B. Tech. (ECE) – 2024 Curriculum

Course Code	Semester - I	Credit
MA101	Mathematics - I	3
HM101	English for Communication	2
CS101	Introduction to Computer Programming	3
EC151	Introduction to Electronics and Communication Engineering	3
ME151	Engineering Graphics	3
EC101	Electronics Laboratory	2
CS102	Introduction to Computer Programming Laboratory	2
ME102	Engineering Practice	2
SH151	Energy and Environmental Science	0
	Total Credits	20

Course Code	Semester – II	Credit
MA151	Mathematics – II	3
ME101	Basics of Mechanical Engineering	2
PH101	Physics	3
CS151	Introduction to Python Programming	3(2T+2L)
EC152	Programme Core -I / Network Analysis	3
EC153	Programme Core -II / Electronic Devices and Circuits	3
EC154	Networks Laboratory	2
PH102	Physics Laboratory	2
	Total Credits	21

Course Code	Semester – III	Credit
MA201	Mathematics -III	3
EC201	Programme Core -III / Electronic Circuits	3
EC202	Programme Core -IV / Digital Principles and System Design	3
EC203	Programme Core -V / Signals and Systems	3
HM251	Economics for Engineers	3
EC204	Data Structures and Algorithms	3
EC205	Electronic Circuits Laboratory	2
EC206	Digital Principles & System Design Laboratory	2
	Total Credits	22

Course Code	Semester – IV	Credit
MA252	Programme Core -VI /Probability and Random Processes	4
EC251	Programme Core -VII / Digital Signal Processing	3
EC252	Programme Core -VIII /Analog Integrated Circuits	3
EC253	Programme Core – IX / Engineering Electromagnetics	3
EC254	Programme Core – X / Control Systems	3
EC255	Computer Networks	3
EC256	Digital Signal Processing Laboratory	2
EC257	Analog Integrated Circuits Laboratory	2
	Total Credits	23

Course Code	Semester – V	Credit
EC301	Programme Core – XI / Communication Theory	3
EC302	Programme Core – XII / Antenna and Propagation	3
EC303	Programme Core – XIII / Embedded Systems	3
EC304	Programme Core – XIV /Digital Communication	3
E1	Elective -I	3
GE1	Global Elective -I	3
EC305	Digital Communication Laboratory	2
EC306	Embedded Systems Laboratory	2
	Total Credits	22

Course Code	Semester – VI	Credit
EC351	Programme Core – XV / VLSI System Design	3
EC352	Programme Core – XVI / Optical Communication	3
EC353	Programme Core – XVII / RF and Microwave Engineering	3
HM351	Technical English	2
E2	Elective -II	3
GE2	Global Elective -II	3
EC354	VLSI Design Laboratory	2
EC355	Microwave and Optical Communication Laboratory	2
	Total Credits	21

Course Code	Semester – VII	Credit
EC401	Summer Internship	2
EC402	Programme Core - XVIII /5G and Beyond 5G	3
E3	Elective -III	3
E4	Elective -IV	3
E5	Elective -V	3
E6	Elective -VI	3
EC403	5G and Beyond 5G Laboratory	2
EC404	Comprehensive Viva	1
	Total Credits	20

Course Code	Semester – VIII	Credit
EC452	Project work	6
E7	Elective - VII / MOOC online course	3
E8	Elective -VIII / MOOC online course	3
E9	Elective -IX / MOOC online course	3
	Total Credits	15

Summary:

Branch/Sem	I	II	III	IV	V	VI	VII	VIII	Total
ECE	20	21	22	23	22	21	20	15	164

FIRST SEMESTER

Course Code	:	MA101
Course Title	:	**Mathematics – I**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Examine the system of linear equations with matrices.

CO2 Convert linear first order differential equations into separable form.

CO3 Solve the ordinary linear differential equations with constant coefficients

CO4 Identify the maxima and minima of multivariable functions

CO5 Analyze the physical problems that arise in the field of engineering and apply the concepts to solve them.

Course Content:

Matrices: Rank of a matrix - Consistency of the system of linear equations - linear dependence and independence of vectors. Eigen values and Eigen vectors of a matrix - Caley-Hamilton theorem and its applications - Reduction to diagonal form - Reduction of a quadratic form to canonical form - orthogonal transformation and congruent transformation. Properties of complex matrices - Hermitian, skew-Hermitian and Unitary matrices.

Ordinary differential equations of first order: Separable equations - equations reducible to separable form - exact equations - integrating factors. Linear first order equations - Bernoulli's equation - Orthogonal trajectories - Newton's law of cooling - Law of natural growth and decay.

Ordinary higher order differential equations: Higher order linear equations with constant coefficients. Euler and Cauchy's equations - Method of variation of parameters - System of linear differential equations with constant coefficients – Applications to electrical circuits.

Differential Calculus: Rolle's theorem - Mean value theorem - Taylor's and Maclaurin's theorems (without proof) with remainders – simple illustrations; Functions of several variables - Partial differentiation - Total Differentiation - Euler's theorem and generalization. Maxima and minima of functions of several variables (two and three variables) – Lagrange's method of Multipliers - Change of variables –Jacobians – simple illustrations.

Multiple Integrals: Double and triple integrals - computation of surface areas and volumes; change of variables in double and triple integrals.

Text Books:

1 R. K. Jain and S. R. K. Iyengar, “Advanced Engineering Mathematics”, 5th ed, Narosa Publishing House, 2016.

2 B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publications, 44nd ed, 2015.

3 Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th ed, John Wiley and Sons, 2015.

Reference Books:

1 N. Piskunov, “Differential and Integral calculus”, Vol. 1&2, MIR Publishers, Moscow - CBS Publishers and Distributors (India).

2 Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Education Pvt. Ltd.

Web link(s):

1 https://nptel.ac.in/courses/111/101/111101115/https://nptel.ac.in/courses/111/102/111102133/

2 https://nptel.ac.in/courses/111/104/111104092/

Course Code	:	**HM101**
Course Title	:	**English for Communication**
Number of Credits	:	**2**
Prerequisites (Course code)	:	**None**
Course Type	:	**GIR**

Course outcomes: At the end of the course, the student will be able to:

CO1 Use the features of communication to express themselves orally in English in an intelligible way.

CO2 Develop an awareness of problems related to listening in different contexts.

CO3 Apply reading strategies to comprehend different difficulty levels in English at a speed suited to their needs.

CO4 Employ strategies to write acceptable sentences and coherent paragraphs in English.

Course Content:

Communication: An introduction – Its role and importance in the corporate world – Tools of communication – Barriers – Levels of communication – English for Specific purposes.

Listening: Listening process & practice – Exposure to recorded & structured talks, class room lectures – Problems in comprehension & retention – Note-taking practice – Listening tests – Importance of listening in the corporate world.

Reading: Introduction of different kinds of reading materials: technical & non-technical – Different reading strategies: skimming, scanning, inferring, predicting and responding to content – Guessing from context – Note making – Vocabulary extension.

Speaking: Barriers to speaking – Building self-confidence & fluency – Conversation practice- Improving responding capacity – Extempore speech practice – Speech assessment.

Writing: Effective writing practice – Effective sentences: role of acceptability, appropriateness, brevity & clarity in writing – Cohesion & coherence in writing – Writing of definitions, descriptions & instructions – Paragraph writing – Perspective Writing – Letter Writing – Introduction to report writing

Text Books:

1 William Strunk Jr. and E.B. White "The Elements of Style", Allyn & Bacon, Pearson Education, 1999.

2 Dhanavel, S. P., "English And Communication Skills For Students Of Science And Engineering", Orient Black Swan, Chennai, 2009.

3 Geoffrey Leech, Fan Svartvik, "A Communicative Grammar of English", Pearson Education Asia, 1994.

Reference Books:

1 Krishna Mohan and Meenakshi Raman , "Effective English Communication", Tata McGraw Hill, New Delhi, 2000.

2 Golding S.R., "Common Errors in English Language", Macmillan, 1978.

3 Christopher Turk, "Effective Speaking", E & FN Spon, London, 1985**.**

Web link(s):

1 Communication - https://nptel.ac.in/courses/109/104/109104031/

2 Listening - https://learnenglish.britishcouncil.org/skills/listening

http://www.elllo.org/archive/

3 Speaking - https://nptel.ac.in/courses/109/106/109106067/

4 Reading & Vocabulary - https://nptel.ac.in/courses/109/106/109106129/ (Week 1 & 2)

5 Writing - https://www.time4writing.com/free-writing-resources/

https://www.edx.org/course/academic-and-business-writing

https://www.coursera.org/learn/advanced-writing

Course Code	:	CS101
Course Title	:	**Introduction to Computer Programming**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the basics of computers and software systems.

CO2 Discuss the various conditional control statements in C programming.

CO3 Apply the concept of arrays to solve sorting and searching problems.

CO4 Define pointers and its association with arrays and functions in C.

CO5 Develop C program with structures and perform Read-Write operations with files.

Course Content:

Introduction to Computers, Number Systems, C language: Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. Number Systems: Binary, Octal, Decimal, Hexadecimal Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

Control Statements: Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, DoWhile and Examples. Continue, Break and Goto statements Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. Recursion- Recursive Functions. Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers

Preprocessors, Arrays: Preprocessors: Preprocessor Commands Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.

Pointers, Strings: Pointers - Introduction, Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, Lvalue and Rvalue, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Commandline Arguments. Strings - Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions.

Structures, Input and Output: Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self Referential Structures, Unions, Type Definition (typedef), Enumerated Types. Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.

Text Books:

1 R G Dromey, "How to Solve It by Computer", Prentice-Hall International Series in Computer Science, 2006.

2 G. Michael Schneider, "Invitation to Computer Science", Eighth Edition, 2018

3 Byron S Gotrified, "Programming with C", Thrid Edition, McGraw Hill Companies, 2017.

Reference Books:

1 Michael Vine, "C Programming for the Absolute Beginner", Third Edition, 2014.

2 Brian W Kernighan, Dennis M. Ritchie, "C Programming Language", Second Edition, Pearson Education India, 2015

3 Herbert Schildt, "C++ Complete Reference", McGraw Hill, Fourth Edition, 2017.

Web link(s):

1 http://uru.ac.in/uruonlinelibrary/Cloud_Computing/Basics%20of%20Computer.pdf

2 https://www.tutorialspoint.com/basics_of_computers/index.htm

3 https://en.wikiBookss.org/wiki/Computers_for_Beginners/The_Basics

4 http://ecoursesonline.iasri.res.in/course/view.php?id=

5 https://www.tutorialspoint.com/cprogramming/index.htm

Course Code	:	EC151
Course Title	:	**Introduction to Electronics and Communication Engineering**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the basic properties of electrical elements, laws and parameters.
CO2 Illustrate the basic properties of semiconductor devices.
CO3 Identify different electronic circuits with semiconductor devices and electrical elements.
CO4 Explain the function of various digital logic gates and blocks.
CO5 To analyse and design of various modulation and demodulation techniques.

Course Content:

Ohms Law -Kirchhoff's Laws - steady state solution of DC Circuits - Introduction to AC circuits - Waveforms and RMS value - power and power factor, single phase and three phase balanced circuits. Principles of operation and characteristics of DC machines, Transformers - Synchronous Machines - three Phase and single phase induction motors

Classification of solids based on energy hand theory - Intrinsic semiconductors - Extrinsic semiconductors - P type and N type - P-N junction – I-V characteristics of PN junction diode - Zener diode - Zener diode characteristics - Half wave and full wave rectifiers - Voltage regulation, SCR, Diac, Triac, Characteristics and simple applications.

Bipolar junction transistor - CB, CE, CC - Configurations and characteristics - Biasing circuits - Field Effect Transistor - Configurations and characteristics - FET amplifier - UJT - characteristics and simple applications - switching transistors - concept of feedback - negative feedback - application in temperature and motor speed control.

Binary number system - AND, OR, NOT, NAND, NOR circuits - Boolean algebra - Exclusive OR gate - Half and Full adders - flip flops - registers and counters - A/D, D/A conversion - Digital computer principle.

Amplitude Modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Basic concepts of Phase Modulation, Frequency Modulation: Single tone Frequency modulation, Narrow band FM, Wide band FM, Types of Pulse modulation- PAM, PWM and PPM. Comparison of FDM with TDM.

Text Books:

1 Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education (India) Private Limited, New Delhi, 2013

2 Simon Haykin,V. K. , “Analog and Digital Communications”, John Wiley, 2005.
3 Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.

Reference Books:

1 Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11/e Pearson, 2013.
2 K. Sam Shanmugam, “Analog and Digital Communication”, Wiley, 2005.

Web link(s):

1 https://nptel.ac.in/courses/108/101/108101091/ (NPTEL Video by Dr.Mahesh B. Patil from IIT Bombay)
2 https://nptel.ac.in/courses/117/106/117106108/ (NPTEL Video by Prof. Nagendra Krishnapura from IIT Madras)

Course Code	:	ME151
Course Title	:	**Engineering Graphics**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Discuss the fundamentals and standards of Engineering drawings/ graphics

CO2 Visualize the structure of engineering components

CO3 Create geometric construction, multi-view, dimensioning and detail drawings of typical 3-D engineering objects

CO4 Develop projections, solid objects and surfaces of engineering components

CO5 Devise 3D Isometric View in relation with 2D orthographic views

Course Content:

Fundamentals Drawing standard - BIS, dimensioning, lettering, type of lines, scaling, conventions

Geometrical constructions Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and hexagon – conic sections – ellipse – parabola – hyperbola – cycloid

Orthographic projection: Introduction to orthographic projection, drawing orthographic views of objects from their isometric views - Orthographic projections of points lying in four quadrants, Orthographic projection of lines parallel and inclined to one or both planes Orthographic projection of planes inclined to one or both planes. Projections of simple solids – axis perpendicular to HP, axis perpendicular to VP and axis inclined to one or both planes.

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Intersection of surfaces: Intersection of cylinder & cylinder, intersection of cylinder and cone, and intersection of prisms

Development of surfaces: Development of prisms, pyramids, cylindrical and conical surfaces. Isometric and perspective projection: Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection

Text Books:

1 Natrajan K.V., “A text Books of Engineering Graphics”, Dhanalakshmi Publishers, Chennai,

2009.

2 Venugopal K. and Prabhu Raja V., “Engineering Graphics” New Age International (P) Limited, 2008.

3 Giesecke, F. E., Mitchell, A., Spencer, H., Hill, I., Dygdon, J., and Novak, J., “Technical drawing with engineering graphics”, 2016

Reference Books:

1 Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

2 Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

3 Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

Web link(s):

1 https://nptel.ac.in/courses/112/103/112103019/

2 http://www.iitg.ac.in/rkbc/me111.htm

Course Code	:	EC101
Course Title	:	**Electronics Laboratory**
Number of Credits	:	2
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Handle different instruments and meters.

CO2 Establish the desired connections among various electronic elements on a bread board.

CO3 Measure the current and voltages across various branches and nodes of the circuit connected on the bread board.

CO4 Observe and explain the working of various digital gates.

CO5 Illustrate the difference between measurement of analog circuits and digital circuits/logic.

List of Experiments:

1. Hands on experience of measuring instruments
2. Verification of Ohm's and Kirchhoff's laws
3. Measurement of AC parameters: Magnitude and frequency
4. Validation of characteristics of various semiconductor devices
5. Design of Half-wave and full-wave rectifiers
6. Validation of Boolean expressions
7. Verifications of various arithmetic and logical operations
8. Verification of different modulators

Course Code	:	CS102
Course Title	:	**Introduction to Computer Programming Laboratory**
Number of Credits	:	2
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Develop C program for solving basic mathematical problems.

CO2 Write C program for solving problems that require more iteration.

CO3 Construct C program for various sorting and searching algorithms.

CO4 Perform operations related to strings using C functions.

CO5 Compose file handling programs in C language.

Course Content:

1. Finding the maximum and minimum of given set of numbers
2. Finding Roots of a Quadratic Equation
3. Sin x and Cos x values using series expansion
4. Conversion of Binary to Decimal, Octal, Hexa and Vice versa
5. Generating a Pascal triangle and Pyramid of numbers
6. Recursion: Factorial, Fibonacci, GCD
7. Matrix addition and multiplication using arrays
8. Bubble Sort, Selection Sort
9. Programs on Linear Search and Binary Search using recursive and non-recursive procedures. Functions for string manipulations
10. Finding the No. of characters, words and lines of given text file
11. File Handling programs

Course Code	:	ME102
Course Title	:	**Engineering Practice**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the basic manufacturing processes of Casting, Joining, Fitting and Forming.

CO2 Use hand tools and basic machineries in Foundry, Welding shop, Carpentry, Fitting shop and Sheet Metal work

CO3 Design simple prototypes and produce engineering products.

Course Content:

Foundry: Preparation of sand mould for the following
01. Flange
02. Hand Wheel
Welding: Fabrication of metals joint of the following
01. Butt Joint
02. Lap Joint
Carpentry: Wood sizing exercise in planning, marking, sawing, chiselling and grooving to make
1. Tee through Halving Joint
2. Dovetail Scarf Joint
Fitting: Preparation of joints, markings, cutting and filling for making
1. Semi-circle part
2. Dovetail part
Sheet metal: Fabrication of simple products of the following
1. Dust Pan
2. Corner Tray

Text Books:

1 R.K. Rajput, “Workshop Practice”, Laxmi Publications (P) Limited

2 Shashi Kant Yadav, “Workshop Practice”, Discovery Publishing House, New Delhi.

3 K.C. John, “Mechanical workshop practice” PHI Learning Pvt. Ltd., (2010).

Course Code	:	**SH151**
Course Title	:	**Energy and Environmental Science**
Number of Credits	:	**0**
Prerequisites (Course code)	:	**None**
Course Type	:	**GIR**

Course outcomes: At the end of the course, the student will be able to:

CO1 Familiar with the foundational science concepts and terminology needed to understand the energy and the environment.

CO2 Analyze the demand for solar and thermal energy.

CO3 Examine the various types of pollution.

CO4 Understand the environment pollution along with social issues and acts.

CO5 Analyze the consequences of today's energy consumption for environmental degradation

Course Content:

Sources of Energy: A brief survey of various energy sources, present and future needs, energy conservation, renewable and non-renewable energy sources of the world. Estimated reserves of on renewable energy sources.

Thermodynamics of Energy Conversion: Principles of energy conversion, conversion between different forms of energy, Thermodynamics of various conversion processes and their comparison in terms of efficiency, Thermodynamic engine cycles and their efficiency.

Direct Electrical Conversion of Solar Energy: Photo voltaic effect, solar photo emissive and photo voltaic cell, Solar cell characteristics, efficiency and spectral response of solar cells, Description and comparison of different types of solar cells.

Environmental Pollution and Control: Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants, Air and water quality standards, Nuclear hazards and human health risks.

Global and Regional Environmental Issues: Global effects of air pollution – Greenhouse gases, global warming, climate change, urban heat islands, acid rain, ozone hole, Factors influencing increase in population, energy consumption, and environmental degradation.

Text Books:

1 J. Andrews, and N. Jelley, “Energy Science: Principles, Technologies and Impacts”, Oxford Universities Press, 2013.

2 J.A. Fay and D.S. Golomb, “Energy and Environment”, Oxford Universities Press, 2011.

3 An Introduction to Solar Energy for Scientist and Engineers: Sol Wieder.

Reference Books:

1 C S Rao, “Environment pollution control Engineering”, New Age International reprint 2015, 2nd edition.

2 W. C. Turner, S. Doty, and W. C. Truner, “Energy Management Hand book”, Fairmont Press 7 th Edition 2009.

3 G. Boyle, “Renewable energy: Power for a sustainable future”, Oxford University press, 2004.

SECOND SEMESTER

Course Code	:	MA151
Course Title	:	**Mathematics - II**
Number of Credits	:	3
Prerequisites (Course Code)	:	**Mathematics – I**
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Apply the concepts of gradient, divergence, and curl to solve engineering problems

CO2 Convert line integrals into area integrals and surface integrals into volume integrals

CO3 Determine the Fourier series for a given function

CO4 Change the given function into transform coefficients using Fourier transformation.

CO5 Apply Laplace transforms to solve physical problems arising in engineering

Course Content:

Vector Calculus: Scalar and Vector fields - Vector Differentiation - Level surfaces - Directional derivative - Gradient of a scalar field - Divergence and Curl of a vector field – Laplacian.

Vector Integrals: Line, surface and volume integrals; Green's theorem in a plane - Gauss Divergence theorem and Stokes' theorem.

Fourier Series: Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions

Fourier Transforms: Complex form of Fourier series -Fourier transformation and inverse transforms - sine, cosine transformations and inverse transforms - simple illustrations.

Laplace Transformation: Laplace transform - Inverse Laplace transform - properties of Laplace transforms - Laplace transforms of unit step function, impulse function and periodic function - Convolution theorem - Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform – Applications to electrical circuits.

Text Books:

1 Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, John Wiley and Sons, 2015.

2 R. K. Jain and S. R. K. Iyengar, “Advanced Engineering Mathematics”, 5th edition, Narosa Publishing House, 2016.

Reference Books:

1 B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publications, 44nd ed, 2015

2 Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Education Pvt. Ltd.

Web link(s):

1 https://nptel.ac.in/courses/111/105/111105122/

2 https://nptel.ac.in/courses/111/102/111102129/

Course Code	:	**ME101**
Course Title	:	**Basics of Mechanical Engineering**
Number of Credits	:	**2**
Prerequisites (Course code)	:	**None**
Course Type	:	**GIR**

Course outcomes: At the end of the course, the student will be able to:

CO1 Discuss the basic concepts of thermodynamics, systems, and energy resources

CO2 Explain the basic functions of internal combustion engines, refrigeration, and heat transfer in engineering applications

CO3 Select a type of power transmission system as per the application

CO4 Identify the suitable Materials for Engineering Applications

CO5 Describe the functions and operations of various conventional and advanced manufacturing processes

Course Content:

Thermodynamics: Thermodynamic system, State, Properties, Thermodynamic Equilibrium, Process and Cycle, Fundamental Units and conversions, Zeroth law of Thermodynamics, Work and Heat, First law- Cyclic process, Change of State, Limitations of First law, Thermal Reservoirs, Heat Engine, Heat Pump/Refrigerator, Efficiency/COP, Second law, PMM2, Carnot Cycle, Entropy - Example problems. Energy Sources - Conventional/Renewable.

I.C. Engines: 2-Stroke & 4-Stroke Engines, P-v Diagram; S.I. Engine, C.I. Engine, Differences, **Refrigeration**: Vapour Compression Refrigeration Cycle - Refrigerants, Desirable Properties of Refrigerants **Heat Transfer**: Modes of Heat Transfer, Thermal Resistance Concept, Composite Walls and Cylinders, and Overall Heat Transfer Coefficient - Example problems

Power Transmission: Classification of different power transmission systems, Transmission of Power, Belt Drives, Chain Drives, Gears and Gear Trains – Example problems

Engineering Materials Properties of materials, Classification of Materials, Selection of Engineering Materials, Introduction to materials structure, Applications, Testing of materials.

Manufacturing Processes: Casting - Patterns and Moulding, Hot Working and Cold Working, **Metal Forming processes:** Extrusion, Drawing, Rolling, Forging, Welding - Arc Welding & Gas Welding, Soldering, Brazing. **Advanced manufacturing**: introduction to CNC machines, laser based manufacturing processes, 3D printing.

Text Books:

1 Basant Agarwal and C.M. Agarwal, "Basic Mechanical Engineering", Wiley India Pvt. Ltd., 2008.

2 Sadhu Singh, "Basic Mechanical Engineering", S. Chand & Company Limited, 2009.

3 Praveen Kumar, "Basic Mechanical Engineering", Pearson Education, India, 2013.

Reference Books:

1 M.L. Mathur, F.S. Mehta and R.P. Tiwari, R.S. Vaishwnar, "Elements of Mechanical Engineering", Jain Brothers, New Delhi, 2008.

2 P.N. Gupta, M.P. Poonia, "Elements of Mechanical Engineering", Standard Publishers, 2004

3 C.P. Gupta, Rajendra Prakash, "Engineering Heat Transfer", NemChand Brothers, New Delhi, 1994.

Web link(s):

1 https://nptel.ac.in/courses/112/105/112105123/

2 https://nptel.ac.in/courses/112/103/112103262/

3 https://nptel.ac.in/courses/112/105/112105234/

Course Code	:	PH101
Course Title	:	**Physics**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Define the basic principles of thermodynamics and its significance.

CO2 Describe electromagnetic theory in the field of signal propagation.

CO3 Interpret various concepts and theories of waves and quantum optics.

CO4 Explain the principle of light transmission in a fiber for modern communication.

CO5 Apply the concepts of semiconductor physics in solid state electronic devices and technologies.

Course Content:

Thermodynamics: Introduction to thermodynamic system, surrounding, equilibrium, heat and work, Zeroth Law of Thermodynamics, Equation of state of ideal and real gases, Internal energy, first law and its applications enthalpy, second law, reversible and irreversible processes, Carnot cycle, entropy, Maxwell's relations, Clausius-Clayperon equation, Joule-Thomson process, Clausius inequality, entropy as a property, principle of increase of entropy. Calculation of entropy change, Third law.

Electromagnetics: Gauss's Theorem of Electrostatics, Ampere's law of Magnetostatics, EMF, Ohm's Law and laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Maxwell's Equations in free space and dielectric media, Propagation of Electromagnetic Waves in Free Space

Waves and Quantum Optics: Wave motion, Wave equation, Superposition of waves along same direction (equal frequency) and in perpendicular directions, Lissajous figures. Transverse waves, solution of wave equation, Theory of interference of light- Newton's rings, Diffraction, applications of Interference (colours of thin films). Diffraction, Fraunhoffer diffraction due to single slit, double slit and, Diffraction grating (N-slit), applications of Diffraction (List only).

Lasers and Fiber Optics: Introduction, Coherence, Spontaneous and stimulated emissions, Einstein‟s coefficients, population inversion and lasing action, laser systems: Ruby laser, HeNe Laser, semiconductor laser, Applications. Fiber Optics Introduction, numerical aperture, different types of fibres, attenuation & dispersion mechanism in optical fibers (Qualitative only), application of optical fibres, Fiber optic communication (block diagram only).

Semiconductor Physics: Energy bands; semiconductors different types, charge carriers: electrons and holes, effective mass, doping. Carrier concentration: Fermi level, temperature

dependence of carrier concentration. Drift and diffusion of carriers: excess carriers; recombination and lifetime, Hall effect, p-n Junction: depletion region, forward and reversebias, depletion and diffusion capacitances, switching characteristics; breakdown mechanisms.

Text Books:

1 M. N. Avadhanulu and P.G. Kshirsagar, "A textBooks of Engineering Physics", S. Chand and Company, New Delhi 2009

2 R.K. Gaur and S.L. Gupta, "Engineering Physics",Dhanpat Rai Publications (P) Ltd., 8th ed., New Delhi 2001.

3 R. K. Rajput, "A TextBooks of Engineering Thermodynamics" 4th Edition, L.B. Enterprizes, New Delhi 2010.

Reference Books:

1 Halliday, Resnic and Walker, "Fundamentals of Physics", John Wiley, 9 th Edition, 2011.

2 David J. GriffitSH, "Introduction to Electrodynamics", 3rd Edition, Printice Hall of India, New Delhi 2012.

3 Donald A. Neamen, "Semiconductor Physics and Devices: Basic principle", 4th Edition,, McGraw- Hill, New York 2012

Course Code	:	CS151
Course Title	:	**Introduction to python programming**
Number of Credits	:	3 (2T+2L)
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: After completion of the course, student will be able to:

CO1 Describe the basic data types and operations in Python programming language.

CO2 Explain the various conditional control statements and string manipulations in Python.

CO3 Discuss the advanced data types and built-in functions in Python.

CO4 Develop python programs for simple graphical applications.

CO5 Construct simple web applications using Django

Course Content:

Introducing Programming: Concepts of datatypes, operations Conceptual introduction: topics in computer science, algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system; installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Conditions, boolean logic, logical operators; ranges

Loops, strings, text: Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers

Datatypes: Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries. Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

Graphics, images, classes and OOPs: Simple Graphics and Image Processing: turtle module; simple 2d drawing - colors, shapes; digital images, image file formats, image processing. Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc). Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes,

data modeling; persistent storage of objects OOP, continued: inheritance, polymorphism, operator overloading (eq _, str, etc); abstract classes; exception handling, try block

Multithreading, Web development: Multithreading in Python. Concurrent threads, applications, examples. Web development; introduction to HTML, introduction to Django, models, templates, forms etc.

Text Books:

1 Kenneth Lambert, "Fundamentals of Python: First Programs", Course Technology, Cengage Learning, 2012, ISBN-13: 978-1-111-82270-5

2 Swaroop, H. "A Byte of Python". Independent, 2013. ISBN: 9781365042911

3 Pilgrim, Mark, and Simon Willison. "Dive Into Python 3". Vol. 2. Apress, 2009. ISBN: 9786612825347

Reference Books:

1 Beazley, David M. "Python essential reference". Addison-Wesley Professional, 2009. ISBN: 0672329786

2 Beazley, David, and Brian K. Jones. "Python CookBooks: Recipes for Mastering Python 3". O'Reilly Media, Inc., 2013

3 George, Nigel. "Beginning django CMS". Apress, 2015. ISBN: 978-1-4842-1669-9

Web link(s):

1 https://python.swaroopch.com/

2 https://goalkicker.com/PythonBooks/PythonNotesForProfessionals.pdf

3 https://www.w3schools.com/python/

4 https://diveintopython3.problemsolving.io/

5 https://docs.djangoproject.com/en/3.0/intro/tutorial01/

6 https://docs.python.org/3/

Course Code	:	EC152
Course Title	:	**Network Analysis**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	PC

Course Outcomes: After completion of the course, student will be able to:

CO1 Analyze the electric circuit using network theorems

CO2 Explain transient & forced response of first and second order networks.

CO3 Determine sinusoidal steady state response.

CO4 Discuss the two–port network parameters and overall response for interconnection.

CO5 Combine one port networks using Foster form, and Cauer form.

Course Content:

Network concept. Elements and sources. Kirchoff‘s laws. Tellegen‘s theorem. Network equilibrium equations. Node and Mesh method. Source superposition. Thevenin‘s and Norton‘s theorems.

First and second order networks. State equations. Transient response. Network functions. Determination of the natural frequencies and mode vectors from network functions. Millman Theorem.

Sinusoidal steady-state analysis. Maximum power-transfer theorem. Resonance. Equivalent and dual networks. Design of equalizers. Substitution Theorem.

Two-port network parameters. Interconnection of two port networks. Barlett‘s bisection theorem. Image and Iterative parameters. Design of attenuators. Network graph theory, Tree, Cutset, Incident Matrix.

Two-terminal network synthesis. Properties of Hurwitz polynomial and Positive real function. Synthesis of LC, RC and RL Networks, Foster Forms and Cauer Forms.

Text Books:

1 Hayt W. H., Kemmerly J. E. and Durbin S. M., ―Engineering Circuit Analysis, 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.

2 F.F. Kuo, ―Network analysis and Synthesis, Wiley International Edition, 2008.

3 Valkenberg V., ―Network Analysis, 3rd Ed., Prentice Hall International Edition, 2007

Reference Books:

1 B.S.Nair and S.R.Deepa, ―Network analysis and Synthesis, Elsevier,2012

2 Charles A Desoer, Ernest S Kuh, Basic Circuit Theory, McGraw Hill, 1969

3 G.K. Mithal and Ravi Mittal, Network Analysis, Khanna Publications, 1998

Web link(s):

1 https://nptel.ac.in/courses/108/105/108105159/ (NPTEL Video by Prof.Tapas Kumar from IIT Kharagpur)

2 https://nptel.ac.in/courses/108/102/108102042/ (NPTEL Video by Prof.S.C.Dutta Roy from IIT Delhi)

Course Code	:	EC153
Course Title	:	**Electron Devices and Circuits**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Illustrate the importance of four major building blocks of semiconductor devices.

CO2 Discuss the physics behind the parameters of a semiconductor device model.

CO3 Explain the transient and ac behavior of P-N junction.

CO4 Design basic amplifier and logic switches using semiconductor devices.

CO5 Describe the operations of MOSFET.

Course Content:

Semiconductors. Energy band formation in solids: charge carriers, intrinsic, extrinsic semiconductors, and effective mass. Equilibrium Carrier concentration: Fermi-Dirac statistics, charge neutrality.

Carrier transport: conductivity, Drift, Diffusion, G-R, continuity equation, Hall effect and its applications. Temperature effects. Excess carriers: optical absorption.

P-N junction: equilibrium conditions, biasing, diode models, steady-state, transient and ac behavior. Temperature effects. Break down mechanisms, applications and types of diodes. Metal-semiconductor junctions.

BJT Physics and modes of operation, threshold, biasing, BJT models, I-V characteristics, BJT as a switch and amplifier, breakdown mechanisms, non-ideal and thermal effects.

MOS capacitor: ideal and non-ideal, C-V characteristics. MOSFET: operation, models, ideal I-V characteristics, non-ideal effects, scaling, SCE introduction. Other FET devices, BiCMOS logic. Basics of semiconductor fabrication process.

Text Books:

1 Ben G Streetman, S Banerjee, “Solid state electronic devices”, (4/e) Prentice hall, 1995

2 S M Sze, “Semiconductors Devices: Physics and Technology”, (2/e), Wiley, 2002

3 M S Tyagi, “Introduction to semiconductor materials and devices”, John Wiley, 2008

Reference Books:

1 C T Sah, “Fundamentals of solid state electronics”, World Scientific Publication, 1991.

2 Y Taur and T H Ning, “Fundamentals of modern VLSI devices”, Cambridge university press, 2013.

3 Robert Pierret, “Semiconductor Device Fundamentals,” Pearson Education, 1996

Web link(s):

1 https://nptel.ac.in/courses/117/106/117106091/ (NPTEL lecture on Sold-State Devices by Prof. Karmalkar, IIT Madras)

2 https://nanohub.org/courses/PSF/fall2018 (Purdue University lecture on Semiconductor Fundamentals by Prof. Mark Lundstrom)

Course Code	:	EC154
Course Title	:	**Networks Laboratory**
Number of Credits	:	2
Prerequisites	:	None
Course Type	:	ELR

Course Outcomes: After the completion of the course, student will be able to:

CO1 Experiment network theorems in electric circuits.

CO2 Review responses of RL, RC and RLC circuits.

CO3 Design constant K high pass filter.

CO4 Demonstrate attenuators and equalizers.

CO5 Discuss the two–port network parameters and overall response for interconnection.

List of Experiments:

1 Node and Mesh Analysis to measure voltage and current

2 Verifications of Thevenin‘s and Norton‘s theorems

3 Response study of RL Circuit

4 Response study of RC Circuit

5 Response study of RLC Circuit

6 Constant K High pass Filter

7 Attenuators

8 Equalizers

9 Driving point and transfer functions of a two port network

10 LAB view implementation

Course Code	:	PH102
Course Title	:	**Physics laboratory**
Number of Credits	:	2
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Describe the basic scientific principles of the designed experiments

CO2 Practice the theoretical concepts of physics through experiments

CO3 Demonstrate experiments through various experimental setups.

CO4 Evaluate, analyze and interpret the experimental data.

CO5 Design new devices based on scientific understanding

Course Content:

1. Wavelength of laser using diffraction grating
2. Wavelength of mercury spectrum – Spectrometer
3. Radius of curvature of lens – Newton's rings
4. Numerical aperture of an optical fiber
5. Field along the axis of a circular coil
6. Measurement of temperature using thermistor
7. Thermo e.m.f by Potentiometer

THIRD SEMESTER

Course Code	:	MA201
Course Title	:	**Mathematics – III**
Number of Credits	:	3
Prerequisites (Course Code)	:	**Mathematics - II**
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Apply the Z- transform for a given sequence.

CO2 Determine the solution of a PDE by variable separable method

CO3 Calculate the series solutions for ordinary differential equations and analyze improper integrals

CO4 Transform a region to another region using conformal mapping

CO5 Evaluate real integrals using residue theorem

Course Content:

Z-transforms : Z- transform and Inverse Z-transforms – Properties – convolution theorem-simple illustrations.

Partial Differential Equations: Method of separation of variables - Solution of one dimensional wave equation, one dimensional heat conduction equation and two dimensional steady state heat conduction equation with illustrations to vibrating string, one dimensional unsteady heat flow and two dimensional steady state heat flow – Applications of PDE's.

Power Series & Improper Integrals: Review of Taylor's series – Series solution to differential equations – Gamma and Beta functions – properties – Evaluation of improper integrals

Complex Variables: Analytic function - Cauchy Riemann equations - Harmonic functions - Conjugate functions - complex integration - line integrals in complex plane - Cauchy's theorem (without proof), Cauchy's integral formula. Taylor's and Laurent's series expansions - zeros and singularities - Bilinear transformations, conformal mapping.

Residue Calculus: Residues - residue theorem, evaluation of real integrals using residue theorem.

Text Books:

1 Complex variables and its applications, R.V. Churchill, McGraw Hill, 1960.

2 Advanced Engineering Mathematics, R.K.Jain and S.R.K.Iyengar, , Narosa Pub. House, 5th ed, 2016.

3 Advanced Engineering Mathematics, Erwyn Kreyszig, John Wiley and Sons, 8th ed, 2008.

Reference Books:

1 Higher Engineering Mathematics, B.S. Grewal, Khanna Publications, 44nd ed, 2015.

2 Elements of Partial Differential Equations, I. Sneddon Tata McGraw Hill, 1972.

3 Engineering Mathematics, T.K.V. Iyengar & Others, Vol III, 9th ed, S. Chand., 2012.

4 Differential Equations, G.F. Simmons, Tata McGraw Hill, 2003.

Web link(s):

1 https://nptel.ac.in/courses/111/103/111103070/https://nptel.ac.in/courses/111/107/111107111/

https://nptel.ac.in/courses/111/103/111103021/

2 https://nptel.ac.in/courses/111/106/111106100/

Course Code	:	EC201
Course Title	:	**Electronic Circuits**
Number of Credits	:	3
Prerequisites (Course Code)	:	Network analysis and synthesis, Signals and systems, SSD
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Restate and systematically analyze any basic amplifier topology.

CO2 Indicate suitable approximations in circuits to get insight over the design.

CO3 Explain constant voltage biasing and constant current biasing in amplifier design.

CO4 Describe the importance of negative feedback in designing controlled sources and gain stabilization.

CO5 Examine stability analysis of differential amplifiers.

Course Content:

Idea of power gain and need for non-linear devices. Diode: single-port non-linearity, large-signal operating point, load line, small-signal incremental model, circuit analysis with single port non-linear elements.

Two port non-linearity, amplifier constraints, BJT/MOSFET: basic regions of operation, large signal and small signal models. CE/CS amplifier: biasing, ac coupling, incremental picture, constraints on coupling capacitances and bias resistances for gain boosting. Dependence of output current on output voltage: small-signal output conductance, self-gain of CE/CS amplifier.

Constant current biasing of CE/CS amplifier: emitter/source feedback, collector/drain feedback (diode connection), current mirror bias, resistor substitution, C/D to E/S and E/S to B/G feedback using op-amp.

Controlled sources using BJT/MOSFET: properties and advantages, VCVS as CC/CD amplifier (voltage buffer), CCCS as CB/CG amplifier (current buffer), CCVS as CE/CS amplifier with emitter/source degeneration (transimpedance amplifier), and VCCS (transconductance amplifier). Controlled sources using opamp: negative feedback and virtual short, VCVS and CCVS. Frequency response and swing limit of amplifiers. Cascade stages, cascode stages and active load for gain boosting.

Differential Amplifiers, CMRR, Differential amplifiers with active load, notion of single-stage and two opamp. Stability analysis, Condition for oscillation, Sinusoidal oscillators. Power amplifiers- class A, class B, class AB, Biasing circuits, class C and class D.

Text Books:

1 A S Sedra, K C Smith, “Microelectronic Circuits”, (6/e), Oxford, 2013.

2 B Razavi, “Design of Analog CMOS Integrated Circuits”, (2/e), McGraw-Hill Education, 2016.

Reference Books:

1 J Millman, A Grabel, “Microelectronics”, McGraw Hill, 1987.

2 D L Schilling, C Belove,”Electronic Circuits: Discrete and Integrated”, (3/e), McGraw Hill, 1989.

Web link(s):

1 https://nptel.ac.in/courses/108/106/108106084/(NPTEL Video by Dr.Nagendra Krishnapura from IIT Madras)

2 https://nptel.ac.in/courses/108/102/108102112/ (NPTEL Video by Prof. Souribrata Chatterji from IIT Delhi)

Course Code	:	EC202
Course Title	:	**Digital Principles and System Design**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	PC

Course outcomes: After completion of the course, student will be able to:

CO1 Review number systems and Boolean algebra.

CO2 Design combinational circuits with basic logic gates.

CO3 Devise sequential logic circuits with basic logic gates.

CO4 Analyze synchronous circuit using state diagrams based on Moore and Mealy configurations.

CO5 Develop Verilog HDL program for combinational and sequential logic circuits.

Course Content:

Review of number systems-representation-conversions, error detection and error correction. Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates.

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs.

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recognizer, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Introduction to Verilog HDL, Structural, Dataflow and behavioral modelling of combinational and sequential logic circuits.

Text Books:

1 D. D. Givone, “Digital Principles and Design”, Tata Mc-Graw Hill, New Delhi, 2003.

2 Wakerly J F, “Digital Design: Principles and Practices, Prentice-Hall”, 2nd Ed., 2002.

3 S.Brown and Z.Vranesic, “Fundamentals of Digital Logic with Verilog Design”, Tata Mc-Graw Hill, 2008.

Reference Books:

1 M. M. Mano, “Digital Design”, 3rd ed., Pearson Education, Delhi, 2003.

2 D.P. Leach, A. P. Malvino, Goutam Guha, “Digital Principles and Applications”, Tata Mc-Graw Hill, New Delhi, 2011.

3 R.J.Tocci and N.S.Widner, “Digital Systems - Principles& Applications”, PHI, 10th Ed., 2007.

Web link(s):

1 https://nptel.ac.in/courses/108/105/108105132/ (NPTEL Video by Prof. Gautam Saha from IIT Kharagpur)

2 https://nptel.ac.in/courses/108/105/108105113/ (NPTEL Video by Prof.Santanu from IIT Kharagpur)

Course Code	:	EC203
Course Title	:	**Signals and Systems**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Classify the signals as Continuous time and Discrete time.

CO2 Analyze the spectral characteristics of signals using Fourier analysis.

CO3 Classify systems based on their properties and determine the response of LTI system using convolution.

CO4 Identify system properties based on impulse response and Fourier analysis.

CO5 Apply transform techniques to analyze continuous-time and discrete-time signals and systems.

Course Content:

CLASSIFICATION OF SIGNALS AND SYSTEMS: Continuous time signals (CT signals), Discrete time signals (DT signals), Step, Ramp, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals. CT systems and DT systems: Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS: Response of LTI systems to Complex Exponentials, Fourier series Representation of CT periodic Signals, properties of CT Fourier Series, Fourier Series representation of DT periodic Signals, properties of DFS, Fourier series and LTI Systems, Filtering, Examples of CT filters, Examples of DT filters.

CONTINUOUS TIME FOURIER TRANSFORM: Representation of a periodic Signals by continuous time FT, FT of periodic signals, convolution and multiplication property of continuous time FT, systems characterized by Linear Constant Coefficient Differential Equations. TIME AND FREQUENCY CHARACTERIZATION OF SIGNALS AND SYSTEMS: Magnitude and phase representation of FT, Magnitude and phase response of LTI systems, Time domain and Frequency domain aspects of ideal and non-ideal filters. Laplace Transforms in analysis of Continuous time systems.

DISCRETE TIME FOURIER TRANSFORMS (DTFT): Properties of DTFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations. SAMPLING: Sampling theorem, Impulse sampling, sampling with zero order Hold, Reconstruction of signal from its samples using interpolation,

Effect of under sampling.

Z-TRANSFORM: Z-transform, Region of convergence and its properties, Inverse Z transform, properties of ZT,

Analysis and characterization of LTI systems using ZXT, LTI Systems, System function algebra and block diagram representations.

Text Books:

1 A.V.Oppenheim, A. Willsky, S. Hamid Nawab, Signals and Systems (2/e), Pearson, 2000.

2 B. P. Lathi, Linear Systems and Signals, Oxford University Press, USA, 2004.

3 Simon Haykin, Barry Van Veen, Signals and Systems, 2nd Edition, Wiley (2002).

Reference Books:

1 Robert A. Gable, Richard A. Roberts, Signals & Linear Systems, 3rd Edition, John Wiley, 1995.

2 M.J.Roberts, Signals & Systems Analysis using Transform Methods & MATLAB, Tata McGraw Hill, 2007.

3 John Alan Stuller, An Introduction to Signals and Systems, Thomson, 2007.

Web link(s):

1 https://nptel.ac.in/courses/108/106/108106075/ (NPTEL Video by Prof. V.G.K.Murti from IIT Madras)

2 https://nptel.ac.in/courses/108/104/108104100/ (NPTEL Video by Prof. Aditya from IIT Kanpur)

Course Code	:	HM251
Course Title	:	**Economics for Engineers**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1	Explain the various forms of Business and define the impact of economic variables.
CO2	Perform demand and supply analysis.
CO3	Analyze production function, cost analysis, pricing methods suitable for different market structures.
CO4	Review the elements of Financial Statements and prepare Final Accounts.
CO5	Discuss and interpret the framework for financial analysis through ratios.

Course Content:

Introduction to Business and Economics: Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance. Economics: Significance, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

Demand and Supply Analysis: Demand and Supply Analysis: Determinants, Law of Demand and supply and its exceptions. Elasticity of Demand and Supply: Definition, Types, Measurement and Significance of Elasticity of Demand and Supply. Demand and Supply Forecasting, Methods of forecasting, Factors governing forecasting.

Production, Cost, Market Structures & Pricing: Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Economies of Scale. Cost analysis: Concepts, Types, Short run and Long run Cost Functions, Break Even Analysis (BEA), Determination and Limitations. Market Structures: Nature of Competition and Markets, Features of Perfect competition, Monopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing

Financial Accounting: Financial accounting objectives, functions, importance, Accounting concepts and Conventions, Double-Entry system of Accounting, Rules for maintaining Bookss of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

Financial Analysis through Ratios: Concept of Ratio Importance, Analysis, and interpretation of Liquidity Ratios, Activity ratio, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Leverage Ratios – Analysis and Interpretation (simple problems).

Text Books:

1 Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.

2 Robert Pindyck, and Daniel Rubinfeld, "Microeconomics", 9th Edition,Pearson, 2018

3 Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

Reference Books:

1 Paresh Shah, "Financial Accounting for Management", 2e, Oxford Press, 2015.

2 Lipsey & Chrystel, "Economics", Oxford University Press, 2012.

3 S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

Web link(s):

1 https:// thenthata.web4kurd.net/mypdf/managerial-economics-and- financialanalysis

2 https://open.umn.edu/opentextBookss/textBookss/principles-of-microeconomics

Course Code	:	EC204
Course Title	:	**Data Structures and Algorithms**
Number of Credits	:	3
Prerequisites (Course Code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Compare Time Complexity and Space Complexity for algorithm.

CO2 Develop programs to implement linear data structures such as stacks, queues, linked lists, etc.

CO3 Apply the concept of trees and graph data structures in real world scenarios.

CO4 Review sorting and searching algorithms.

CO5 Decide appropriate data structure for any practical problem.

Course Content:

Introduction: Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: Representations and applications.

Linked list, Stacks, and Queues: Linked Lists - Linked stacks and queues - Operations on polynomials - Doubly linked lists - Circularly linked lists - Dynamic storage management - Garbage collection and compaction.

Trees: Binary Trees - Binary search trees - Tree traversal - Expression manipulation - Symbol table construction - Height balanced trees – AVL trees - Red-black trees.

GrapSH: GrapSH - Representation of grapSH - BFS, DFS - Topological sort. String representation and manipulations - Pattern matching.

Sorting and Searching: Sorting Techniques - Selection, Bubble, Insertion, Merge, Heap, Quick, and Radix sort - Address calculation - Linear search - Binary search - Hash table methods.

Text Books:

1 J. P. Tremblay and P. G. Sorenson, “An Introduction to Data Structures with applications”, Second Edition, Tata McGraw Hill, 1981

2 M. Tenenbaum and Augestien, “Data Structures using C”, Third Edition, Pearson Education 2007

3 Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd edition, Addison Wesley Educational Publishers, 2006.

Reference Books:

1 Alfred V. Aho, John E. Hopcroft, Jeffrey D.Ullman, “Data Structure and Algorithms”, Second Edition, Pearson Education, 2009

2 Sara Baase and Allen Van Gelder, “Computer Algorithms - Introduction to Design and Analysis”, Third Edition, Pearson Education, 2008.

3 Sartaj Sahni, “Data Structures, Algorithms and Applications in C++”, Universities Press (I) Pvt. Ltd.

Web link(s):

1 https://courses.cs.washington.edu/courses/cse373/20sp/

2 https://nptel.ac.in/courses/106/102/106102064/

Course Code	:	EC205
Course Title	:	**Electronic Circuits Laboratory**
Number of Credits	:	2
Prerequisites(Course Code)	:	Devices and networks lab
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to:

CO1	Illustrate stable biasing techniques for BJT and MOSFET on breadboard
CO2	Design single stage amplifiers with desired gain using BJT and MOSFET
CO3	Predict controlled sources in negative feedback ensuring stability
CO4	Interpret the frequency response of the amplifiers with respect to the circuit elements and transistor internal components
CO5	Simulate the internal circuitry of a single stage opamp

List of Experiments:

1. Quiescent Point Stabilization in BJT and MOSFET
2. Single-Stage Common-Source Amplifier
3. Single-Stage RC-Coupled Common-Emitter Amplifier
4. Unity Gain VCVS Using BJT in a Negative Feedback
5. Unity Gain CCCS Using BJT in a Negative Feedback
6. Simulating a CS/CE Amplifier with Current Mirror Bias and Active Load
7. Study on Cascade Amplifiers with MOSFET and BJT
8. Study on Cascode Amplifiers with MOSFET and BJT
9. Study on Differential Amplifier using MOSFET and BJT
10. Design and simulation of a Single-Stage Op-Amp Circuits

Course Code	:	EC206
Course Title	:	**Digital Principles and System Design Laboratory**
Number of Credits	:	2
Prerequisites (Course Code)	:	None
Course Type	:	ELR

Course outcomes: After completion of the course, student will be able to:

CO1 Validate the Boolean laws using digital ICs.

CO2 Develop logic circuit for combinational circuits and assess the functions using ICs.

CO3 Perform logic shifting for sequential circuits and test the functions using ICs.

CO4 Evaluate logic level counting for sequential circuits using flipflops.

CO5 Demonstrate the implementation of digital circuits using Verilog HDL.

List of Experiments:

1. Study of logic gates and verification of Boolean Laws.
2. Design of adders and subtractors.
3. Design of code converters.
4. Design of Multiplexers.
5. Design of De-multiplexers.
6. Design of Encoder and Decoder.
7. 2-bit and 8-bit magnitude comparators.
8. Design of flip-flops.
9. Design and implementation of counters using flip-flops.
10. Design and implementation of shift registers.
11. Implementation of digital circuits using Verilog HDL

FOURTH SEMESTER

Course Code	:	MA252
Course Title	:	**Probability and Random Processes**
Number of Credits	:	4
Prerequisites (Course Code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the axiomatic formulation of modern probability theory.

CO2 Describe probability models and functions of random variables.

CO3 Evaluate and apply moments & characteristic functions of multiple random variables.

CO4 Determine covariance and spectral density of stationary random processes.

CO5 Discuss the concept of Gaussian processes for linear systems application.

Course Content:

Sample Space and Probability: Sets, Probabilistic Models, Conditional Probability, Total Probability theorem and Baye's Rule, Independence, and Counting.

Random Variables: Probability mass functions (PMFs), Probability density functions (PDFs), Cumulative distribution functions (CDFs), Functions of random variables, Expectation and variance, Joint PMFs and PDFs of multiple random variables, Conditioning, and independence. Bernoulli, Binomial, Geometric, Poisson, Exponential, and Normal Random variables.

Multiple Random Variables: Moments, Derived distribution, Covariance and Correlation, transforms and characteristic functions, Chebyshev and Schwartz inequality, and Convergence concepts.

Random Processes – Temporal Characteristic: Concept, Stationarity and independence, Correlation functions, Gaussian random process, Bernoulli Process, Poisson random process

Random Processes – Spectral Characteristic: Power Density spectrum and its properties, Relationship between power spectrum and autocorrelation function, Cross-power density spectrum, Cross power spectrum and cross-correlation function, White and colored noise, Linear systems with random inputs.

Text Books:

1 Dimitri P. Bertsekas and John N. Tsitsiklis, Introduction to probability, Athena Scientific, Belmount, Masschusetts, 2008.

2 Peyton Z. Peebles Jr. - Probability, Random Variables, and Random Signal Principles, McGraw-Hill, 2000.

3 Henry Stark, John W. Woods, Probability and Random Processes with Applications to Signal Processing-Prentice Hall, 2001

Reference Books:

1 Davenport, Probability and Random Processes for Scientist and Engineers, McGraw-Hill, 1970.

2 Papoulis. A, Probability Random variables and Stochastic Processes, McGraw-Hill, 2002.

3 Jim Pitman, Probability, Springer, 1993.

Web link(s):

1 https://ocw.mit.edu/resources/res-6-012-introduction-to-probability-spring-2018/

2 https://www.youtube.com/channel/UC3l1RPdC7259bQZ8JWQYdrw

Course Code	:	EC251
Course Title	:	**Digital Signal Processing**
Number of Credits	:	3
Prerequisites (Course code)	:	Signals and Systems
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Calculate DFT of a given signal through Fast Fourier Transform Techniques.

CO2 Design FIR and IIR type digital filters.

CO3 Identify filter structures and evaluate the coefficient quantization effects.

CO4 Discuss sample rate conversion techniques.

CO5 Compare the architectures of DSP and General Purpose Processors.

Course Content:

Discrete Fourier Transform: Discrete Signals and Systems, A Review, Introduction to DFT, Properties of DFT, Circular Convolution, Filtering methods based on DFT, FFT Algorithms, Decimation in time Algorithms, Decimation in frequency Algorithms, Use of FFT in Linear Filtering.

IIR Filter Design: Structures of IIR, Analog filter design, Discrete time IIR filter from analog filter, IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives (LPF, HPF, BPF, BRF) filter design using frequency translation.

FIR Filter Design: Structures of FIR, Linear phase FIR filter, Fourier Series, Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques, Finite word length effects in digital Filters, Errors, Limit Cycle, Noise Power Spectrum.

Multirate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D.

DSP Processors: TMS 320X/ ADSP 21XX Architecture and Applications.

Text Books:

1 J. G. Proakis & D. G. Manolakis, Digital Signal Processing, Principles, algorithms & Applications, PHI, 2000.

2 S. K. Mitra, Digital Signal Processing – A computer Based Approach, 2nd Edition, MGH, 2001.

3 Reference Manuals of Texas TMS 320X and Analog Devices 21XX Processors

Reference Books:

1 Emmanuel C. Ifeachor, & Barrie. W. Jervis, Digital Signal Processing, Second Edition, Pearson Education Prentice Hall, 2002.

2 A. V. Oppenheim, R. W. Schafer and J. R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, 2004.

3 Andreas Antoniou, Digital Signal Processing, Tata Mc Graw Hill, 2006.

Web link(s):

1 https://nptel.ac.in/courses/117/102/117102060/ (NPTEL Video by Prof. S.C.Dutta Roy from IIT Delhi)

2 https://nptel.ac.in/courses/108/106/108106151/ (NPTEL Video by Prof.C.S.Ramalingam from IIT Madras)

Course Code	:	EC252
Course Title	:	**Analog Integrated Circuits**
Number of Credits	:	3
Prerequisites (Course Code)	:	Networks analysis, Electronic circuits
Course Type	:	PC

Course Outcomes: After the completion of the course, the student will be able to:

CO1 Describe the characteristics of op-amp and design op-amp circuits to perform arithmetic operations.

CO2 Design linear and non-linear applications using op-amps.

CO3 Apply filters and voltage regulators using functional ICs.

CO4 Evaluate the functions of timer functional ICs.

CO5 Choose appropriate A/D and D/A converters for signal processing applications.

Course Content:

Introduction to op-amps: ideal Characteristics, Pin configuration of 741 op-amp. Bias, offsets and drift, bandwidth and slew rate. Offset and Frequency compensation. Exercise problems. Practical op amps, Basic building blocks: Current sources and active loads

Linear and non-linear applications of op-amps: Inverting and non-inverting amplifiers, Applications: inverting and non- inverting summers, difference amplifier, differentiator and integrator, Voltage to current converter. Instrumentation amplifier, Log and antilog amplifiers. Precision rectifier, Non-linear function generator. Analog IC Multipliers, Comparators, Astable and Monostable multi vibrator, Wave form- generators: Triangular, and Sine-RC-phase shift oscillator, Wein's bridge oscillator

Active filters: Low pass, High pass, Band pass and Band Reject filters. IC voltage regulators: IC 723 general purpose regulator, Switching Regulator.

Timers & phase locked loops: 555 Timer functional diagram, monostable and astable operation, applications. PLL- basic block diagram and operation, capture range and lock range; applications of PLL IC 565, AM detection, FM detection and FSK demodulation. VCO IC 566.

Digital to analog and analog to digital converters: Weighted resistor DAC, R-2R and inverted R-2R DAC. Counter type ADC, successive approximation ADC, Flash ADC, dual slope ADC, sigma-Delta ADC.

Text Books:

1 G B Clayton, Operational Amplifiers, 5th Edition, Elsevier science, 2003

2 Sergio Franco, Design With Operational Amplifier and Analog Integrated Circuits, 4th Edition, TMH, 2011.

3 Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4th Edition, New Age International Publishers, 2010

4 Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th Edition, PHI, 2010.

Reference Books:

1 Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004

2 Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.

Web link(s):

1 https://nptel.ac.in/courses/108/108/108108125/ (NPTEL Video by Prof.Hardik J Pandya from IISC Bangalore)

2 https://nptel.ac.in/courses/108/108/108108114/ (NPTEL Video by Prof.Hardik J Pandya from IISC Bangalore)

Course Code	:	EC253
Course Title	:	**Engineering Electromagnetics**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Describe basic electrostatic theorems and laws and derive them.

CO2 Discuss the behavior of electric fields in matter.

CO3 Use Magnetostatics theorems and laws to infer the magnetic properties of matter.

CO4 Explain the basic theorems of electrodynamics and its derivation.

CO5 Interpret electromagnetic wave equation and wave polarization.

Course Content:

Electrostatics: Coulomb's law – Vector Form - Electric Field Intensity - flux Density - Gauss's law and applications - Electrostatic potential - Poisson's and Laplace equations.

Electrostatic fields in matter: Electric properties of matter – Electric current – Current density – point form of ohm's law – continuity equation for current. Dielectrics and dielectric polarization - Capacitors with dielectric substrates - Boundary conditions for electric fields - Force and energy in dielectric systems.

Magnetostatics: Magnetic fields of steady currents -Biot- Savart's and Ampere's laws and simple applications - Magnetic flux density, Inductance of loops and solenoids, The Lorentz force equation for a moving charge and applications – Magnetic moment – Magnetic vector potential - Magnetic boundary conditions, Magnetic properties of matter.

Electrodynamics: Flux rule for motional emf - Faraday's law - Self and mutual inductances - Maxwell's equations in integral form and differential form - Poynting theorem -Poynting Vector

Electromagnetic wave propagation: Wave Equation -Uniform plane waves - Reflection and refraction - Wave polarization –types - Dependence on Polarization - Brewster angle.

Text Books:

1 Hayt, WH. And Buck,J.A.,"EngineeringElectromagnetics",7thEdition,TMH, 2009

2 D.J. Griffiths Introduction to Electrodynamics (4/e), Addison-Wesley, 2012

3 E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems" PHI Learning, 2ndedition 2011

Reference Books:

1 J.D. Krauss, "Electromagnetics", Fourth edition ,McGraw Hill,1999

2 MathewN.O.Sadiku,"ElementsofEngineeringElectromagnetics",5thEdition, Oxford University Press , 2009.

3 Narayana Rao, N., "Elements of Engineering Electromagnetics", 6th Edition, Pearson Education, 2009.

Web link(s):

1 https://swayam.gov.in/nd1_noc20_ee93/preview (SWAYAM Video by Prof.Pradeep Kumar from IIT Kanpur)

2 https://www.coursera.org/learn/electrodynamics-introduction (Course from Coursera by Seungbum Hong from KAIST)

Course Code	:	EC254
Course Title	:	**Control Systems**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Represent a complicated system in a simplified form using algebraic equations.

CO2 Employ time domain analysis to predict transient response parameters of systems.

CO3 Apply the concepts of various system stability criteria.

CO4 Illustrate different specifications of the system in frequency domain.

CO5 Design various transfer functions of digital control systems using state variable models.

Course Content:

Concepts of Control Systems- Open Loop and closed loop control systems and examples- Feedback Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions. Block diagram representation of systems considering electrical systems as examples – Representation by Signal flow graph - Reduction using mason's gain formula.

Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems – Steady state response - Steady state errors and error constants

The concept of stability – Ruth's stability criterion – qualitative stability and conditional stability – limitations of Ruth's stability. Root locus concept - construction of root loci

Frequency domain Specifications-Bode diagrams- Phase margin and Gain margin - Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots Stability Analysis. Compensation techniques – Lag, Lead, and Lead-Lag.

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

Text Books:

1 K. Ogata, Modern Control Engineering, (5/e), PHI, 2009.

2 B.C. Kuo, Automatic Control Systems, (9/e), PHI, 2009.

3 K. Morris, An Introduction to Feedback Control, Academic Press, 2001

Reference Books:

1 R.C. Dorf& R.H. Bishop, Modern Control Systems (8/e), Pearson, 1999.

2 M.Gopal, ―Control System – Principles and Design‖, Tata McGraw Hill, 4th Edition, 2012.

3 S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

Web link(s):

1 https://nptel.ac.in/courses/107/106/107106081/ (NPTEL Video by PROF. C.S. Shankar Ram from IIT Madras)

2 https://nptel.ac.in/courses/108/106/108106098/ (NPTEL Video by Prof. Ramakrishna from IIT Madras)

Course Code	:	EC255
Course Title	:	**Computer Networks**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Describe the architecture of network hardware and software.

CO2 Summarize the functions of Datalink layer.

CO3 Review the functions of Network layer.

CO4 Define the elements of transport layer.

CO5 Explain the functions of application layer.

Course Content:

Introductory Concepts - Network hardware - Network software – Review of Physical layer - Guided transmission media - Cable television

Data Link Layer - Design issues - Channel allocation problem - Multiple access protocols - Ethernet - Wireless LAN - 802.11 architecture

Network Layer - Design issues - Routing algorithms - Congestion control algorithms - Quality of Service - Internetworking

Transport Layer - Transport service - Elements of transport protocols - User Datagram Protocol - Transmission Control Protocol

Application Layer - DNS - Electronic mail - World Wide Web - Multimedia

Text Books:

1 Forouzan, B.A., “Data Communication and Networking”, 4th Ed., Tata McGraw-Hill,2012

2 Tanenbaum, A.S, “Computer Networks”, 4th Ed., Pearson Education,2010

3 Stallings W., “Data and Computer Communication”, 8th Ed., Prentice-Hall,2010

Reference Books:

1 Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Ed., Addison Wesley.,2009

2 Comer, D.E. and Droms, R.E., “Computer Networks and Internets”, 4th Ed., Prentice-Hall.

3 LL Peterson, BS Davie, Computer Networks: A Systems Approach, 5th Ed., Morgan-Kauffman, 2011

Web link(s):

1 https://nptel.ac.in/courses/106/106/106106091/ (Prof. Sujoy Ghosh from IIT Kharagpur)

2 http://www.cs.cmu.edu/~srini/15-441/F06/syllabus.html (David Anderson from Carnegie Mellon University)

Course Code	:	EC256
Course Title	:	**Digital Signal Processing Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to:

CO1 Experiment various discrete signals.

CO2 Design and implement FIR filter and IIR filter.

CO3 Demonstrate Bayes and Min-max techniques.

CO4 Describe the various addressing modes and basic operations of TMS320C54X Processor.

CO5 Produce wave pattern and apply FIR filter implantation in the processor.

List of Experiments:

MATLAB Experiments

1. Generation of various discrete time signals.
2. Realization of correlation of two discrete signals
3. Study of linear and circular convolution.
4. Realization of sub band filter using linear convolution
5. Design and implementation of FIR filter
6. Design and implementation of IIR filter
7. Realization of STFT using FFT
8. Demonstration of Bayes technique
9. Demonstration of Min-max technique
10. Realization of FIR Wiener filter

TMS320C54X Processor Experiments

11. Study of various addressing modes
12. Sequence generation and number sorting
13. Convolution using overlap add and overlap save methods

14 Wave pattern generation

15 FIR filter implementation

Course Code	:	EC257
Course Title	:	**Analog Integrated Circuit Laboratory**
Number of Credits	:	2
Prerequisites (Course Code)	:	Electronic circuits laboratory
Course Type	:	ELR

Course Outcomes: After the completion of the course the student will be able to:

CO1 Measure the parameters of IC741 Op-amp.

CO2 Use Op-amp to design analog filters.

CO3 Design the waveform generators using op-amp.

CO4 Develop monostable and astable multivibrators using 555 IC.

CO5 Devise voltage regulator using IC723.

List of Experiments:

1 Measurement of op-amp parameters: (i) Offset voltage, (ii) Offset current, (iii) CMRR and (iv) Slew rate

2 Frequency response of inverting and non-inverting amplifier

3 Difference amplifier, differentiator and integrator

4 Square and Triangular wave- generators

5 Oscillators

6 Analog Filters

7 Op-amp monostable and astable multivibrators

8 Low voltage regulator IC 723

9 555 Timer

10 555 timer: Monostable and astable multivibrators

11 PLL IC 565

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FIFTH SEMESTER

Course Code	:	EC301
Course Title	:	**Communication Engineering**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Discuss the basics of communication system and analog modulation techniques.

CO2 Apply the basics of signals and systems to understand the concept of frequency modulation.

CO3 Determine the impact of noise in communication system.

CO4 Examine the effect of noise performance in FM systems.

CO5 Explain TDM and Pulse Modulation techniques.

Course Content:

Amplitude Modulation: Basic blocks of Communication System, Amplitude (Linear) Modulation – AM, DSB-SC, SSB and VSB, Comparison. Methods of generation and detection, Frequency division Multiplexing (FDM).

Angle Modulation: Phase and frequency modulation, Narrow Band and Wind band FM, Spectrum, FM modulation and demodulation, FM Discriminator, PLL as FM Demodulator, Transmission bandwidth. Super Heterodyne Receivers

Noise Characterization: Review of Random Process, Transmission of Random Process through an LTI filter, PSD, Properties of PSD. Gaussian Process, Noise, Narrow Band Noise, Noise Figure, Noise Bandwidth, Noise Temperature. Noise in AM Receivers, Noise DSB-SC, Noise in SSB Receivers.

Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.

Pulse Modulation techniques: Sampling Process, PAM, PWM and PPM concepts, Methods of generation and detection. TDM. Noise performance.

Text Books:

1 S.Haykins, Communication Systems, Wiley, 4th Edition, 2009.

2 John G. Proakis and Masoud Salehi, Communication Systems Engineering, 2nd Edition, 2001.

3 Kennedy, Davis, Electronic Communication Systems, 4th Edition, McGraw Hill, 2008.

Reference Books:

1 B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.

2 A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems, 4th Edition, McGraw Hill New York, 2002.

3 J. S. Beasley & G. M. Miler, Modern Electronic Communication, 9th Edition, Prentice-Hall, 2008.

Web link(s):

1 http://www.nptelvideos.in/2012/11/communication-engineering.html (NPTEL Video by Prof.Surendra Prasad from IIT Delhi)

2 https://nptel.ac.in/courses/117/105/117105143/ (NPTEL Video by Prof.Goutam Das From IIT Kharagpur)

Course Code	:	EC302
Course Title	:	**Antenna and Propagation**
Number of Credits	:	3
Prerequisites (Course code)	:	Engineering Electromagnetics
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Apply electromagnetic theory and fundamentals to estimate antenna parameters.

CO2 Analyze the characteristics of receiving antenna and linear antennas.

CO3 Assess the need for antenna arrays and mathematically analyze the types of antenna arrays.

CO4 Distinguish primary from secondary antennas and analyze their characteristics.

CO5 Review the factors involved in the propagation of radio waves using practical antennas.

Course Content:

Antenna Fundamentals: Introduction to antennas & its significance, Scalar electric potential, vector magnetic potential, radiation from an alternating current element, Induction field, radiation field, power radiated by a current element, Definition of electric dipole, radiation by a half wave dipole. Power by a half wave dipole & its radiation resistance, Radiation from a quarter wave monopole Power radiation and radiation resistance of dipole & monopole (approximate analysis), Radiation resistance of aerials and loop, problems Isotropic radiator, network theorem, application of network theorem to antennas

Antenna Parameters: Radiation pattern, power pattern, field pattern Radiation intensity, Antenna impedance, mutual impedance, gain and directivity, bandwidth, Polarization, efficiency, effective length, area or aperture, scattering loss, collecting aperture, physical aperture-relation between large aperture and gain Effective aperture of a small elementary dipole, half wave antenna, effective length, front to back ratio, Antenna beam width and side lobes. Friss Transmission formula, Radar range equation

Antenna arrays - Array factorization - Array parameters - Broad side and end fire arrays - Yagi-Uda arrays - Log-periodic arrays

Aperture antenna - Fields as sources of radiation - slot antenna - Horn antennas - Babinet‟s principle - Parabolic reflector antenna – lens antenna-Phased array antennas, Smart antennas – switched beam and adaptive arrays-UWB antennas- RFID Antennas- Wearable antennas-Reconfigurable antennas.

Antenna Measurements: Radiation pattern measurements Measurement of antenna beam width and gain, Polarization measurements. Measurement of radiation resistance-Measurement

of S parameter, Anechoic chamber-

Wave Propagation: Types of wave propagation, space wave propagation and line of sight distance for flat and curved surfaces

Text Books:

1 John D. Kraus, Antennas, 5nd Edition, McGraw Hill, 2017

2 Constantine. A. Balanis ”Antenna Theory Analysis and Design” Wiley student edition,2006

3 Rajeswari Chatterjee, ”Antenna Theory and Practice” Revised Second edition, New Age international Publishers,2006

Reference Books:

1 S.Drabowitch,”Modern Antennas” Second edition, Springer Publications,2007

2 Robert S.Elliott ”Antenna theory and Design” Wiley student edition,2006

3 Annaprna Das, Sisir K Das, “Antenna and wave propagation” McGraw Hill, 2012

Web link(s):

1 https://swayam.gov.in/nd1_noc20_ee20/preview (SWAYAM Video by Prof. Girish Kumar from IIT Bombay)

2 https://nptel.ac.in/courses/117/107/117107035/(NPTEL Video by Dr. Amalendu Patnaik from IIT Roorkee)

Course Code	:	EC303
Course Title	:	**Embedded Systems**
Number of Credits	:	3
Prerequisites (Course code)	:	Digital principles and system design
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Describe the overall landscape and characteristics of embedded systems.

CO2 Summarize the architecture and programming aspects of the embedded processor.

CO3 Develop application software for embedded systems using RTOS functions.

CO4 Review Linux capabilities and develop embedded Linux systems.

CO5 Analyze various embedded systems applications.

Course Content:

Introduction to Embedded Computing: Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process. Embedded System Architecture: Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture (ATOM processor, Introduction to Tiva family etc.)

Designing Embedded Computing Platform: Bus Protocols, Bus Organization, Memory Devices and their Characteristics, Memory mapped I/O, I/O Devices, I/O mapped I/O, Timers and Counters, Watchdog Timers, Interrupt Controllers, Interrupt programming, DMA Controllers, GPIO control, A/D and D/A Converters, Need of low power for embedded systems, Mixed Signals Processing

Programming Embedded Systems: Basic Features of an Operating System, Kernel Features, Real-time Kernels, Processes and Threads, Context Switching, Scheduling, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Dynamic Allocation, Device Drivers, Real-time Transactions and Files, Realtime OS (VxWorks, RT-Linux, Psos).

Network Based Embedded Applications: Embedded Networking Fundamentals, Layers and Protocols, Distributed Embedded Architectures, Internet-Enabled Systems, IoT overview and architecture, Interfacing Protocols (like UART, SPI, I2C, GPIB, FIREWIRE, USB,). Various wireless protocols and its applications: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, WiFi. CAN. Overview of wireless sensor networks and design examples

Case studies: Embedded system design using ATOM processors, Galileo and Tiva based embedded system applications.

Text Books:

1 Wayne Wolf, "Computers as Components- Principles of Embedded Computing System Design", Morgan Kaufmann Publishers, Second edition, 2008

2 C.M. Krishna, Kang G. Shin, "Real time systems", Mc- Graw Hill, 2010

3 Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.

Reference Books:

1 Tim Wilmshurst, "The design of Small –Scale Embedded Systems, Palgrave, 2003.

2 K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009

3 Marwedel Peter, "Embedded System Design, Kluwer Publications, 2004

Web link(s):

1 https://swayam.gov.in/nd1_noc20_ee98/preview (SWAYAM NPTEL Video by Prof.Dhananjay from Netaji Subhas University of Technology)

2 https://nptel.ac.in/courses/106/105/106105159/(NPTEL Video by Prof. Anupam Basu from IIT Kharagpur)

Course Code	:	EC304
Course Title	:	**Digital Communication**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Convert analog signals into digital signals using PCM.

CO2 Compute probability of error and inter symbol interference from eye diagram in data transmission.

CO3 Explain the power spectra of digital modulated signals.

CO4 Describe various digital demodulation schemes.

CO5 Design encoder and decoder schemes for error control.

Course Content:

Digital Representation of Analog Signals: Introduction, Analog communications versus digital communications, Pulse code modulation (PCM), Differential Pulse code modulation (DPCM), Delta modulation (DM), Adaptive delta modulation (ADM), Quantization Noise in PCM and DM.

Baseband Transmission: Properties of Line codes, Power spectral density of unipolar / polar RZ & NRZ, Bipolar NRZ, Manchester. ISI, Nyquist criterion for distortionless transmission, Pulse shaping, Correlative coding, Mary schemes, Eye pattern, Equalization.

Digital Modulation Scheme: Geometric Representation of signals, Binary baseband digital modulation, M-ary baseband digital modulation. Passband Modulation: Amplitude shift keying (ASK), Frequency shift keying (ASK), Phase shift keying (PSK), Quadrature phase shift keying (QPSK), Offset-QPSK, Minimum Shift Keying (MSK), Passband waveforms for M-ary signaling, Passband modulations for band limited channels.

Digital Demodulation Scheme: Matched filters, Correlation Receivers, Coherent demodulation of binary waveforms, noncoherent demodulation of binary waveforms, Rayleigh and Ricean probability distributions, Error rates of non-coherent signaling, Demodulators for M-ary orthogonal signaling, Error rates for M-ary orthogonal signaling.

Information Theory And Error Control Coding: Introduction to information theory, Source coding, Error free communication over a noisy channel, the concept of channel capacity. Channel coding theorem, Linear Block codes, Hamming codes, Cyclic codes, Convolutional codes, Vitterbi Decoder.

Text Books:

1 Richard E. Blahut, Modem Theory An Introduction to Telecommunications, Cambridge University Press, 2009

2 S. Haykin, Digital Communications, John Wiley, 2005.

3 J.G Proakis, Digital Communication, 4th Edition, Tata Mc Graw Hill Company, 2001.

Reference Books:

1 B. Sklar, Digital Communication Fundamentals and Applications, 2nd Edition, Pearson Education, 2009

2 B.P.Lathi, Modern Digital and Analog Communication Systems, 3rd Edition, Oxford University Press, 2007.

3 Amos Lapidoth, "A Foundation in Digital Communications," Cambridge University Press, 2009.

Web link(s):

1 https://nptel.ac.in/courses/108/102/108102096/ (NPTEL Video by Prof. Surendra Prasad from IIT Delhi)

2 https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/

Course Code	:	EC305
Course Title	:	**Digital Communication Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to :

CO1	Practice AM modulation and demodulation to evaluate their performance.
CO2	Determine sampling rates to reconstruct the signals through signal sampling.
CO3	Produce digital modulation signals for ASK, PSK and FSK using soft tool and evaluate their performance.
CO4	Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER.
CO5	Demonstrate wireless communication system using Wi-Comm Kit.

List of Experiments:

1. AM Modulation and Demodulation
2. DSB-SC Modulation
3. Pulse Amplitude Modulation and Demodulation
4. Pulse Width Modulation and Demodulation
5. Pulse Position Modulation using PLL(IC 565)
6. Amplitude Shift Keying (ASK) Modulation and Demodulation
7. Frequency Shift Keying (FSK) Modulation and Demodulation
8. Frequency Multiplier using PLL
9. Analog and digital modulation using COMMSIM simulation tool
10. Analog and digital modulation using MATLAB
11. Study of wireless communication system using Wi-Comm Kit

Course Code	:	EC306
Course Title	:	**Embedded Systems Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to:

CO1 Practice the programs in microcontroller.

CO2 Use various interfacing kits with microcontroller.

CO3 Connect various peripheral devices I/O with microcontroller.

CO4 Perform various process and scheduling in RTOS.

List of Experiments:

I Basic programming of micro controllers Study of the architecture and instruction set of popular micro controllers (8 bit, 16 bit, 32 bit processors)

1. Assembler and Embedded Programming

2. High level language programming (C, C++) and porting it on a processor

II. Interfacing experiments using microcontrollers

1. Using interrupts and interfacing clocks.

2. Interfacing peripheral devices / IO.

3. Motor speed control

III. RTOS Experiments

1. Introduction to Real-Time /Embedded Operating Systems.

2. Process Management & Inter Process Communication

3. Memory management

4. I/O subsystem

5. Real Time Scheduling

SIXTH SEMESTER

Course Code	:	EC351
Course Title	:	**VLSI System Design**
Number of Credits	:	3
Prerequisites (Course code)	:	Digital Principles, SSD
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Define the fabrication, operation and characteristics of MOSFET.

CO2 Analyze the performance of CMOS inverter.

CO3 Design digital circuits using CMOS gates.

CO4 Discuss the characteristics of VLSI circuits such as area, speed and power dissipation.

CO5 Explain the importance of placement, floorplan, and routing in VLSI circuits.

Course Content:

Unit process steps of CMOS technology and Fabrication process flow. Structure and operation of the MOS transistor, I-V and C-V characteristics, MOSFET capacitances, layout, design rules, stick diagram. Scaling and Short channel effects.

Inverters with resistive, MOSFET load; CMOS inverter: Voltage transfer characteristics, Noise margins, switching characteristics, calculation of delay times; effect of load on switching characteristics and driving large loads, logical effort of patSH

Pseudo NMOS, Pass transistor, transmission gates, Dynamic logic, Domino logic, Differential cascode voltage switch logic, design of combinational circuits, design of sequential circuits, timing requirements.

Introduction to hardware description language (HDL) Verilog/VHDL. A logic synthesis example. Introduction to VLSI Design, Different types of VLSI design styles: Full custom, standard cell based, gate array based, programmable logic, field programmable gate arrays etc. Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

Floor-planning and Placement: I/O and power planning, clock planning. Routing: global and detailed. Example design technique: mapping of architecture to silicon

Text Books:

1 D.A. Pucknell and K. Eshraghian, Basic VLSI Design, PHI Learning Private Limited, 2013.

2 N.H.E. Weste, D. Harris and A. Banerjee, CMOS VLSI Design: A Circuits and Systems Perspective, Third Edition, Pearson, 2006.

Reference Books:

1 Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004.

2 M.J.S. Smith, Application Specific Integrated Circuits, Addison-Wesley Pub. Co., 1997.

3 Samir Palnitkar, "Verilog HDL", First Edition, Prentice Hall India Private Limited, 2003.

Web link(s):

1 https://nptel.ac.in/courses/117/101/117101058/ (NPTEL Video by Prof. A.N. Chandorkar from IIT Bombay)

2 https://nptel.ac.in/courses/108/106/108106158/ (NPTEL Video by Prof.Janakiraman from IIT Madras)

Course Code	:	EC352
Course Title	:	**Optical Communication**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the propagation of signal through Fiber cable.

CO2 Describe the various modes of propagation and its importance.

CO3 Illustrate the functions of optical sources and detectors.

CO4 Discuss the implementation of fiber optic systems.

CO5 Summarize the functions of optical networks.

Course Content:

Introduction: Ray theory transmission- Total internal reflection-Acceptance angle –Numerical aperture – Skew rays – Electromagnetic mode theory of optical propagation –EM waves – modes in Planar guide – phase and group velocity – cylindrical fibers –SM fibers

Transmission characteristics of optical fibers: Attenuation – Material absorption losses in silica glass fibers – Linear and Non linear Scattering losses - Fiber Bend losses –Intra and inter Modal Dispersion – Polarization. Optical fiber connectors, Fiber alignment and Joint Losses – Fiber Splices– Fiber connectors – Expanded Beam Connectors – Fiber Couplers.

Sources and Detectors Optical sources: Light Emitting Diodes - LED structures - surface and edge emitters, internal - quantum efficiency, injection laser diode structures - comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties.

Fiber Optic Receiver and Measurements: Fundamental receiver operation, Pre amplifiers, Error sources – Receiver Configuration – Probability of Error – Quantum limit. Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber numerical Aperture Measurements – Fiber diameter measurements.

Optical Networks: Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Non linear effects on Network performance – Performance of WDM , EDFA system – Solitons – Optical CDMA – Ultra High Capacity Networks.

Text Books:

1 G. Keiser, Optical Fiber Communications (4/e), TMH, 2008

2 G.P. Agrawal, Fiber Optic Communication Systems, (3/e), Wiley, 2002.

3 MMK. Liu, Principles and Applications of Optical Communications, TMH, 2010

Reference Books:

1 J. Gowar, Optical Communication Systems, (2/e), PHI, 2001

2 A.Ghatak & K.Thygarajan, "Introduction to Fiber Optics", Cambridge, 1999

3 M. Sathish Kumar, "Fundamentals of optical fibre communication" PHI,2014

Web link(s):

1 https://www.coursera.org/specializations/optical-engineering? (Course from Cousera by Amy Sullivan & Robert McLeod from Colorado University)

2 https://swayam.gov.in/nd1_noc20_ee48/preview (SWAYAM Video by Prof. Shanti Bhattacharya from IIT Madras)

Course Code	:	EC353
Course Title	:	**RF and Microwave Engineering**
Number of Credits	:	3
Prerequisites (Course code)	:	Networks synthesis, Electronic circuits
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Explain the active & passive microwave devices & components used in Microwave communication systems.

CO2 Analyze the multi-port RF networks and RF transistor amplifiers.

CO3 Produce microwave signals and design microwave amplifiers.

CO4 Measure and analyze microwave signal and parameters.

CO5 Illustrate the use of semiconductor devices for microwave applications.

Course Content:

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors.

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers.

Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers.

Crystal and Schottky diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC.

Text Books:

1 Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson Education Inc., 2011

2 Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005

3 David M. Pozar, “Microwave Engineering”, Wiley India (P) Ltd, New Delhi, 2008.

Reference Books:

1 Thomas H Lee, “Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits”, Cambridge University Press, 2004.

2 Mathew M Radmanesh, “RF and Microwave Electronics”, Prentice Hall, 2000.

3 Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

Web link(s):

1 https://nptel.ac.in/courses/117/105/117105138/ (NPTEL Video by Prof. Amitabha Bhattacharya from IIT Kharagpur)

2 https://nptel.ac.in/courses/108/103/108103141/ (NPTEL Video by Prof.Ratnajith Batacharjee from IIT Guwahati)

Course Code	:	HM351
Course Title	:	**Technical English**
Number of Credits	:	2
Prerequisites (Course code)	:	NIL
Course Type	:	GIR

Course outcomes: At the end of the course, the student will be able to:

CO1 Develop competence in English for independent and effective professional communication.

CO2 Apply thinking strategies to convince people.

CO3 Evaluate the scenario and decide the suitable writing style.

CO4 Identify suitable language to persuade and to reasonably present the analysis of a situation related to his/her profession.

Course Content:

Listening: Barriers to listening: Physical & psychological – Steps to overcome them – Purposive listening practice – Active listening and anticipating the speaker – Use of technology in the professional world – Listening online – Video Lectures.

Speaking: Fluency & accuracy in speech – Positive thinking – Kinds of thinking – Improving self-expression – Tonal variations – Listener oriented speaking – Group discussion practice– Interpersonal Conversation – Developing persuasive speaking skills – Making presentation online – Organising online events

Reading: Speed reading practice – Use of extensive readers – Trans-coding: verbal and nonverbal – Analytical and critical reading practice – Introduction to ethics & values through case – Choosing study materials

Writing: Professional Correspondence – Formal letters – CV/Resume – Argument Writing – Perspectives in writing – Narrative writing – Different registers – Tone in formal writing – Report Writing – Writing SOP – Online tools to effective writing – Publishing online - Blog writing

Study Skills: Reference Skills - Use of dictionary, thesaurus etc. – Importance of contents page, cover & back pages – Bibliography – Use of online resources – Articles, Blogs and others

Text Books:

1 Herta A Murphy, Herbert W Hildebrandt, and Jane P Thomas, Effective Business Communication, 7th Edition, McGraw Hill, Irwin, 1997.

2 Martin Hewings, Advanced Grammar in Use, 2nd Edition, Cambridge University Press, 2008.

3 Michae Swan, Practical English Usage, Oxford University Press, Oxford, 1995.

Reference Books:

1 Perelman, Leslie C, James Paradis, and Edward Barrett, The Mayfield HandBooks of Technical & Scientific Writing, Mountain View, Calif: Mayfield Pub. Co, 1998.

2 Robert Gannon, Best Science Writing: Readings and Insights, University Press, Hyderabad, 2000.

3 Shirley Taylor, Communication for Business, Longman, New Delhi, 1999.

Web link(s):

1 https://nptel.ac.in/courses/109/106/109106094/ (NPTEL Course by Prof. Aysha Iqbal, IITM)

2 https://www.youtube.com/watch?v=lQrj_7xkeNI - Technical Presentation (Part of an NPTEL Course by Prof. Prathap Haridoss, IITM)

3 https://www.youtube.com/watch?v=9SB4tfD0hxM - Technical Writing

4 https://writingcenter.fas.harvard.edu/pages/strategies-essay-writing

Course Code	:	EC354
Course Title	:	**VLSI Systems Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	Digital Principles
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to :

CO1 Practice the concepts of combinational and sequential logic circuits using HDL.

CO2 Compare the advantages of structural, behavioral, and data-flow models of HDL for different logic circuits.

CO3 Explain the RTL generated for non-structural modeling logic circuits.

CO4 Interpret the auto-generated layout from the tool for the implemented logic design.

CO5 Illustrate the differences between power-delay-aware design and conventional design.

List of Experiments:

1. Adders and subtractors
2. Mux & Demux
3. Encoders & Decoders
4. Flip-Flops
5. Shift-Registers
6. Working with RAM
7. Comparators, parity generators & ALU
8. Counters
9. Carry look ahead adder
10. Multipliers

Course Code	:	EC355
Course Title	:	**Microwave and Optical Communication Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to:

CO1 Analyze the mode characteristics of reflex klystron oscillator.

CO2 Measure power and analyze the characteristics of Gunn oscillator.

CO3 Observe radiation pattern and calculate the gain of an antenna.

CO4 Describe the properties of circulators, directional couplers and magic tee.

CO5 Discuss the characteristics of various Optical Sources, Detectors and Fiber.

List of Experiments:

1 Antenna Demonstration

2 Mode characteristics of Reflex Klystron oscillator

3 Gunn oscillator characteristics and power measurement

4 Measurement of VSWR & impedance

5 Measurement of radiation pattern and gain of an antenna

6 Properties of circulators & Directional coupler

7 Properties of the Magic Tee Junction

8 Vector Network Analyser Demonstration

9 Measurement of Numerical Aperture

10 Integrated Voice and Data Optical Communication System

11 Study of Optical Sources, Detectors and Fiber Characteristics

SEVENTH SEMESTER

Course Code	:	EC402
Course Title	:	**5G and Beyond 5G**
Number of Credits	:	3
Prerequisites (Course code)	:	None
Course Type	:	PC

Course outcomes: At the end of the course, the student will be able to:

CO1 Discuss the evolution of cellular communication systems beyond 3G.

CO2 Design cellular link and estimate the power budget.

CO3 Choose proper multiple accessing methods depending on channel model.

CO4 Identify traffic channels for call processing.

CO5 Calculate key performance metrics of a cellular communication system.

Course Content:

An Overview of Wireless Systems - Introduction - Everything moves - Mobility versus portability - Mobile devices – Wireless communication and the layer model - First- and Second- Generation Cellular Systems - Cellular Communications from 1G to 3G - Road Map for Higher Data Rate Capability in 3G - Wireless 4G Systems - Future Wireless Networks – Standardization Activities for Cellular Systems.

Cellular System design concepts and fundamentals - Frequency Reuse – Channel Assignment - Handoff Strategies – Interference and System Capacity – Trunking and Grade of service – Improving Coverage and Capacity in cellular systems. Mobile Radio Wave propagation - I – Large scale path loss and propagation models – Reflection – Diffraction – Scattering – Practical link budget design – Outdoor propagation models – Indoor propagation models.

Mobile Radio Wave propagation – II - Small- Scale fading and multipath propagation, Rayleigh and Ricean Distributions. Multiple Access Techniques for Wireless Communications -I – FDMA – TDMA –Spread Spectrum multiple access – FHMA, CDMA – SDMA.

Multiple Access Techniques for Wireless Communications – II - Packet radio – Pure ALOHA, Slotted ALOHA, CSMA, Reservation ALOHA, PRMA - Capacity of Cellular Systems. Wireless systems and standards – I – AMPS and ETACS – IS 54 and IS 136 – GSM features – Architecture. – Radio subsystems – Traffic channels – call processing.

Wireless systems and standards – II – CDMA features – Architecture – IS 95 – Forward and reverse channels – power control - system capacity. Wireless Networking – WLAN – PAN – Mobile network layer – Mobile Transport layer – Wireless data services, Common channel

signaling. Wireless Networking – Satellite data communication - cellular data communications, third generation UMTS system features – WiMAX - RFID.

Text Books:

1 William C Y Lee, "Mobile Cellular Telecommunications, McGraw Hill.

2 Schwartz, Mobile Wireless Communications, Cambridge University Press.(Main Books)

3 Theodore S Rappaport, "Wireless Communications Principles and Practice", Prentice Hall.

Reference Books:

1 Stallings, Wireless Communications and Networks, Prentice Hall.

2 A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.

3 A.F.Molisch, Wireless Communications, Wiley, 2005.

Web link(s):

1 https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee48/ (NPTEL Video by Prof. Koi Pillai from IIT Madras)

2 https://nptel.ac.in/courses/117/102/117102062/ (NPTEL Video by Prof. Ranjan Bose from IIT Delhi)

Course Code	:	EC403
Course Title	:	**5G and Beyond 5G Laboratory**
Number of Credits	:	2
Prerequisites (Course code)	:	None
Course Type	:	ELR

Course outcomes: At the end of the course, the student will be able to:

CO1 Describe the use of AT commands

CO2 Practice modulation and demodulation of DSSS signal

CO3 Analyze the functions of various parts of mobile phone

CO4 Measure the test point voltages of mobile

CO5 Demonstrate the concept behind video calling

List of Experiments:

1 Study & use of AT commands

2 Study of voice call using AT command

3 Sending message using AT command

4 Study theory of direct sequence spread spectrum modulation & demodulation

5 Generation of DSSS modulated signal

6 Demodulation of DSSS modulated signal.

7 Introduction to parts of mobile phone

8 Measurement of test point voltages of mobile

9 Observe waveforms at different test points of mobile

10 Study of switch faults

11 Video calling