 23/01/2026
2. https://www.microsoft.com/en-us/research/wp-content/uploads/2006/01/Bishop-Pattern-Recognition-and-Machine-Learning-2006.pdf Accessed on 23/01/2026
3. https://www.statlearning.com/resources-python Accessed on 23/01/2026
4. https://github.com/tarunnegi196/100-Days-of-ML-Handwritten-Notes/blob/main/Complete_ML_Notes_Tarun_Negi.pdf Accessed on 23/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Machine Learning	Prof. P. S. Nuggehalli	IISc Bangalore	https://nptel.ac.in/courses/106106139
2	Artificial Intelligence	Prof. S. N. Merchant	IIT Bombay	https://nptel.ac.in/courses/106102220

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: FSEC101
Course Title: Career Skills and Aptitude Development

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 2
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 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: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Project work, Seminar and Internship		

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

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

CO#	Course Outcomes
CO1	Apply quantitative aptitude and data-interpretation techniques to solve placement-style numerical problems.
CO2	Use logical reasoning and problem-solving strategies to analyze and solve complex aptitude and reasoning tasks.
CO3	Demonstrate effective technical communication skills including professional email writing, technical reports, and structured presentations.
CO4	Prepare professional candidature documents (resume, cover letter, LinkedIn profile) and present project summaries for internship and placement processes.
CO5	Use basic digital tools and programming (Excel/Python) and online coding platforms to prototype solutions and improve employability.
CO6	Exhibit professional behavior, time-management, stress-management and ethical conduct required for internships and workplace readiness.

Contents

Part-A

Unit-1 Quantitative Aptitude and Analytical Skills **6(L) hrs**

Number Systems, Average, Percentages, Profit and Loss, Problem on Ages, Ratio and Proportion, Partnership, Chain Rule, Time & Work, Time & Distance, Area, Volume, Problems on Trains, Boats and Streams.

Unit-2 Data Interpretation **5(L) hrs**

Interpretation of numerical data using Tables, Bar Graphs, Pie Charts and Line Graphs, Comparison of data sets, percentage analysis, ratio-based analysis.

Unit-3 Logical Reasoning and Problem Solving **7(L) hrs**

Analogy, Classification, Coding-Decoding, Series Completion, Syllogisms, Direction Sense Test, Blood Relations, Seating Arrangements, Arithmetic Reasoning, Mathematical Operations.

Part-B

Unit 4 Quantitative Reasoning and Data Analysis **6(L) hrs**

Advanced arithmetic problems, data sufficiency, caselets, mixed data interpretation, approximation techniques, logical data analysis, interpretation of complex datasets.

Unit 5 Professional and Career Development Skills **6(L) hrs**

Career planning and goal setting, self-assessment techniques, professional behavior and workplace etiquette, resume writing and cover letter preparation, Introduction to recruitment processes in engineering companies, basics of technical and HR interviews, professional ethics and responsibilities of engineers, time management and stress management for professional life.

Text Books

1. Arun Sharma, "Quantitative Aptitude for CAT", McGraw-Hill, 13th Edition, 2026.
2. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S. Chand, Revised Edition 2025.
3. Meenakshi Raman & Sangeeta Sharma, "Technical Communication", Oxford, 4th edition.
4. Prashant Sharma, "Soft Skills: Personality Development for Life Success", BPB Publications, 4th Edition, 2024.

Reference Books

1. K. Alex, "Soft Skills: Know Yourself & Know the World", S. Chand Publishing, 3rd Edition, 2023.
2. M. Ashraf Rizvi, "Effective Technical Communication", McGraw-Hill Education, 2nd Edition, 2017.
3. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publishing, Revised Edition, 2024.

Online Learning Materials

1. https://mrcet.com/downloads/MBA/Professional%20Communication%20Skills.pdf Accessed on 06/03/2026
2. https://baou.edu.in/assets/pdf/BCADES_201_slm.pdf Accessed on 09/03/2026
3. https://jecrcfoundation.com/wp-content/uploads/notes/btech/Computer%20Science%20Engineering/4th%20Semester/Technical%20Communication/TC%20notes.pdf Accessed on 09/03/2026

Supplementary SWAYAM Course

Sr No.	Course Name	Instructor	Host Institute	URL
1	Developing Soft Skills and Personality	Prof. T. Ravichandran	IIT Kanpur	https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_hs174
2	Soft Skills	Prof. Binod Mishra	IIT Roorkee	https://nptel.ac.in/courses/109107121

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: FSEC102
Course Title: Skill Development for GATE, PSU and Higher Education

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 2
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 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: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Project work, Seminar and Internship		

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

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

CO#	Course Outcomes
CO1	Apply engineering mathematics concepts to solve GATE-level analytical and numerical problems.
CO2	Analyze electrical networks and signals using fundamental laws and transforms relevant to competitive examinations.
CO3	Apply core ECE concepts to solve conceptual and numerical problems.
CO4	Interpret and solve communication systems and electromagnetic theory problems relevant to GATE/PSU exams.
CO5	Develop problem-solving strategies, accuracy, and time management for competitive examinations.
CO6	Demonstrate structured preparation strategy including previous year analysis, mock testing, and self-evaluation.

Contents

Part-A

Unit-1 Engineering Mathematics **8(L) hrs**

Matrices, determinants, Eigen values and Eigen vectors. Calculus: Limits, continuity, differentiability, maxima and minima, multiple integrals, Differential Equations: First-order and higher-order differential equations, Probability and Statistics: Random variables, probability distributions, mean, variance.

Unit-2 Network Theory and Signals & Systems **7(L) hrs**

Network Theory: KCL, KVL, Network Theorems, Transient and Steady-State analysis, Two-port Networks, Signals & Systems: Continuous and Discrete Signals, System Properties, Convolution, Fourier series, Fourier transform, Laplace transform, Z-transform basics.

Unit-3 Electronic Devices and Circuits **5(L) hrs**

Semiconductor fundamentals, PN junction, Zener diode, BJT, MOSFET basics, Analog Circuits: Biasing, Small Signal analysis, Amplifiers, Operational Amplifiers, Digital Electronics: Number systems, Boolean algebra, Combinational Circuits, Sequential Circuits, Flip-Flops.

Part-B

Unit-4 Communication Systems and Electromagnetics **5(L) hrs**

Analog Communication: AM, FM, Modulation techniques, Digital Communication: Sampling, quantization, PCM basics, Electromagnetic Theory: Maxwell's equations, Wave Propagation, Transmission Lines basics.

Unit-5 Competitive Examination Strategy and Practice **5(L) hrs**

Understanding GATE/PSU exam pattern and syllabus, Previous year question analysis, Accuracy improvement strategies and error analysis, Mock tests and performance evaluation.

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition.
2. H.K. Dass, "Engineering Mathematics", S. Chand Publishing, Latest Edition.
3. A. Anand Kumar, "Signals and Systems", PHI Learning.
4. Sedra & Smith, "Microelectronic Circuits", Oxford University Press.

Reference Books

1. G.K. Publications, "GATE Electronics & Communication Engineering Guide", Latest Edition.
2. Made Easy Publications, "GATE ECE Handbook", Latest Edition.
3. Network Theory – Van Valkenburg, Prentice Hall.
4. Simon Haykin, "Communication Systems", Wiley.

Online Learning Materials

1. https://www.vidyalankar.org/infinite/assets/docs/study-material/ece-module-16.pdf Accessed on 09/03/2026

Supplementary SWAYAM Course

Sr No.	Course Name	Instructor	Host Institute	URL
1	Engineering Mathematics	Prof. Jitendra Kumar	IIT Roorkee	https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ma58
2	Signals and Systems	Prof. S. C. Dutta Roy	IIT Delhi	https://nptel.ac.in/courses/108102042
3	Analog Circuits	Prof. Nagendra Krishnapura	IIT Madras	https://nptel.ac.in/courses/108106084

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: FSEC103

Course Title: Skill Development for Research, Innovation and Entrepreneurship

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 2
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 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: Project work, Seminar and Internship		

Prerequisites (if any): NA

Additional Material Allowed in ESE: NA

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

CO#	Course Outcomes
CO1	Identify real-world engineering problems and formulate research questions using systematic approaches.
CO2	Conduct literature survey and critically analyze research papers, patents and technical reports.
CO3	Apply modeling, simulation and basic programming tools to develop and validate engineering solutions.
CO4	Design innovative solutions using structured design thinking and prototyping methodologies.
CO5	Demonstrate understanding of entrepreneurship concepts including business models, startup lifecycle and intellectual property rights.
CO6	Present research ideas and startup proposals effectively through technical reports, posters and pitch presentations.

Contents

Part-A

Unit-1 Research Methodology and Literature Survey **6(L) hrs**

Introduction to Research Methodology, Types of Research, Problem Identification and Formulation, Research Objectives, Literature Review techniques, use of digital libraries (IEEE, Springer, Google Scholar), understanding Research Papers, Plagiarism and Ethics in Research.

Unit-2 Modeling, Simulation and Data Analysis Tools **7(L) hrs**

Introduction to MATLAB/Python for Engineering Applications, Modeling and Simulation concepts. Data Visualization and Interpretation. Documentation tools (LaTeX/technical report writing tools).

Unit-3 Design Thinking and Prototyping **5(L) hrs**

Empathize, Define, Ideate, Prototype, Test, Idea generation techniques and feasibility analysis, Basic prototyping approaches (hardware/software), Testing, Validation, and Iterative Design.

Part-B

Unit-4 Innovation, IPR and Entrepreneurship **6(L) hrs**

Innovation Ecosystem in Engineering Institutions, Intellectual Property Rights (IPR): Patents, Copyrights, Trademarks, Startup Ecosystem, Funding Mechanisms, Incubation Centers, Business Model Canvas, Market Analysis.

Unit-5 Project Development and Technical Presentation **6(L) hrs**

Preparation of Research/Project proposals, Technical Report Writing and Documentation Standards, Poster preparation and Research Paper structuring, Pitching ideas to Investors/Incubators, Teamwork, Project Planning and Execution Strategies.

Text Books

1. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 3rd Edition.
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations", Harper Business.
3. Eric Ries, "The Lean Startup", Crown Business.
4. B. Karl T. Ulrich & Steven Eppinger, "Product Design and Development", McGraw Hill.

Reference Books

1. Robert A. Day & Barbara Gastel, "How to Write and Publish a Scientific Paper", Cambridge University Press.
2. Peter Thiel, "Zero to One", Crown Business.
3. Ash Maurya, "Running Lean", O'Reilly Media.
4. WIPO, "Understanding Intellectual Property", World Intellectual Property Organization.

Online Learning Materials

1. https://www.wipo.int/edocs/pubdocs/en/wipo_report_ip_inn.pdf Accessed on 09/03/2026
2. https://www.scribd.com/document/964650504/RM-SDP Accessed on 09/03/2026
3. https://www.researchgate.net/publication/399882757_Modeling_and_Simulation_with_MATLAB_Simulink_and_Python Accessed on 09/03/2026

Supplementary SWAYAM Course

Sr No.	Course Name	Instructor	Host Institute	URL
1	Developing Soft Skills and Personality	Prof. T. Ravichandran	IIT Kanpur	https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_hs174
2	Project Management	Prof. Raghu Nandan Sengupta	IIT Kanpur	https://nptel.ac.in/courses/110104073
3	Introduction to Research	Prof. Prathap Haridoss	IIT Madras	https://onlinecourses.nptel.ac.in/noc20_ge04/preview

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

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC106
Course Title: Optical Fiber Communication

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:**4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75hrs
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 Elective Course		

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

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

CO#	Course Outcomes
CO1	Apply the knowledge of engineering fundamentals to the concept of optical fiber communication.
CO2	Demonstrate the basic concept of degradation and measurement techniques.
CO3	Design system components of optical sources and detectors, and derive the expression for their efficiency.
CO4	Select electronic components to describe the concept of Optical link design.
CO5	Analyze the performance of different optical amplifiers and integrated optical devices.
CO6	Use research-based knowledge to describe the concepts advanced optical communication technologies.

Contents

Part A

Unit 1 Introduction **9(L) hrs**

Elements of an optical fiber transmission link, Comparison of Optical fiber technology with other transmission media, Advantages of optical communication, Principles of light propagation through a fiber, Numeric Aperture, Total internal reflection, Ray model: Meridional rays and skew rays

Unit 2 Optical Fibers **11(L) hrs**

Types of Fiber: Step index fiber, Graded index fiber, Single Mode and Multi-mode fiber. Attenuation in optical fibers: absorption losses, bending loss, scattering losses, Dispersion: Modal Dispersion, Chromatic Dispersion, Bit rate and bandwidth, Non linear effects: Stimulated Brillion and Raman scattering, Self and Cross phase modulation, Four wave mixing, Measurement techniques: optical spectrum analyzers, Optical Time Domain Reflectometer (OTDR).

Part-B

Unit 3 Optical Sources and Detectors **8(L) hrs**

Optical sources – LEDs: Working Principle, Types of LED: Homostructure and Hetero structure LED, LASER: Principle of operation, Lasing effect. Photo-detectors - PIN-detectors, Avalanche photodiode, Detector Responsivity, Optical Receivers. Optical link design-BER calculation, quantum limit, power

penalties.

Unit 4 Optical Amplification and Integrated Optics **9(L) hrs**

Optical amplifiers–Semiconductor Optical Amplifier (SOA), Erbium Doped Fiber Amplifiers (EDFA), Raman Amplifier, Integrated Optical devices: directional couplers, splitters, electro-optic switches, polarization transformer, frequency translators.

Unit 5 Advances in Optical Communication **8(L) hrs**

Introduction of Free Space Optical Communication and its applications, Radio over Fiber RoF, WDM systems, DWDM, Optical wireless (Li-Fi) and its application.

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 demonstrate fiber optic analog and digital link.
2.	To Study and measurement of propagation loss in optical fiber.
3.	To demonstrate and measurement of bending loss in optical fiber.
4.	To demonstrate and measurement of numerical aperture of optical fiber.
5.	To Measure the optical power using optical power meter.
6.	To demonstrate Voice Transmission through optical fiber using PWM.
7.	To measure the sensitivity of the fiber optic link.
8.	To demonstrate V-I characteristics of fiber optic LEDs.
9.	To demonstrate V-I characteristics of photo detector.
10	To design free space optical communication using FSO channel in Opti system and analyze the outputs using various optical analyzers.
11.	To demonstrate parametric effect on free space optical communication using Opti system.
12.	To analyze Frees pace optical communication for different weather conditions in terms of BER and Q factor using Optisystem.
13.	Study of Optical Amplifiers (EDFA) in Fiber Optic Communication using OptiSystem
14.	Design and Simulation of a basic optical Fiber Communication System using OptiSystem
15.	Performance analysis of WDM (Wavelength Division Multiplexing) system using OptiSystem

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, 3rdEdition, 2010.
3. DjafarK.Mynbaev,"Fiber optic communication technology", Pearson,2001.

Reference books

1. J.E.Midwinter,"Optical Fibers for Transmission", JohnWiley,1979.
2. J.Gowar, "Optical Communication Systems", Prentice Hall India, 1987.
3. G.Agrawal, "Nonlinear Fibre Optics", Academic Press, 2nd Edition,2ndEdition 1994.
4. G.Agrawal,"Fiber Optic Communication Systems", John Wiley and Sons, NewYork, 1992

Online learning material

1. https://www.youtube.com/watch?v=pavBq7HIoIE Accessed on 13/01/2026
2. https://www.youtube.com/watch?v=KW3HSJthFws Accessed on 13/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Optical Communications	Prof. Pradeep Kumar K	IIT Kanpur	https://nptel.ac.in/courses/108104113
2	Fiber Optic Communication Technology	Prof. Deepa Venkitesh	IIT Madras	https://nptel.ac.in/courses/108106167
3	Fiber-Optic Communication Systems and Techniques	Prof. Pradeep Kumar K	IIT Kanpur	https://nptel.ac.in/courses/108104113

Experiments to be performed through Virtual Labs

Sr. No.	**Experiment Name**	**Experiment Link(s)**
1.	Characterization of LED	https://oc-iitr.vlabs.ac.in/exp/char-led/
2.	Characterization of Laser Diode	https://oc-iitr.vlabs.ac.in/exp/char-laser/
3.	Measurement of Numerical Aperture of Optical Fiber.	https://oc-iitr.vlabs.ac.in/exp/num-aperture/
4.	Optical Power Measurements	https://oc-iitr.vlabs.ac.in/exp/power-measure/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC107
Course Title: Cyber Security

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 5
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75hrs
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 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	Summarize the classification of cybersecurity attacks, emerging threats, and typical attack sequences in modern cyber environments.
CO2	Describe the design idea of symmetric ciphers and the evolution of modern cryptography.
CO3	Interpret the essentials of public-key cryptosystems, including RSA and key exchange mechanisms.
CO4	Outline security vulnerabilities and protection mechanisms in mobile and wireless communication systems.
CO5	Analyze security challenges in social networking and network environments, and explain suitable incident-handling mechanisms.
CO6	Comprehend the evolution of Blockchain technology.

Contents

Part-A

Unit-1 Cyber Threats and Attacks **9(L) hrs**

Introduction to cyber security, emerging cyber threats, cyberattack categorization, typical attack sequence, types of cyberattacks, foot printing, wiretapping, social engineering, packet sniffing, known ports, password vulnerabilities, malware, viruses and worms, logic bombs, BOT and BOTNET, Trojan Horse, cryptojacking, and supply chain attack.

Unit-2 Essentials of Cyber Security **12(L) hrs**

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, Encryption and Decryption structure of Advanced Encryption Standard, Practical aspects of Asymmetric Cryptography, Number Theory—Euclidean Algorithm, Extended Euclidean Algorithm, Euler's Phi Function, Encryption and Decryption of RSA Cryptosystem – Key Generation, Diffie-Hellman Key Exchange.

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rdYear (ECE)

Part-B

Unit -3 Mobile and Wireless Cyber security **8(L) hrs**

Capabilities of mobile devices, mobile operating systems, mobile threats, cybersecurity measures, Bluetooth and cybercrimes, attacks on Bluetooth communication, Bluetooth security techniques, IoT use cases, Security and privacy issues of IoT, IoT Security, Standardization activities for IoT security.

Unit-4 Social and Network Security **9(L) hrs**

Social Networking and Cyber Security, Network Security, Identifying Threats, Protection against attacks, Hijacking of Social Networking Sites, Social Media Security threats, Incident Handling, Types of Incident Handling, Incident Handling Security

Unit-5 Block chain Technology: **7(L) hrs**

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

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 a program to read multimedia information such as text, audio and image.
2	To develop an algorithm for finding a greatest common divisor of two integers.
3	To demonstrate the following properties of modular arithmetic. $[(a \bmod n) + (b \bmod n)] \bmod n = (a + b) \bmod n$ $[(a \bmod n) - (b \bmod n)] \bmod n = (a - b) \bmod n$ $[(a \bmod n) \times (b \bmod n)] \bmod n = (a \times b) \bmod n$
4	To construct a program for evaluating the inverse of an integer.
5	To develop an extended Euclidean algorithm.
6	To understand the concept of key using the Caesar Cipher.
7	To evaluate the ciphertext using the Hill Algorithm.
8	To understand the concept of transportation of data using the rail fence technique.
9	To develop a program for understanding the concept of image-based steganography using the least-significant bit insertion technique.
10	To develop a program for analyzing the working of stream ciphers and block ciphers.
11	To develop a program for creating the S-boxes of the DES algorithm.
12	To analyze the output of the mix column transformation of the AES algorithm.
13	To develop a generic program of the popular Diffie-Hellman secure key exchange protocol.
14	To develop a program for implementing the RSA public key cryptosystem.
15	The student has to do a mini project based on any type of OSINT (open-source) tools.

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

Text Books

1. Ramjee Prasad and Vandana Rohokale, "Cyber Security: The Lifeline of Information and Communication Technology", Springer, 2020.
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson, 7th Edition, 2017.

Reference Books

1. Nigel P. Smart, “Cryptography Made Simple”, Springer, 2016.
2. Rick Howard, “Cyber Security Essentials”, CRC Press, 2011.
3. Christof Paar and Jan Pelzl, “Understanding Cryptography”, Springer, 2010.

Online Learning Materials

1. https://www.cs.umd.edu/~waa/414-F11/IntroToCrypto.pdf Accessed on 13/02/2026
2. https://www.fcc.gov/cyber/cyberplanner.pdf Accessed on 13/02/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host	URL
1.	Cyber Security	Dr.G.Padmavathi	Avinashilingam Institute for Home Science & Higher Education for Women, Coimbatore	https://onlinecourses.swayam2.ac.in/cec20_cs15/preview
2.	Introduction to Cyber Security	Dr. Jeetendra Pande	Uttarakhand Open University, Haldwani	https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

Experiments to be performed through Virtual Labs

Sr. No.	**Experiment Name**	**Experiment Link(s)**
1.	Diffie-Hellman Key Establishment	https://cse29-iiith.vlabs.ac.in/exp/diffie-hellman/

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC108
Course Title: Edge Computing Software Development

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**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): CEC108
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Describe the fundamental concepts, evolution and paradigms of Edge and Fog Computing.
CO2	Analyze the architecture, standards and hardware/software components of Edge Computing and IoT devices.
CO3	Apply microservices architecture and containerization technologies for edge software development.
CO4	Evaluate data analytics, machine learning and communication protocols at the network edge.
CO5	Assess edge data storage security, privacy-preserving schemes and integrate blockchain for secure edge applications.

Contents

Part-A

Unit-1 Introduction **8(L) hrs**

Evolution of Computing Paradigms, Parallel, Distributed, Cluster, Grid and Cloud Computing, Edge Computing, Definition, Limitations of Cloud Computing for Low Latency and Round-Trip Time (RTT) applications, Principles of Edge Computing and Multi-access Edge Computing (MEC), Comparison of Cloud, Fog and Edge Computing Paradigms.

Unit-2 Edge Computing Architecture **10(L) hrs**

Edge Devices, Edge Server Clusters, Cloud Servers, Multi-access Edge Computing (MEC) framework, Standards on Edge Platforms, Networking Architecture and Network Management, IoT Devices, Sensors and Actuators, Edge Computing Simulators.

Part-B

Unit-3 Edge Software Development **10(L) hrs**

Software Development Principles for the Network Edge, Monolithic vs Microservices Architecture for Edge Computing Environments, Introduction to Docker containers, Container Orchestration using Kubernetes in Edge Computing, Middleware and Application Interfaces (APIs) for Edge Services.

Unit-4 Edge Analytics and Data Management **9(L) hrs**

Types of Data, Phases of Data Analytics, Machine Learning fundamentals for Edge Devices, 'TinyML' and On-Device inference to support Latency-based Applications, Data Transmission and Communication Protocols at the Edge, MQTT and Kafka for end-to-end Edge/IoT pipelines, Concepts of distributed systems in IoT, Time Ordering and Clock Synchronization.

Unit-5 Edge Data Storage Security **8(L) hrs**

Data Confidentiality, Authentication, Privacy-preserving Schemes and Homomorphic Encryption, Introduction to Block chain technology and it's integration with Edge Computing systems, Real-world Edge Computing Software use cases: Autonomous Vehicles, Smart Cities, Smart Healthcare (Remote monitoring) and Industrial automation.

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 set up a Linux-based edge node and verify system resources and network connectivity to a simulated cloud server.
2	To develop a program for the acquisition of sensor data on an IoT device and forward it to an edge gateway over TCP/UDP.
3	To develop a simple MQTT-based publisher–subscriber application between an IoT device and an edge gateway using a local MQTT broker.
4	To develop and deploy a RESTful API service on the edge node for sensor data ingestion and retrieval.
5	To implement a monolithic edge application for data collection, processing and cloud forwarding, and measure end-to-end latency.
6	To refactor the monolithic application into microservices and compare performance with the monolithic design.
7	To containerize an edge microservice using Docker and demonstrate basic container lifecycle operations.
8	To design and deploy a multi-container edge application using Docker Compose or a lightweight Kubernetes/K3s setup on the edge node.
9	To implement data preprocessing and rule-based decision-making at the edge.
10	To implement on-device machine learning inference at the edge using a pre-trained model and evaluate latency.
11	To develop an end-to-end Edge/IoT data pipeline using MQTT at the device–edge interface and a file/DB or stream sink representing the cloud.
12	To measure and compare latency and bandwidth usage for cloud only processing versus edge-assisted processing for a chosen IoT workload.
13	To implement basic authentication and access control for an edge API or MQTT broker and demonstrate authorized and unauthorized access scenarios.

14	To implement encryption of data in transit between device and edge, and between edge and simulated cloud, using standard cryptographic libraries.
15	To study and demonstrate a simple blockchain-based or append-only ledger prototype for logging edge transactions/events for integrity and auditability.

Text Books

1. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy "Edge Computing: Fundamentals, Advances and Applications", CRC Press/Taylor & Francis Group, 1st Edition, 2022.
2. Dario Sabella, "Multi-access Edge Computing: Software Development at the Network Edge", Springer International Publishing, 1st Edition, 2021.

Reference Books

1. Rajkumar Buyya, Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms," Wiley, 1st Edition, 2019.
2. Jie Cao, Quan Zhang, Weisong Shi, "Edge Computing: A Primer," Springer, 2018.

Online Learning Materials

1. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/4_18KP2CS07_2021012902234424.pdf Accessed on 13/03/2026
2. https://soclibrary.futa.edu.ng/books/Fog%20and%20edge%20computing%20principles%20and%20paradigms%20by%20Buyya,%20Rajkumar%20Srirama,%20Satish%20Narayana%20(z-lib.org).pdf Accessed on 13/03/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1.	Foundation of Cloud IoT Edge ML	Prof. Rajiv Misra	IIT, Patna	https://nptel.ac.in/courses/106104242
2.	Introduction to Internet of Things	Prof. Sudip Misra	IIT Kharagpur	https://nptel.ac.in/courses/106105166

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

TRACK-II (Elective-II)
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: EEC109
Course Title: Arduino and MSP430 based Embedded System

Programme: B.Tech.	**L:**3 **T:**0 **P:**2	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective course		

Prerequisites: CEC103, CEC110
Additional Material Allowed in ESE: Scientific calculator

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

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

Contents

Part –A

Unit 1 Introduction to Arduino **4(L) hrs**

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

Unit 2 Programming in Arduino **8(L) hrs**

Arduino IDE, Arduino IDE 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.

Unit 3 I/O Functions **14(L) hrs**

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

Unit 4 MSP430/432 Overview **9(L) hrs**

MSP 430/432 micro-controller architecture and launch pad. GPIO programming and interfacing. LED and 7-segment display interfacing. I/O PORT programming and PORT mapping.

Unit 5 Programming on MSP430/432 **12(L) hrs**

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.

Unit 6 Interfacing with MSP430/432 **5 (L) hrs**

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

Laboratory Work

Experiment No.	Experiment Title
1	Introduction to Tinkercad and its dashboard
2	Demonstration of the Arduino UNO board and Arduino IDE installation on a computer
3	Write a program to interface the LED brightness control and 7-segment display using Arduino Uno
4	Write a program of 16x2LCDinterfacing with Arduino Uno
5	Write a program to interface the temperature and humidity DHT-11 sensor using Arduino Uno
6	Write a program to interface the Wi-Fi module ESP-32 with Arduino Uno
7	Write a program to interface the Servo Motor SG-90 with Arduino Uno
8	Demonstration of MSP 430/432 kit and Energia IDE installation on the computer
9	Write a program to interface LED with tact switch and a 7-segment display using MSP 430/432
10	Write a program of 16x2 LCD interfacing with MSP 430/432
11	Write a program to interface the Temperature and Humidity DHT-11 sensor using MSP 430/432
12	Write a program to Control DC Motors Using MSP430/432
13	Write a program to Interface Wi-Fi module ESP-8266with MSP430/432

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

1. Cornel Amariei, "Arduino Development Cookbook," Packet 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

Online learning materials

1. https://www.arduino.cc/ Accessed on 13/02/2026
2. http://www.microdigitaled.com/ARM/EnergiaForArduino.html Accessed on 13/02/2026
3. https://training.ti.com/msp430-workshop Accessed on 13/02/2026

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host	URL
1	Introduction to Embedded Systems Design	Prof. Dhananjay V. Gadre, Prof. Badri Subudhi	NPTEL	https://onlinecourses.nptel.ac.in/noc26_cs22/preview
2	Arduino Step by Step	Dr. Peter Dalmaris	Udemy	https://www.udemy.com/course/arduino-sbs-17gs/

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: EEC110
Course Title: Low Power VLSI Design

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 6	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**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): NIL
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Understand sources of power dissipation and low-power challenges in VLSI systems.
CO2	Analyze power consumption using circuit, logic, and architectural-level power models.
CO3	Apply circuit-level techniques such as voltage scaling, power gating, and MTCMOS to reduce power.
CO4	Implement logic and architectural-level power optimization techniques including clock gating and operand isolation.
CO5	Evaluate low-power design strategies for memories and interconnects.
CO6	Understand system-level low-power methodologies and power-aware design tools.

Contents

Part -A

Unit 1 Introduction to Low Power VLSI **7(L) hrs**
Power dissipation in CMOS circuits; sources of power consumption; impact of technology scaling; power–performance trade-offs; low-power design challenges.

Unit 2 Power Estimation and Modeling **8(L) hrs**
Dynamic and static power models; switching activity estimation; capacitance modeling; power estimation techniques at circuit, logic, and architectural levels.

Unit 3 Circuit-Level Low Power Techniques **8(L) hrs**
Transistor sizing; voltage scaling; multi-threshold CMOS (MTCMOS); power gating; body biasing; adiabatic logic basics.

Part-B

Unit 4 Logic and Architecture-Level Techniques **8(L) hrs**

Clock gating; operand isolation; logic restructuring; parallelism and pipelining for low power; low-power FSM design.

Unit 5 Memory and Interconnect Power Reduction **7(L) hrs**

Low-power memory design; SRAM power optimization; memory hierarchy techniques; interconnect power reduction; bus encoding techniques.

Unit 6 System-Level Low Power Design and Tools **7(L) hrs**

Dynamic voltage and frequency scaling (DVFS); power-aware design methodologies; low-power EDA tools; power optimization in SoCs; case studies.

Laboratory Work

Experiment No.	Experiment Title
1	Design a CMOS inverter and measure its dynamic power.
2	• Design a CMOS inverter and measure its leakage power. • Compare it with dynamic power.
3	Simulate the CMOS inverter at two different technology nodes.
4	Compare and analyze leakage and dynamic power of the CMOS inverter at different technology nodes.
5	Examine the delay parameter of the CMOS Inverter at different technology nodes.
6	Design a full adder and Estimate power.
7	Simulate a logic circuit at different V_{DD} values to implement the concept of supply voltage scaling.
8	Measure the delay and the power of the logic circuit designed at different supply voltages.
9	Design a circuit with sleep transistor and implement power gating to reduce leakage.
10	Compare leakage in active vssleep mode with the application of power gating technique.
11	Determine threshold voltage and leakage current with the implementation of forward body biasing.
12	Determine threshold voltage and leakage current with the implementation of reverse body biasing.
13	Compare leakage current with forward and reverse body biasing.
14	Design and simulate a 6T SRAM cell. Also, compare and Analyze read/write power in SRAM.
15	To implement any low power design technique on a circuit other than the mentioned above.

Text Books

1. Neil H. E. Weste and DavidHarris, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson Education, 4th Edition, 2011, ISBN: 0-321-54774-8.
2. Gary Yeap,“Practical Low Power Digital VLSI Design”,Kluwer Academic Publishers,1998.

3. AjitPal,"Low-Power VLSI Circuits and Systems,Springer, 2015, ISBN 978-81-322-1936-1.

Reference Books

1. Kiat-Seng Yeo and Kaushik Roy, "Low-Voltage Low-Power VLSI Subsystems",McGraw-Hill, 2005.
2. Anantha P. Chandrakasan and Robert W. Brodersen ,"Low Power Digital CMOS Design", ,Kluwer Academic Publishers, 1995.
3. Koushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Circuit Design",John Wiley & Sons Inc., 2000.

Online Learning Materials

1. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://vemu.org/uploads/lecture_notes/30_12_2019_521719505.pdf Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1.	Low Power VLSI Circuits & Systems	Prof. Ajit Pal	IIT, Kharagpur	https://nptel.ac.in/courses/106105034

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

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

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC111
Course Title: Satellite and Radar Communication

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 6	**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	Comprehend the basic concept of Satellite Systems and the importance of various Satellite applications & services
CO2	Develop an understanding of Kepler's laws, satellite orbital elements, and the Space segment
CO3	Comprehend the basic concept of propagation impairments in Satellite Systems
CO4	Design and analyze the Satellite System Link budget
CO5	Analyze the performance of different types of Multiple Access systems
CO6	Demonstrate the basic principle of the RADAR System and describe the operation of different types of radar.

Contents

Part-A

Unit-1 Satellite Communication and its applications **8(L) hrs**

Historical evolution of Satellite Communication, Frequency allocation, Services: INTELSAT, INSAT, VSAT, Mobile satellite services-GPS, Satellite Navigation system, Direct Broadcast satellite (DBS)-television, Digital Audio Broadcast (DAB), Future trends in Satellite Communication

Unit-2 Orbital Mechanism and Space Segment **8(L) hrs**

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

Unit-3 Propagation Impairments and Multiple Access Techniques **9(L) hrs**

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

Part-B

Unit-4 Satellite Link design **9(L) hrs**

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

Unit-5 Radar Systems **11(L) hrs**

Basic Principle: Block diagram and operation of Radar, Radar range Equation, Applications of Radar, Continuous Wave (CW) radar and its limitations, Frequency Modulated Continuous Wave (FMCW) radar, Principle and operation of Moving Target Indicator (MTI) radar, Scanning techniques (horizontal, vertical, spiral, palmer, raster, nodding), Angle tracking systems (lobe switching, conical scan, monopulse), Range tracking systems, Doppler (velocity) tracking 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. 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 Laboratory Manuals
3. M.I. Skolnik, "Introduction to radar systems", McGraw-Hill

Reference Books

1. 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. D. C. Agarwal, 'Satellite Communications', 6th Ed., Khanna Publishers,2008
4. M.Kulkarni, "Microwave devices and Radar Engg", Umesh Publications

Online Learning Materials

1. http://archive.mu.ac.in/myweb_test/Satelight%20Comm.pdf Accessed on 15/01/2026
2. https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/Radar%20Systems.pdf Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Satellite communication	Prof. Kalyan Kumar Bandyopadhyay	IIT Kharagpur	https://nptel.ac.in/courses/117105131

2	Principles and Techniques of Modern Radar Systems	Prof. Amitabha Bhattacharya	IIT Kharagpur	https://nptel.ac.in/courses/108105154

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC112
Course Title: Information Theory and Coding

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 6	**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: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

Prerequisites (if any): CEC102, BSEC101.
Additional Material Allowed in ESE: Scientific Calculator

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

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

Contents

Part-A

Unit-1 Fundamentals of Information Theory **13(L) hrs**

Uncertainty & 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.

Unit-2 Linear Block Codes **7(L) hrs**

Parity–check & generator matrices, equivalent codes, syndrome decoding, Perfect Codes, Hamming Codes, Optimal Linear codes, Maximum Distance Separable (MDS) codes.

Unit-3 Cyclic and Algebraic Codes **8(L) hrs**

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

Part-B

Unit 4. Convolutional Codes and Decoding **11(L) hrs**

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

Unit 5. ARQ Strategies and System Implementation **6(L) hrs**

Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes, comparison of ARQ strategies.

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

Text Books

1. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw Hill Education, 3rd Edition, 2016.

Reference Books

1. Roberto Togneri, Christopher J.S. deSilva, "Fundamentals of Information Theory and Coding Design", Taylor & Francis, 1st Edition, 2003.
2. Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", Wiley, 2nd Edition, 2012.
3. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn, "Coding Theory: Algorithms, Architectures and Applications", Wiley, 2007.

Online Learning Materials

1. https://electrobian.wordpress.com/wp-content/uploads/2016/07/ece-v-information-theory-coding-10ec55-notes.pdf Accessed on 14/01/2026
2. information-theory-and-coding-10EC55.pdf Accessed on 14/01/2026

Supplementary SWAYAM Course

SN.	Course Name	Instructor	Host Institute	URL
1	Information Theory and Coding	Prof. Pavan S. Nuggehalli	IISc Bangalore	https://nptel.ac.in/courses/117108097
2	Information Theory and Coding	Prof. S. N. Merchant	IIT Bombay	https://nptel.ac.in/courses/117101053

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

Course Code: EEC113
Course Title: Quantum Computing

Programme: B.Tech.	**L:** 3 **T:**1 **P:** 0	**Credits:** 4
Semester: 6	**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: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective Course		

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

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

CO#	Course Outcomes
CO1	Understand basic principles of quantum computing.
CO2	Explain qubits, quantum gates, and simple algorithms.
CO3	Relate quantum computing concepts to electronics and communication systems.
CO4	Identify applications and future scope without advanced mathematics.
CO5	Explain basic quantum algorithms and their advantages.
CO6	Discuss quantum hardware platforms and applications.

Contents

Part-A

Unit-1 Introduction to Quantum Computing **9(L) hrs**

Limitations of classical computing, Motivation for quantum computing, Difference between classical bits and quantum bits (qubits), Basic quantum concepts: superposition and measurement, History and evolution of quantum computing, Applications of quantum computing in electronics and communication.

Unit-2 Fundamentals of Qubits and Quantum States **9(L) hrs**

Physical realization of qubits (spin, photon, superconducting qubits—overview), quantum states and state representation (conceptual view), Superposition and probability interpretation, Bloch sphere (basic understanding, no heavy math), Measurement of qubits and collapse of quantum states

Unit-3 Quantum Logic Gates and Circuits **9(L) hrs**

Quantum logic gates vs classical logic gates, Single-qubit gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard (conceptual operation), Multi-qubit gates: CNOT and SWAP gates, Simple quantum circuits, Reversible logic and its importance

Part-B

Unit-4 Basic Quantum Algorithms **8(L) hrs**

Need for quantum algorithms, Deutsch algorithm (idea only), Deutsch–Jozsa algorithm (basic working),

Grover's search algorithm (conceptual steps and advantage), Comparison of classical and quantum algorithms

Unit-5 Quantum Hardware, Noise and Applications **10(L) hrs**

Overview of quantum hardware platforms, Errors and noise in quantum systems (introductory), Concept of quantum error correction (basic idea), Quantum computing tools and simulators (IBM Q, Qiskit – overview), Applications in cryptography, electronics design, optimization, and communication, Future challenges and scope of quantum computing

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

Text Books

1. Eleanor Rieffel and Wolfgang Polak**,** *Quantum Computing: A Gentle Introduction*, MIT Press, 1965.
2. Phillip Kaye, Raymond Laflamme, and Michele Mosca**,** *An Introduction to Quantum Computing*, Oxford University Press, 2007

Reference Books

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
2. M. M. Wilde, Quantum Information Theory, Cambridge University Press, 2013.
3. Jack D. Hidary**,**Quantum Computing: An Applied Approach, Springer, 2021.

Online Learning Materials

1. https://quantum.ibm.com Accessed on 15/01/2026
2. https://qiskit.org/textbook Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	Prof. Prabha Mandayam, Prof. Anupama Ray	IBM and IITM	https://nptel.ac.in/courses/106106232
2	Quantum Computing	Prof. Debabrata Goswami	IIT Kanpur	https://onlinecourses.nptel.ac.in/noc19_cy31/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rd Year (ECE)

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

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 3rdYear (ECE)

Course Code: EEC114
Course Title: PLC and Industrial Automation

Programme: B.Tech	**L:**3 **T:**1 **P:**0	**Credits:** 4
Semester: 6	**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: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional 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
CO1	Acquire the hardware knowledge of PLC module
CO2	Understand the ladder programming skills of PLC module.
CO3	Develop the basic understanding of PLC Intermediate Functions
CO4	Acquire the advance skills of PLC Programming
CO5	Understand the concept of PLC interfacing with various devices
CO6	Illustrate the applications of automation with PLC

Contents

Part A

Unit 1 Introduction to PLC **8(L) hrs**

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.

Unit 2 Logic Concepts and PLC Programing **8(L) hrs**

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

Unit 3 Basic and Intermediate Functions of PLC **9(L) hrs**

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

Part-B

Unit 4 Advance PLC Programming **10(L) hrs**

Introduction to PLC programming, Different programming methods (Instruction list, functional block

diagram, Sequential text, signal flow chart), ABB PLC programming, SIEMENS PLC & FUJIPLC programming

Unit 5 PLC Interfacing **9(L) hrs**

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

Unit 6 Applications of PLC in Industrial Automation **8(L) hrs**

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. Frank D. Petruzella, Programmable Logic Controllers, McGraw-Hill Education, 4th Edition.
2. Hugh Jack, Automating Manufacturing Systems with PLCs, Pearson Education.
3. Gary Dunning, Introduction to Programmable Logic Controllers, Tata McGraw-Hill.

Reference Books

1. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Prentice Hall, 5th Edition.
2. S. R. Majumder, Programmable Logic Controllers, Tata McGraw-Hill.

Online Learning Materials

1. https://plcopen.org Accessed on 13/02/2026
2. https://www.automationdirect.com Accessed on 13/02/2026

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host	URL
1	Industrial Automation and Control	Prof. S.Mukhopadhyay	IIT Kharagpur	https://nptel.ac.in

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 3rd Year (ECE)

Course Code: EEC115
Course Title: VLSI Physical Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 6	**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): NIL
Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes
CO1	Explain the VLSI design and physical design cycles, fabrication processes, design rules, and system packaging styles.
CO2	Implement partitioning algorithms to optimize area, delay, and power in VLSI circuit design.
CO3	Design and evaluate floorplanning techniques, including slicing and non-slicing approaches, for efficient chip layout.
CO4	Evaluate placement problems and implement suitable placement algorithms for different VLSI design styles and architectures.
CO5	Examine routing problems and apply global and detailed routing techniques to achieve optimized VLSI physical designs.
CO6	Develop algorithms to solve the complex physical design problems in ICs.

Contents

Part-A

Unit-1 Introduction **10(L) hrs**

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, Power, Delay, Area (PDA**)** in physical design.

Unit-2 Partitioning **10(L) hrs**

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

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

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

Unit-4 Placement **8(L)hrs**

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

Unit- 5 Routing **9(L)hrs**

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

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

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

1. Charles J. Alpert, Dinesh P. Mehta, and Sachin S. Sapatnekar, "Handbook of algorithms for physical design automation", CRC press, 2008.
2. W. Wolf, "Modern VLSI Design System on Silicon", 2nd ed., New York: Pearson Education, 2000.
3. S.K. Lim, "Practical Problems in VLSI Physical Design Automation", Massachusetts: Springer, 2008
4. Physical Design Essentials: An ASIC Design Implementation Perspective", Khosrow Golshan, Springer Science and Business Media, 2007.
5. Physical Design and Automation of VLSI systems", Preas M. Lorenzatti, The BenjaminCummins Publishers, 1998.

Online Learning Materials

1. https://www.slideshare.net/slideshow/vlsi-physical-designnotes/34067876 Accessed on 15/01/2026

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1.	VLSI Physical Design	Prof. Indranil Sengupta	IIT, Kharagpur	https://nptel.ac.in/courses/106105161

2.	VLSI Physical Design with Timing Analysis	Prof. Bishnu Prasad Das	IIT, Roorkee	https://onlinecourses.nptel.ac.in/noc24_ee77