CMR TECHNICAL CAMPUS

UGC AUTONOMOUS

B. Tech. I Year Syllabus

Common for ECE, CSE[AIML] & CSE[DS]

I SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1	22MA101BS	Matrices and Calculus	3	1	0	4
2	22PH102BS	Applied Physics	3	1	0	4
3	22CS103ES	Programming for Problem Solving	3	0	0	3
4	22EN104HS	English for Skill Enhancement	3	0	0	3
5	22CS105ES	IT Workshop	0	0	3	1.5
6	22PH106BS	Applied Physics Laboratory	0	0	3	1.5
7	22CS107ES	Programming for Problem Solving Laboratory	0	0	2	1
8	22EN108HS	English Language and Communication Skills Laboratory	0	0	2	1
9	22CS109ES	Basic Elements of Engineering and Technology	0	0	2	1
		Induction Programme				
Total			**12**	**2**	**12**	**20**

II SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1	22MA201BS	Ordinary Differential Equations and Vector Calculus	3	1	0	4
2	22CH202BS	Engineering Chemistry	3	1	0	4
3	22CS203ES	Data Structures	3	0	0	3
4	22EC204ES	Basic Electrical and Electronics Engineering	3	1	0	4
5	22ME205ES	Computer Aided Engineering Graphics	1	0	2	2
6	22CH206BS	Engineering Chemistry Laboratory	0	0	2	1
7	22CS207ES	Data Structures Laboratory	0	0	2	1
8	22EC208ES	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
9	22CH209MC	Environmental Science	3	0	0	0
Total			**16**	**3**	**8**	**20**

CMR TECHNICAL CAMPUS
UGCAUTONOMOUS

B. Tech. II Year Syllabus

Electronics and Communication Engineering

III SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	22EC301PC	Electronic Devices and Circuits	3	0	0	3
2	22EC302PC	Digital System Design	3	0	0	3
3	22EC303PC	Signals and Systems	3	0	0	3
4	22EC304PC	Probability Theory and Stochastic Processes	3	0	0	3
5	22EC305ES	Network Analysis	3	1	0	4
6	22EC306PC	Electronic Devices and Circuits Lab	0	0	3	1.5
7	22EC307PC	Digital System Design Lab	0	0	2	1
8	22EC308PC	Basic Simulation Lab	0	0	3	1.5
9	22EN309MC	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**1**	**10**	**20**

IV SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	22EC401PC	Analog and Digital Communications	3	0	0	3
2	22MA402BS	Numerical Methods and Complex Variables	3	0	0	3
3	22EC403PC	Electronic Circuit Analysis	3	0	0	3
4	22EC404PC	Electromagnetic Waves and Transmission lines	3	0	0	3
5	22EC405PC	Fundamentals of Database Management Systems	3	0	0	3
6	22EC406PC	Analog and Digital Communications Lab	0	0	2	1
7	22EC407PC	Electronic Circuits Analysis Lab	0	0	2	1
8	22EC408PC	Database Management Systems Lab	0	0	2	1
9	22EC409PC	Real Time Project/ Field Based Project	0	0	4	2
10	22EN410MC	Constitution of India	3	0	0	0
		Total Credits	**18**	**0**	**10**	**20**

CMR TECHNICAL CAMPUS
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B. Tech. III Year Syllabus

Electronics and Communication Engineering

V SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1	22EC501PC	Microcontrollers and fundamentals of IoT	3	1	0	4
2	22EC502PC	Control Systems	3	1	0	4
3	22EC503PC	Linear and Digital IC Applications	3	0	0	3
4	22MB504HS	Business Economics and Financial Analysis	3	0	0	3
5		Professional Elective – I	3	0	0	3
6	22EC505PC	Microcontrollers Lab	0	0	2	1
7	22EC506PC	IoT Lab	0	0	2	1
8	22EC507PC	Linear and Digital IC Applications Lab	0	0	2	1
9	22EC508MC	Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**2**	**6**	**20**

VI SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1	22EC601PC	Antennas and Wave Propagation	3	0	0	3
2	22EC602PC	Digital Signal Processing	3	0	0	3
3	22EC603PC	CMOS VLSI Design	3	0	0	3
4		Professional Elective – II	3	0	0	3
5		Open Elective – I	3	0	0	3
6	22EC604PC	Digital Signal Processing Lab	0	0	2	1
7	22EN605HS	Advanced English Communication Skills Lab	0	0	2	1
8	22EC606PC	CMOS VLSI Design Lab	0	0	2	1
9	22CH607MC	*Environmental Science	3	0	0	0
10	22EC608PC	Industry Oriented Mini Project/ Internship	0	0	4	2
		Total Credits	**18**	**0**	**10**	**20**

*Environmental Science in VI Semester Should be Registered by Lateral Entry Students Only.

CMR TECHNICAL CAMPUS
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B. Tech. IV Year Syllabus

Electronics and Communication Engineering

VII SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1	22MB701HS	Professional Practice, Law and Ethics	3	0	0	3
2		Professional Elective – III	3	0	0	3
3		Professional Elective – IV	3	0	0	3
4		Open Elective – II	3	0	0	3
5	22EC702PC	Microwave Engineering	3	1	0	4
6	22EC703PC	Microwave Engineering Lab	0	0	2	1
7	22EC704PC	Project Stage – I	0	0	6	3
		Total Credits	**15**	**1**	**8**	**20**

VIII SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1		Professional Elective – V	3	0	0	3
2		Professional Elective– VI	3	0	0	3
3		Open Elective – III	3	0	0	3
4	22EC801PC	Project Stage – II including Seminar	0	0	22	11
		Total Credits	**9**	**0**	**22**	**20**

***MC- Pass/Fail**

Professional Elective – I

22EC511PE	Computer Organization & Operating Systems
22EC512PE	Data Communications and Computer Networks
22EC513PE	Electronic Measurements and Instrumentation

Professional Elective – II

22EC621PE	Object Oriented Programming through Java
22EC622PE	Mobile Communications and Networks
22EC623PE	Embedded System Design

Professional Elective – III

22EC731PE	Artificial Neural Networks
22EC732PE	CMOS Analog IC Design
22EC733PE	Digital Image Processing

Professional Elective – IV

22EC741PE	Multimedia Database Management Systems
22EC742PE	Network Security and Cryptography
22EC743PE	Satellite Communications

Professional Elective – V

22EC851PE	Radar Systems
22EC852PE	Wireless Sensor Networks
22EC853PE	Low Power VLSI Design

Professional Elective – VI

22EC861PE	Biomedical Instrumentation
22EC862PE	System on Chip Architecture
22EC863PE	5G and beyond Communications

Open Electives

Open Elective (OE – I)	Open Elective (OE – II)	Open Elective (OE – III)
1. Fundamentals of Internet of Things (22EC611OE) 2. Principles of Signal Processing (22EC612OE) 3. Digital Electronics for Engineering (22EC613OE)	1. Electronic Sensors (22EC721OE) 2. Electronics for Health Care (22EC722OE) 3. Telecommunications for Society (22EC723OE)	1. Measuring Instruments (22EC831OE) 2. Communication Technologies (22EC832OE) 3. Fundamentals of Social Networks (22EC833OE)

Matrices and Calculus

B. Tech. I Semester **L T P C**

Subject Code: 22MA101BS **3 1 0 4**

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

1. Types of matrices, their properties and concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
2. Concept of eigen values and eigenvectors and to reduce the quadratic form to canonical form.
3. Apply geometrical approach to the mean value theorems and their application to the mathematical problems and evaluation of improper integrals using Beta and Gamma functions.
4. Utilize partial differentiation, concept of total derivative and finding maxima and minima of function of two and three variables.
5. Evaluation of multiple integrals and their applications.

Course Outcomes:

After completion of this course, the students will be able to:

1. Use the matrix representation of a set of linear equations and to analyze the solution of the system of equations.
2. Find the Eigen values and Eigenvectors and reduce the quadratic form to canonical form using orthogonal transformation.
3. Solve the applications on the mean value theorems and evaluate the improper integrals using Beta and Gamma functions.
4. Applythe extreme values of functions of two variables with/ without constraints.
5. Compute multiple integrals and applythe concept to find areas, volumes.

UNIT-I: Matrices [12 Lectures]

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations: solving system of Homogeneous and Non-Homogeneous equations, Gauss -elimination method, Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors [12 Lectures]

Linear Transformation and Orthogonal Transformation: Eigen values and Eigenvectors and their properties: Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

UNIT-III: Calculus [12 Lectures]

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem (without proof) with their Geometrical Interpretation and applications, Cauchy's Mean Value Theorem (without proof), Taylor's series for single variable.

Definition of improper integral: Definition of Beta and Gamma functions, properties, other forms of Beta functions, Relation between Beta and Gamma functions and their applications.

UNIT-IV: Multivariable Calculus (Partial Differentiation and Applications) [12 Lectures]

Definitions of Limit and continuity. Partial Differentiation, Euler's Theorem; Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V: Multivariable Calculus (Integration) [12 Lectures]

Evaluation of Double integrals (Cartesian and Polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple integrals: Change of variables (Cartesian to polar) for double integrals.

Applications: Areas and volumes by double integrals.

TEXT BOOKS:

1. T.K.V.Iyengar, B.Krishna Gandhi, Engineering Mathematics, S.Chand Publishers, 19th edition,2020
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44thEdition,2018.
3. R.K. Jain and S.R.K. Iyengar, Advanced Engineering mathematics, Narosa Publications, 6th Edition, 2020.

REFERENCE BOOKS:

1. Erwin kreyzig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi publications, Reprint,2008.
4. H.K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S.Chand publishers, 2014.

Web Links:

1. https://www.mooc-list.com/tags/matrix
2. https://www.mooc-list.com/tags/mean-value-theorem

Applied Physics

B. Tech. I Semester **L T P C**

Subjects Code: 22PH102BS **3 1 0 4**

Prerequisites: 10 + 2 physics

Course Objectives: The objectives of this course for the student are to:

1. Understand the basic principles of quantumphysics and band theory of solids.
2. Summarize the underlying mechanism involved in construction and working principles of various semiconductor devices.
3. Study the fundamental concepts related to the dielectric and magnetic materials.
4. Identify the importance of nanoscale, quantumconfinement and various fabrications techniques.
5. Explain the characteristics of lasers and optical fibres.

Course Outcomes:

After completion of this course, the students will be able to:

1. Understand physical world from fundamental point of view by the concepts of Quantum mechanics and visualize the difference between conductor, semiconductor, and an insulator byclassification of solids.
2. Identify the role of semiconductor devices in science and engineering Applications.
3. Explore the fundamental properties of dielectric and magnetic materials for their applications.
4. Interpret the features and applications of nanomaterials.
5. Relate various aspects of Lasers and Optical fibres andtheir applications in diverse fields.

UNIT-I: QUANTUM PHYSICS AND SOLIDS [15 Lectures]

Quantum Mechanics: Introduction to quantum physics, Blackbody radiation, Planck's radiation law, Wein's and Rayleigh-Jean's law, Stefan-Boltzmann's law, Photo electric effect, De Broglie hypothesis, Davisson and Germer experiment, Heisenberg uncertainty principle, Born interpretation of the wave function, Time independent Schrodinger wave equation, Particle in one dimensional potential box.

Solids: Free electron theory (Drude and Lorentz, Sommerfield - qualitative), Fermi-Dirac distribution, Periodic potentials - Bloch's theorem, Kronig-Penney model (qualitative), E-K diagram, Effective mass of electron, Origin of energy bands- classification of solids.

UNIT-II: SEMICONDUCTORS AND DEVICES [15 Lectures]

Introduction to semiconductors, Intrinsic and extrinsic semiconductors - carrier concentration, Direct and indirect band gap semiconductors, Hall effect, Construction, Principle of operation and characteristics of P-N Junction diode, Zener diode, Bipolar junction transistor (BJT), LED, PIN diode, Avalanche photodiode (APD) and Solar cells.

UNIT-III: DIELECTRIC AND MAGNETIC MATERIALS [10 Lectures]

Dielectric Materials: Basic definitions, Electronic and ionic polarizations, Ferroelectric, Piezoelectric and Pyroelectric materials -applications.

Magnetic Materials: Hysteresis - soft and hard magnetic materials, Magnetostriction, Magneto resistance, Bubble memory devices, Magnetic field sensors and Multiferroics, Applications of magnetic materials.

UNIT-IV: NANO TECHNOLOGY [10 Lectures]

Nanoscale, Quantum confinement, Surface to volume ratio, Bottom-up fabrication: Sol-Gel, Precipitation, Combustion methods, Top-down fabrication: Ball milling, Physical vapor deposition (PVD), Chemical vapor deposition (CVD), XRD, SEM & TEM, Applications of nanomaterials.

UNIT-V: LASER AND FIBER OPTICS [15 Lectures]

Lasers: Laser beam characteristics, three quantum processes, Einstein coefficients and their relations, Lasing action, Pumping methods, Ruby laser, Nd-YAG laser, He-Ne laser, Semiconductor laser, Applications of laser.

Fiber Optics: Introduction to optical fibers, Total internal reflection, Construction of optical fiber, Numerical aperture, Acceptance angle, Classification of optical fibers, Losses in optical fiber, Optical fiber for communication system, Applications of optical fibers.

TEXT BOOKS:

1. M.N.Avadhanulu, P.G.Kshirsagar & TVS. Arun Murthy" A Textbook of Engineering Physics"-S.Chand Publications, 11th Edition, 2019.
2. Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson Publication, 2019.
3. Donald A, Neamen, Semiconductor Physics and Devices-Basic Principle–Mc Graw Hill, 4thEdition, 2021.
4. B.K.Pandey and S.Chaturvedi, Engineering Physics, Cengage Learning, 2nd Edition, 2022.
5. Narasimha Reddy Katta, Essentials of Nanoscience & Nanotechnology, Typical Creatives NANO DIGEST, 1st Edition, 2021.

REFERENCE BOOKS:

1. H.C.Verma, Quantum Physics, TBS Publication, 2ndEdition2012.
2. Halliday, Resnick and Walker, John Wiley & Sons, Fundamentals of Physics 11thEdition, 2018.
3. Charles Kittel, Introduction to Solid State Physics, Wiley Eastern, 2019.
4. S.L.Gupta and V.Kumar, Elementary Solid State Physics, Pragathi Prakashan, 2019.
5. A.K. Bhandhopadhya – Nano Materials, New Age International, 1stEdition, 2007.

Web Links:

1. https://youtu.be/TcmGYe39XG0
2. https://youtu.be/JA3sCmrv11M
3. https://youtu.be/qUEbxTkPIWI

Programming for Problem Solving

B. Tech. I Semester **L T P C**

Subject Code: 22CS103ES **3 0 0 3**

Prerequisites: Basic knowledge on mathematics & problem solving skills.

Course Objectives:

1. Design solutions to simple engineering problem by applying the basic programming principles of C language and basic mathematical knowledge.
2. Implement the programs using conditional statements and loops.
3. Develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.
4. Develop the programs of searching and sorting techniques using Arrays.

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

1. Illustrate and explain the basic computer concepts, algorithms, flowcharts and programming principles of C Language.
2. Develop C programs to solve simple mathematical and decision making problems.
3. Understand, distinguish and implement arrays, strings and structures to write C programs.
4. Understand the concepts of pointers and files using C programs.
5. Decompose a problem into functions and to develop modular reusable code.
6. Understand the Searching and sorting problems.

UNIT – I: [10 Lectures]

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, types of computer languages, compilers, creating, compiling and executing a program etc., Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart with examples.

Introduction to C Programming Language: History, Basic Structure of a C program, variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, type conversion, Bitwise operations: Bitwise AND, OR, XOR and NOT operators. I/O: Simple input and output with scanf and printf.

UNIT - II: [12Lectures]

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, go to, Iteration with for, while, do- while loops

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays

Strings: Introduction to strings, handling strings as arrayof characters, basic string handling functions available in C .

Structures: Defining structures, initializing structures, Nested structures, Array of structures

Unions: Defining Unions, initializing unions, basic program on union. Enumeration data type.

UNIT - III: [10 Lectures]

Pointers: Idea of pointers, defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation).

Pre-processor: Commonly used Pre-processor commands like include, define, undef, if, ifdef, ifndef

Files: Text and Binary files, Creating and Reading and writing text and binary files, appending data to existing files, Random access using fseek, ftell and rewind functions.

UNIT - IV: [12 Lectures]

Functions: Designing structured programs, declaring a function, Signature of a function, Parameters and return type of a function, categories of functions, passing parameters to functions, call by value, Passing arrays to functions, idea of call by reference, Some C standard functions andlibraries
Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions, Storage classes (auto, extern, static and register), The main method and command line arguments.
Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: [8 Lectures]

Basic searching in an array of elements (linear and binary search techniques).Basic algorithms to sort arrayof elements (Bubble, Insertion and Selection sort algorithms).

TEXT BOOKS:

1. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, 3rd edition,2006.
2. Jeri R. Hanlyand Elliot B.Koffman, Problem solving and Program Design in C 7th Edition, Pearson,2006.

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice Hall of India
2. R.G. Dromey, How to solve it byComputer, Pearson(16thImpression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.
4. Herbert Schildt, C: The Complete Reference, Mc Graw Hill,4thEdition

Web Links:

1. https://nptel.ac.in/courses/106104074
2. https://onlinecourses.nptel.ac.in/noc21_cs01/preview
3. https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx
4. https://www.programiz.com/c-programming.

English for Skill Enhancement

B. Tech. I Semester **L T P C**

Subject Code: 22EN104HS **3 0 0 3**

Prerequisites: Basic knowledge in Grammar as well as in prose

Course Objectives:

This course will enable the students to:

1. Improve the language proficiency of students in English with an emphasis on Vocabulary,Grammar, Reading and Writing skills
2. Develop studyskills and communication skills in various professional situations.
3. Equip students to study engineering subjects more effectively and critically using the theoretical and practical components of the syllabus.

Course Outcomes:

After completion of the course, the students will be able to:

1. Understand the importance of vocabularyand sentence structures.
2. Demonstrate their understanding of the rules of functional grammar.
3. Take an active part in drafting paragraphs, letters, essays, abstracts, précis and reports in various contexts.
4. Develop comprehension skills from the known and unknown passages.
5. Acquire basic proficiency in reading and writing modules of English.

UNIT – I **[8 Lectures]**

Chapter entitled '*Toasted English*' byR.K. Narayan from *"English: Language, Context and Culture"* published byOrient BlackSwan, Hyderabad.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes -Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives- Synonyms and Antonyms
Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading.
Writing: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT – II **[7 Lectures]**

Chapter entitled **'Appro JRD' by Sudha Murthy** from ***"English: Language, Context and Culture"published*** byOrient BlackSwan, Hyderabad.

Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs
Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.
Reading: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice
Writing: Nature and Style of Writing- Defining /Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence.

UNIT – III **[8 Lectures]**

Chapter entitled 'Lessons from Online Learning' byF. Haider Alvi, Deborah Hurst et al from *"English: Language, Context and Culture"* published by Orient BlackSwan, Hyderabad.
Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.
Reading: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice.
Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume.

UNIT – IV **[8 Lectures]**

Chapter entitled 'Art and Literature' by Abdul Kalam from *"English: Language, Context and Culture"* published byOrient BlackSwan, Hyderabad.
Vocabulary: Standard Abbreviations and Acronyms in English
Grammar: Redundancies and Clichés in Oral and Written Communication.
Reading: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice
Writing: Writing Practices- EssayWriting-Writing Introduction and Conclusion -Précis Writing.

UNIT – V **[7 Lectures]**

Chapter entitled 'Go, Kiss the World' bySubroto Bagchi from *"English: Language, Context and Culture"* published byOrient BlackSwan, Hyderabad.
Vocabulary: Technical Vocabulary and their Usage
Grammar: Common Errors in English
Reading: Reading Comprehension-Exercises for Practice
Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Note: Listening and Speaking Skills which are given under Unit-6 in AICTE Model Curriculum arecovered in the syllabus of ELCS Lab Course.

- **Note: 1**. As the syllabus of English given in AICTE *Model Curriculum-2018 for B. Tech. First Year is* ***Open-ended***, besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.
- **Note**: **2**. Based on the recommendations of NEP2020, teachers are requested to be flexible to adopt Blended Learning in dealing with the course contents. They are advised to teach 40 percentof each topic from the syllabus in blended mode.

TEXT BOOK:

1. "English: Language, Context and Culture" byOrient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

REFERENCE BOOKS:

1. Effective Academic Writing by Liss and Davis (OUP)
2. Richards, Jack C. Interchange Series. Introduction, 1,2,3. Cambridge University Press. (2022)
3. Wood, F.T. Remedial English Grammar. Macmillan. (2007).

4. Chaudhuri, Santanu Sinha. Learn English: A Fun Book of Functional Language, Grammar and Vocabulary. (2nd ed.,). Sage Publications India Pvt. Ltd. (2018).
5. Technical Communication. Wiley India Pvt. Ltd. (2019).
6. Vishwamohan, Aysha. English for Technical Communication for Engineering Students. Mc Graw-Hill Education India Pvt. Ltd. (2013).
7. Swan, Michael. Practical English Usage. Oxford University Press. Fourth Edition. (2016).

Web Links:

UNIT I

Vocabulary - Prefixes and Suffixes
WL1:https://nptel.ac.in/courses/109106094/23
WL2:http://teacher.scholastic.com/reading/bestpractices/vocabulary/pdf/prefixes_suffixes.pdf

Synonyms and Antonyms
WL3:https://www.google.com/search?q=Synonyms+an+Antonyms+-+nptel+videos&nfpr=1&sa=X&ved=0ahUKEwi7pbzfluXfAhXBEbwKHXOqC4oQvgUILCgB&biw=1024&bih=657
WL4:https://scoop.eduncle.com/synonyms-antonyms-for-competitive-exams

GRAMMAR - Common errors in Prepositions
WL5:https://nptel.ac.in/courses/109104030/Module12/Lecture39.pdf
WL6:https://nptel.ac.in/courses/109104030/Module12/Lecture38.pdf
WL7:https://www.englishpractice.com/common-mistakes/common-errors-prepositions-3

Techniques of Effective reading
WL8:https://nptel.ac.in/courses/109106129/5
WL9:https://nptel.ac.in/courses/109106129/15
WL10:https://www.howtolearn.com/2012/08/different-reading-techniques-and-when-to-use-them/

UNIT II

GRAMMAR - Common errors in Noun and Pronoun agreement
WL11:https://nptel.ac.in/courses/109104030/Module12/Lecture39.pdf

common errors and Rules of Subject-verb agreement
WL12:https://nptel.ac.in/courses/109106094/8
https://www.grammarbook.com/grammar/subjectVerbAgree.asp

Techniques for improving comprehension skills
WL13:**https://nptel.ac.in/courses/109106129/5**
WL14:**https://joshkaufman.net/3-simple-techniques-to-optimize-your-reading-comprehension-and-retention/**

UNIT III

English Language
Vocabulary- Affixes
WL15:http://www.prefixsuffix.com/rootchart.php
English words from Foreign languages
WL16:https://www.fluentu.com/blog/english/english-words-from-other-languages/
WL17:https://en.oxforddictionaries.com/explore/foreign-words-and-phrases/
Misplaced modifiers
WL18:https://www.grammar-monster.com/glossary/misplaced_modifier.htm
Reading
WL19:http://www.bbc.co.uk/skillswise/topic/skimming-and-scanning
WL20:http://www.bbc.co.uk/skillswise/video/skimming-and-scanning
Writing
WL21:https://writeshop.com/choosing-vocabulary-to-describe-a-place/

Writingformal letters
WL22:https://nptel.ac.in/courses/109104031/14

UNIT IV
Vocabulary
WL23:https://www-pub.iaea.org/MTCD/DSS/OASISGlossary.pdf
WL24:https://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Composite%20Materials/pdf/Glossory.pdf
WL25:https://nptel.ac.in/courses/117105083/pdf/ssg_m2l2.pdf

Reading
WL26:https://nptel.ac.in/courses/109106066/module6/lecture12/lecture12.pdf

Writing

WL27:https://nptel.ac.in/courses/109106094/29
WL28:https://nptel.ac.in/courses/109106066/module3/lecture6/lecture6.pdf

UNIT - V
Vocabulary WL29:https://nptel.ac.in/courses/109106066/module1/lecture1/lecture1.pdf

Grammar - Common errors
WL30:https://www.engvid.com/english-resource/50-common-grammar-mistakes-in-english/

Reading
WL31:https://nptel.ac.in/courses/109106066/module6/lecture12/lecture12.pdf

Writing WL32:https://nptel.ac.in/courses/109104031/17
WL33:https://nptel.ac.in/courses/109107121/31

IT Workshop

B. Tech. I SEM **L T P C**

Subject Code: 22CS105ES **0 0 3 1.5**

Course Objectives:

1. The IT Workshop is a traininglab courseto get trainingon PC Hardware, Internet &Worldwide Web and Productivitytools for documentation, Spreadsheet computations and Presentation.
2. To introduce to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers, hardware and software level troubleshooting process.
3. To introduce connecting the PC on to the internet from home and workplace and effectively usage of the internet, Usage of web browsers, email, newsgroups and discussion forums.
4. To get knowledge in awareness of cyber hygiene, i.e., protecting the personal computer from getting infected with the viruses, worms and other cyber-attacks.
5. To introducethe usage of Productivitytools in craftingprofessional word documents, excel spreadsheets and power point presentations using open office tools.

Course Outcomes:

After completion of this course, the students will be able to:

1. Applyknowledge for PC hardware and computer parts.
2. Applyknowledge for computer assembling and software installation.
3. Abilityhow to solve the trouble shooting problems.
4. Applythe tools for preparation of project certificate, Creating a Newsletter.
5. Applythe tools for preparation of PPT, Documentation and budget sheet etc.

PC Hardware: The students should work on working PC to disassemble and assemble to working condition and install operating system like Linux or any other on the same PC. Students are suggested to work similar tasks in the laptop scenario wherever possible.

Problem 1: Every student should identify the peripherals of a computer, components in a CPUand its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. Every student should disassemble and assemble the PC back to working condition.

Problem 2: Every student should individually install operating system like Linux or MS windows on the personal computer. The system should be configured as dual boot with both windows and Linux.

Problem 3: Hardware Troubleshooting: Students have to be given a PC which does not bootdue to improper assembly or defective peripherals. They should identify the problem and fixit to get the computer back to working condition.

Problem 4: Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. Internet & World Wide Web.

Problem 5: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate how to access the websites and email.

Problem 6: Web Browsers, Surfing the Web: Students customize their web browsers with

the LAN proxy settings, bookmarks, search toolbars and popup blockers. Also, plug- ins like Macro media Flash and JRE for applets should be configured

Problem 7: Search Engines & Netiquette: Students should know what search engines are and howto use the search engines. Usage of search engines like Google, Yahoo, ask.com and others should be demonstrated bystudent.

Problem 8: Cyber Hygiene: Students should learn about viruses on the internet and install antivirus software. Student should learn to customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

Problem 9: Develop home page: Student should learn to develop his/her home page using HTMLconsisting of his/her photo, name, address and education details as a table and his/her skill set as a list. Productivitytools: Word Orientation: An overview of Microsoft (MS) office /equivalent (FOSS) tool word should be learned: Importance of MS office / equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that should be covered in each, using and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

Problem 10: Using and Word to create project certificate. Features to be covered: - Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.

Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs in word.

Problem 11-Spreadsheet Orientation: Accessing, overview of toolbars, saving spreadsheet files, Using help and resources. Creating a Scheduler: - Gridlines, Format Cells, Summation, auto fill, Formatting Text.

Calculating GPA - Features to be covered: - Cell Referencing, Formulae in spread sheet – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyperlinking, Count function, Sorting, Conditional formatting.

Problem 12: Creating Power Point: Student should work on basic power point utilities and tools in Latex and MS Office/equivalent (FOSS) which help them create basic power point presentation. PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting Images, Tables and Charts.

REFERENCEBOOKS:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education. LaTeX Companion – Leslie Lamport, PHI/Pearson.
2. Comdex Information Technologycourse tool kit Vikas Gupta, WILEY Dreamtech
3. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.

PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

Applied Physics Laboratory

B. Tech I Semester **L T P C**

Subject Code: 22PH106BS **0 0 3 1.5**

Prerequisites: Practical physics at basic level.

Co-Prerequisite: A course on 'Applied physics laboratory'.

Course Objectives: The objectives of this course for the student to

1. Capable of handling instruments related to photoelectric effect experiments and their measurements.
2. Understand the characteristics of various devices such as PN junction diode, BJT, LED, solar cell, Hall effect and measurement of energy gap and resistivity of semiconductor materials.
3. To understand the characteristics of dielectric constant of a given material and studythe behavior of B-H curve of ferromagnetic materials.
4. Understand the Characteristics of Laser and optical fiber measurements.
5. Understanding the method of Mechanical oscillator (Torsional) and electrical oscillator (LCR).

Course Outcomes:

After completion of this course, the students will be able to:

1. Know the determination of the Planck's constant using Photoelectric effect.
2. Appreciate quantum physics in semiconductor devices, optoelectronics and identifythe material whether it is n-type or p-type byHall experiment.
3. Gain the knowledge of applications of dielectric constant and understand the variation of magnetic field and behavior of hysteresis curve.
4. Gain the knowledge of Characteristics of Laser and optical fiber measurements.
5. Carried out data analysis.

LIST OF EXPERIMENTS:

1. Determination of work function and Planck's constant using photoelectric effect.
2. To studythe resonant frequency, bandwidth and quality factor of series and parallel LCR circuits.
3. To studythe V-I characteristics of a p-n junction diode.
4. a. To studythe V-I characteristics of solar cell.
   b. To studythe V-I characteristics of light emitting diode (LED).
5. Determination of energygap of a semiconductor.
6. a. Determination of the V-Icharacteristics of the given LASER beam.
   b. Determination of Acceptance Angle and Numerical Aperture of an optical fiber.
7. Determination of dielectric constant of a given material.
8. StudyB-H curve of a magnetic material.
9. Determination of the resistivityof semiconductor bytwo probe method.
10. Determination of Hall co-efficient and carrier concentration of a given semiconductor.
11. Input and output characteristics of BJT(CE,CB & CC configurations).
12. Understanding the method of least squares torsional pendulum as an example.

Note: *Any 8 experiments are to be performed.*

REFERENCE BOOK:

1. S. Balasubramanian, M.N.Srinivasan "A Textbook of Practical Physics"- S Chand Publishers, 2017.

Programming for Problem Solving Laboratory

B. Tech. I Semester **L T P C**

Subject Code: 22CS107ES **0 0 2 1**

Co-requisites: A course on Programming for problem solving.
Pre-requisites: Basic knowledge on mathematics & problem solving skills.

Course Objectives: The students will learn the following:

1. To work with an IDE to create, edit, compile, run and debug programs
2. To analyze the various steps in program development.
3. To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
4. To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.

Course Outcomes:

After completion of this course, the students will be able to:

1. Develop C programs for simple numerical problems.
2. Applythe knowledge of conditional statements and loops in programs.
3. Implement the programs using the concepts of arrays, structures, pointers and files.
4. Create the programs using functions and recursive functions.
5. Implement searching and sorting algorithms.

Practice sessions:

a) Write a simple program that prints the results of all the operators available in C (including pre/ post increment, bitwise and/or/not, etc.). Read required operand values from standard input.

b) Writeasimpleprogramthatconvertsonegivendatatypetoanotherusingautoconversionand casting. Take the values from standard input.

Simple numeric problems:

a) Write a program for finding the max and min from the three numbers.

b) Write the program for the simple, compound interest.

c) Write a program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage fromstandard input.

d) Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:

5 x 1 = 5
5 x 2 =10
5 x 3 =15

e) Write a C program for binary equivalent to a positive number 0 to 255.

Expression Evaluation:

a) Write a C program, which takes two integer operands and one operator from the user,

performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

b) Write a program that finds if a given number is a prime number
c) Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
d) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
e) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied bythe user.
f) Write a C program to find the roots of a Quadratic equation.

Arrays, Pointers and Functions:

a) Write a C program to find the minimum, maximum and average in an array of integers.
b) Write a function to compute mean, variance, Standard Deviation, sorting of n elements in a single dimension array.
c) Write a C program that uses functions to perform the following:
d) Addition of Two Matrices
e) Multiplication of Two Matrices
f) Transposeofamatrixwithmemorydynamicallyallocatedforthenewmatrixasrowandcolumn counts maynot be the same.
g) Write C programs that use both recursive and non-recursive functions
h) To find the factorial of a given integer.
i) To find the GCD (greatest common divisor) of two given integers.
j) To find x^n

Files:

a) Write a C program to displaythe contents of a file to standard output device.
b) Write a C program which copies one file to another file..
c) Write a C program to merge two files into a third file (i.e., the contents of the first file followed bythose of the second are put in the third file).

Strings:

a) Write a C program to implement string handling functions.
b) Write a C Program to find the length of a given string without using strlen() function.
c) Write a C Program to concatenate two string without using a function.

Miscellaneous:

a) Write a C program to construct a pyramid of numbers as follows:

```
1          *          1          1          *
1 2        * *        2 3        2 2        * *
1 2 3      * * *      4 5 6      3 3 3      * *
                                 4 4 4 4    *
                                            * *
                                            *
```

Sorting and Searching:

a) Write a C program that uses non-recursive function to search for a Keyvalue in a given List of integers using linear search method.
b) Write a C program that uses non-recursive function to search for a Keyvalue in a given Sorted list of integers using binarysearch method.

c) Write a C program that implements the Bubble sort method to sort a given list of Integers in ascending order.

d) Write a C program that sorts the given array of integers using selection sort in descending order

e) Write a C program that sorts the given arrayof integers using insertion sort in ascending order

TEXT BOOKS:

1. Jeri R. Hanlyand Elliot B.Koffman, Problem solving and Program Design in C 7th Edition, Pearson,2013.
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition),2006.

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,PHI
2. E. Balagurusamy, Computer fundamentals and C, 2nd Edition,McGraw-Hill.

English Language and Communication Skills Lab

B. Tech. I Semester **L T P C**

Subject Code: 22EN108HS **0 0 2 1**

Prerequisites: Basic Knowledge in speech sounds as well as formal and informal communication

The **English Language and Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

1. To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To bring about a consistent accent and intelligibility in students' pronunciation of English byproviding an opportunityfor practice in speaking
4. To improve the fluencyof students in spoken English and neutralize the impact of dialects.
5. To train students to use language appropriately for public speaking, group discussions and interviews.

Course Outcomes:

After completion of this course, the students will be able to:

1. Pronounce English sounds according to standard pronunciation
2. Understand the nuances of English language through audio- visual experience and practice
3. Speak with clarityand confidence which in turn enhances their employability skills
4. Neutralize their accent for intelligibility
5. Participate in discussion and presentation effectively and confidently

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:

a) Computer Assisted Language Learning (CALL) Lab
b) Interactive Communication Skills (ICS) Lab

Listening Skills:

Objectives

1. To enable students to develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills:

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts
    - Oral practice
    - Describing objects/situations/people
    - Role play– Individual/Group activities
    - Just A Minute (JAM) Sessions

The following course content is prescribed for the **English Language and communication Skills Lab**.

Exercise – I

CALL Lab:

Understand*:* Listening Skill- Its importance – Purpose- Process- Types

Practice**:** Introduction to Phonetics – Speech Sounds – Vowels and Consonants

ICS Lab:

Understand: Spoken vs. Written language- Formal and Informal English**.**

Practice: **Ice**-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave –Introducing Oneself and Others.

Exercise – II

CALL Lab:

Understand: Listening Skills: Barriers- Effective Listening.

Practice: Minimal Pairs-Consonant Clusters- Past Tense Marker and Plural Marker- *Testing Exercises*

ICS Lab:

Understand: Features of Good Conversation – Strategies for Effective Communication.

Practice*:* Situational Dialogues – Role Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise-III

CALL Lab:

Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Stress pattern in sentences – Intonation.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Stress pattern in sentences – Intonation - *Testing Exercises*

ICS Lab:

Understand: Descriptions- Narrations- Giving Directions and Guidelines – Blog Writing

Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

Exercise – IV

CALL Lab:

Understand: Errors in Pronunciation-Neutralization of Mother Tongue Interference (MTI).

Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation -*Testing Exercises*

ICS Lab:

Understand: Public Speaking – Exposure to Structured Talks - Non-verbal Communication- Presentation Skills.

Practice: Making a Short Speech – Extempore- Making a Presentation.

Exercise – V

CALL Lab:

Understand: Listening for General and Specific Details.

Practice: Listening Comprehension Tests -*Testing Exercises*

ICS Lab:

Understand: Introduction to Group Discussion

Practice: Group Discussion

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40systems, with one Master Console, LAN facility and English language learning software for self-studybystudents.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High FidelityHeadphones

2. **Interactive Communication Skills (ICS) Lab :**

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio- visual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder etc.

Source of Material (Master Copy):

- *Exercises in Spoken English. Part 1,2,3*. CIEFL and Oxford UniversityPress

Note: Teachers are requested to make use of the master copy and get it tailor- made to suit the contents of the syllabus.

Suggested Software:

- Cambridge Advanced Learners' English Dictionarywith CD.
- Grammar Made Easyby Darling Kindersley.
- Punctuation Made Easyby Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
- Digital All
- Orell Digital Language Lab (Licensed Version)

REFERENCE BOOKS:

1. *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd. (2022).
2. Shobha, KN & Rayen, J. Lourdes. *Communicative English – A workbook.* Cambridge UniversityPress. (2019).
3. Kumar, Sanjay & Lata, Pushp. *Communication Skills: A Workbook.* Oxford University Press. (2019).
4. Board of Editors.*ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient Black Swan Pvt. Ltd. (2016).
5. Mishra, Veerendra et al. *English Language Skills: A Practical Approach.* Cambridge UniversityPress. (2020).

WEB LINKS:

Listening Skills Lecture nptel
WL1:https://www.youtube.com/watch?v=JIKU_WT0Bls

NPTEL on role-play and conversation skills
WL2:https://www.youtube.com/watch?v=0AM35Nu5McY&list=PLbMVogVj5nJT3a24lj4KOkQCOElxcDQrs

NPTEL on syllables
WL3:https://www.youtube.com/watch?v=4V2CwQJ8pgc

NPTEL on listening for general details
WL4:https://www.youtube.com/watch?v=xY7z3nZOHqk&list=PLzJaFd3A7DZtnTdtOxvjO3GLPd1WVe6oq&index=17

NPTEL on stress shifts
WL 5: https://www.youtube.com/watch?v=_KHtfvob4j4

NPTEL on weak forms and strong forms
WL6:https://www.youtube.com/watch?v=VM0cNDxBySc&list=PL0P6HKIuShRnJeZjhAOy-2NejNjeC2_x2

WL7:NPTEL on Intonation
https://www.youtube.com/watch?v=A6aE4nceJt8

Basic Elements of Engineering Technology

B. Tech. I Semester **L T P C**

Subject Code: 22CS109ES **0 0 2 1**

Objectives:

- Exploring different engineering technologies and their applications.
- Students should able to learn various 3d printing technologies.
- Knowledge towards Assembling and testing of robots.
- Understanding functionality of 3Dprinters and their application.
- Developing team work and in sight towards different disciplines of Engineering.

Module I: Internet of Things

Overview of IoT and Architecture: Brief History, evolution of IoT, Architecture, trends in the Adoption of IoT, Societal Benefits of IoT, Risks, Privacy, Security, Embedded Systems Components, Micro-controller Architecture and Properties and Installing and Setting up the Arduino and Raspberry Pi (RPi) development environment. Build Simple IoT Applications byusing Arduino or RPi.

Module II: Robotics

Introduction, Different types of robots, Components of a Robot, Working principle of robots, Applications of robots in various fields, Innovation challenges, Scope of robotics research & its current trends, assembling and testing of Robot.

ModuleIII:3D Printing

Introduction, Product Design & Development, 3D Scanning & Printing using different types of materials. Components of 3D Printer, Applications of 3D printed products in various fields, Hands on Experience on 3D printing Machine.

ModuleIV: Softwareand Post Processing

Cura, Flash print, 3dslicer, Tinkercad, Meshmixer. 3d printing parameters, print Speed, Layer Height, Infill density.Acetone bathing, Support Structure Removing.

Module V: Case Studies

Students has to submit a report by doing a study on various Engineering applications related to Manufacturing, Retail, Automotive, Logistics, Healthcare, Entertainment and E-Governance.

REFERENCE BOOKS:

1. PC Hardware-A Handbook –KateJ. Chase PHI(Microsoft)
2. ITEssentialsPCHardwareandSoftwareCompanionGuideThirdEditionbyDavid Anfinsonand Ken Quamme.– CISCO Press, Pearson Education.
3. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015,ISBN: 9788173719547.

4. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace,O'Reilly (SPD),2014,ISBN: 9789350239759
5. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford UniversityPress, Sixth impression,2010.
6. DebSR.andDebS.,—RoboticsTechnologyandFlexibleAutomation‖,TataMcGr awHill Education Pvt.Ltd,2010.
7. MikellP Groover,—Automation, Production Systems,and computerintegrat edManufacturing‖,PrenticeHall, 2001.
8. CheeKaiChua,KahFaiLeong,3DPrintingandAdditiveManufacturing:Principles andApplications: Fourth Edition of Rapid Prototyping.
9. Andreas Gebhardt, Understanding Additive Manufacturing: RapidPrototyping, Rapid Tooling,Rapid Manufacturing.

Ordinary Differential Equations and Vector Calculus

B. Tech. II Semester **L T P C**

Subject Code: 22MA201BS **3 1 0 4**

Pre-requisites: Mathematical Knowledge at pre-universitylevel

Course Objectives: To learn

1. Methods of solving the differential equations of first order differential equations.
2. Methods of solving the differential equations of higher order differential equations.
3. Concept, properties of Laplace transforms and Solving ordinary differential equations using Inverse Laplace transforms techniques.
4. The physical quantities of vector valued functions involved in engineering field
5. The basic properties and their applications to line and surface integrals.

Course outcomes: After learning the contents of this paper the student must be able to

1. Identifywhether the given differential equation of first order is exact or not.
2. Solve higher order differential equations.
3. Use Laplace transforms techniques to find the derivatives and integrals of given functions & inverse Laplace transforms techniques for solving ODE's
4. Analyze vector and scalar point functions.
5. Evaluate the line and surface integrals and converting them from one to another

UNIT-I: First Order ODE **[12 Lectures]**

Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (onlyin Cartesian Coordinates).

Applications: Newton's law of cooling, Law of natural growth and decay.

UNIT-II: Ordinary Differential Equations of Higher Order **[12 Lectures]**

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax},sinax, cosax, polynomials in x, $e^{ax}V(x)$and $xV(x)$, method of variation of parameters, Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Laplace transforms **[16 Lectures]**

Laplace Transforms: First shifting theorem and Change of scale property, Multiplication by' t' and division by 't', Laplace transforms of derivatives and integrals .Laplace transform of periodic functions. Inverse Laplace transforms: First Shifting theorem, Change of Scale Property, Inverse Laplace transforms of derivatives and Integrals, convolution theorem(without proof). Applications: Solving Initial value problems by Laplace Transform method.

UNIT-IV: Vector Differentiation **[10 Lectures]**

Vector point functions and scalar point functions, Gradient, Divergence and Curl, Directional

derivatives, Tangent plane and normal line, Scalar potential functions, Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration **[10 Lectures]**

Line, Surface &Volume integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS:

1. B.S.Grewal, Higher Engineering Mathematics,KhannaPublishers,36th Edition,2021
2. R.K.JAIN, S.R.K.Iyengar,Advanced Engineering Mathematics,.Narosa Publishing House, 4th Edition New Delhi,2020
3. T.K.V.Iyengar, B.Krishna Gandhi, S. Ranganathan and M.V.S.S.N.Prasad, Engineering Mathematics, S.Chand Publishing

REFERENCE BOOKS:

1. Kreyszing,Advanced Engineering Mathematics,.JohnWiley&Sons, 9th Edition 2006.
2. G.B.Thomas and R.L.Finney, Calculus and Analytic geometry,9th Edition,Pearson,Reprint,2002.
3. H.K.Dass and Er.Rajnish verma,Higher Engineering Mathematics,S Chand and Company Limited,New Delhi.
4. N.P.Bali and Manish Goyal,A text book of Engineering Mathematics, Laxmi Publocations,Reprint,2008

Web Links:

1. https://nptel.ac.in
2. https://onlinecourses.nptel.ac.in

Engineering Chemistry

B. Tech. II Semester **L T P C**

Subject Code: 22CH202BS **3 1 0 4**

Prerequesities: Engineering chemistryknowledge in school and college level.

Course Objectives:

To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.

1. To include the importance of water in industrial usage.
2. Analyze the properties and applications of industrial polymers.
3. Fundamental aspects of batterychemistry, significance of corrosion its control to protect the structures.
4. To imbibethe basic concepts of petroleum and its products.
5. To acquire required knowledge about engineering materials like cement, smart materials andLubricants.

Course Outcomes:

After completion of this course, the students will be able to:

1. Identifythe basic properties of water and its usage in domestic andindustrial purposes.
2. Learn the fundamentals and general properties of polymers and other engineeringmaterials. Applyin dayto daylife.
3. Make use of basic knowledge of electrochemical procedures related to corrosionand its control.
4. Interpret the concepts of petroleum products and cement, Smartmaterials.
5. Find potential applications of chemistry and practical utilityin order to becomegood engineers and entrepreneurs.

UNIT - I: Water Chemistry [8 Lectures]

Introduction to hardness of water – Estimation of hardness of water by complexometric method and numerical problems. Boiler troubles: Sludges, Scales and Caustic embrittlement. Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning - Colloidal conditioning, External treatment methods - Softening of water by ion- exchange processes. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break - point chlorination. Defluoridation – Removal of F^- ion in water by Nalgonda method. Desalination of water – Reverse osmosis.

UNIT – II : Polymers [8 Lectures]

Definition – Classification of polymers with examples – Types of polymerization –addition (free radical addition) and condensation polymerization with examples – Nylon 6:6.

Plastics: Definition and characteristics - thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC and Bakelite.

Rubbers: Natural rubber and its vulcanization.

Elastomers: Characteristics –preparation – properties and applications of Buna-S, andThiokol rubber.

Biodegradable polymers: Concept and advantages - poly vinyl alcoholand their applications.

Conducting polymers: Characteristics and Classification with examples - mechanism Of conduction intrans - polyacetylene and applications of conducting polymers.

UNIT - III: Batteries & Corrosion [8 Lectures]

Introduction - Classification of batteries- primary, secondary and reserve batteries with examples. Construction, working and applications of Lithium, Lithium ion and Zn-air battery, Applications of Li-ion battery to electrical vehicles. Fuel Cells-Construction and applications of Methanol Oxygen fuel cell.

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current methods. Metallic coating methods: Galvanization, Tinning and Eelectroplating

UNIT - IV: Energy Sources: [8 Lectures]

Introduction, Classification- Calorific value of fuel – HCV, LCV- Dulongs formula. solid fuels: coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Trans esterification, advantages.

UNIT - V: Engineering Materials: [8 Lectures]

Cement: Portland cement, its composition, setting and hardening.

Smart materials and their engineering applications

Shape memory materials- Poly L- Lactic acid. Thermo response materials- Polyacryl amides, Polyvinyl amides.

Lubricants: Classification of lubricants with examples-characteristics Of good lubricants - mechanism of lubrication (thick film, thin film and extreme pressure) properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

TEXT BOOKS:

1. P.C. Jain and M. Jain, Engineering Chemistry by Dhanpatrai Publishing Company, 2010.
2. Rama Devi, Venkata Ramana Reddy and Rath, Engineering Chemistry by Cengage learning,2016.
3. Jaya Shree Anireddy, Textbook of Engineering Chemistry by Wiley Publications.
4. M. Thirumala Chary, E. Laxminarayana and K.Shashikala, A text book of Engineering Chemistry by Pearson Publications, 2021.

REFERENCE BOOKS:

1. Shikha Agarwal, Engineering Chemistryby Cambridge University Press, Delhi 2015.
2. Shashi Chawla, Engineering Chemistry by Dhanpatrai and Company (P) Ltd. Delhi 2011.

Web Links

1. https://nptel.ac.in/courses/122106030
2. https://in.coursera.org/learn/corrosion
3. https://onlinecourses.nptel.ac.in/noc20_cy21/preview
4. https://archive.nptel.ac.in/courses/103/105/103105110/

Data Structures

B. Tech. II Semester **L T P C**

Subject Code: 22CS203ES **3 0 0 3**

Prerequisites: A Course on "Programming for problem solving".

Course Objectives:

1. Exploring basic data structures such as stacks and queues.
2. Introduces a varietyof data structures such as hash tables.
3. Discussion of search trees.
4. Understand the sorting algorithms.
5. Introduces pattern matching algorithms

Course Outcomes:

After completion of this course, the students will be able to:

1. Explain the basic concepts such as Abstract Data Types, Linear and Non-Linear Data structures.
2. Discuss hashing and different collision resolve techniques.
3. Design programs using a varietyof data structures including binarysearch trees, heaps trees and AVL-trees.
4. Design programs on sorting and graphs.
5. Applydifferent searching techniques on Non linear data structure

UNIT–I **[10 Lectures]**

Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

UNIT–II **[6 Lectures]**

Dictionaries: linear list representation, skip list representation, operations - insertion, deletion and searching.

Hash Table Representation: hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

UNIT–III **[8 Lectures]**

Search Trees: Binary Search Trees, Definition, Implementation, Operations-Searching, Insertion and Deletion, AVL Trees, Definition, Height of an AVL Tree, Operations–Insertion, Deletion and Searching, Red –Black, Splay Trees.

UNIT–IV **[8 Lectures]**

Graphs: Graph Implementation Methods. Graph Traversal Methods.

Sorting: Heap Sort, External Sorting- Model for external sorting, Merge Sort.

UNIT–V [8 Lectures]

Pattern Matching and Tries: Pattern matching algorithms-Brute force, the Boyer – Moore algorithm, the Knuth-Morris-Pratt algorithm, Standard Tries, Compressed Tries, Suffix tries.

TEXTBOOKS:

1. E. Horowitz, S. Sahni and Susan Anderson Freed, *Universities Press*. Fundamentals of Data Structures in C, 2nd Edition,2008.
2. A. S. Tanenbaum, Y. Langsam, and M. J.Augenstein,PHI/Pearson Education. Data Structures using C ,2004.

REFERENCE BOOKS:

1. 1. R. F. Gilberg and B.A. Forouzan, Cengage *Learning.* Data Structures: A PseudocodeApproach with C, 2nd Edition,2016.

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://www.programiz.com/dsa/data-structure-types
3. https://www.coursera.org/learn/data-structures

Basic Electrical & Electronics Engineering

L T P C

B. Tech. II Semester
Subject Code: 22EC204ES **3 1 0 4**

Prerequisites:

Course Objectives:

1. To introduce the concepts of electrical circuits and its components.
2. To studyand understand the different types of DC, AC single & three phase circuits.
3. To studyand understand the different types of DC, AC machines and Transformers.
4. To introduce the concepts of diodes & transistors.
5. To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

After completion of this course, the students will be able to:

1. Identifythe basic DC electrical circuits.
2. Evaluate the basic single phase and three phase AC circuits.
3. Analyze the working principles of Electrical Machines.
4. Classifythe concepts of diodes & Rectifiers.
5. Compare the knowledge of various transistor configurations, characteristics and applications.

UNIT- I: **[14 Lectures]**

D.C. CIRCUITS: Introduction, Types of elements, Definitions, Ohm's law and its limitations, Passive elements R-L-C, Energy sources-Ideal and practical, Series and Parallel combination of Resistances, Inductances and Capacitances, Star-Delta Transformation, Source transformation, Kirchhoff's Laws, Mesh analysis, Nodal analysis.

UNIT-II: **[12 Lectures]**

A.C. CIRCUITS: Representation of sinusoidal waveforms, Instantaneous value, Peak value, Average and RMS value, Form factor and Peak factor for sinewave, Rectifier output, Saw tooth and Square Waveforms, Phasor representation, Real power, Reactive power, Apparent power, Power factor, Analysis of single- phase ac circuits RL, RC, RLC series combination. Three phase balanced circuits, Voltage and current relationship in star and delta connections.

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UNIT – III: **[14 Lectures]**

TRANSFORMERS: Construction, Types, Working principle of Single-phase transformer, EMF equation, Equivalent circuit, Losses in transformers, Efficiency and Condition for maximum efficiency.

DC& AC Machines: Construction, Working Principle of DC generator, EMF equation, Types, Working principle of DC motor, Torque equation, Three phase induction motor construction and working, Slip and Rotor current frequency.

UNIT – IV: **[10 Lectures]**

DIODES: Principle of Operation, Diode current equation, Volt-Ampere characteristics, Static and dynamic resistances, Diffusion and Transition capacitances. Half Wave Rectifier, Full Wave Rectifier-Center-Tap and Bridge Rectifier, Ripple factor, Rectification efficiency, Peak

Inverse Voltage, Transformer Utilisation Factor, Simple problems. Zener diode characteristics, Zener diode as voltage regulator.

UNIT – V: **[10 Lectures]**

Bipolar junction Transistor: Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Current amplification factor, Relation between α and β, Comparison of CE, CB and CC configurations. SCR Construction, Operation and V-I characteristics.

TEXT BOOKS:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019
2. MS Naidu and SKamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2008.
3. M. S. Sukhija, T. K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford, 1st Edition, 2012.
4. V.K. Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics – S.Chand Publications, 2nd Edition,2014.

REFERENCEBOOKS:

1. R. L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits – PEI/PHI, 9th Ed, 2006.
2. J. Millman and C. C. Halkias, SatyabrataJit, Electronic Devices and Circuits – TMH, 2/e, 1998.
3. William Hayt and Jack E. Kemmerly, Engineering circuit analysis- McGraw Hill Company, 6th edition,2012.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Web Links:

1. www.youtube.com/watch?v=vh_aCAHThTQ
2. www.electricaleasy.com/2014/03/electrical-transformer-basic.html
3. www.youtube.com/watch?v=Unh99Qn7CmI
4. www.youtube.com/watch?v=d_LOXUEFA-o
5. www.electricaleasy.com/2022/09/construction-and-working-of-dc-generator.html.

Computer Aided Engineering Graphics

B. Tech. II Semester **L T P C**

Subject Code: 22ME205ES **1 0 2 2**

Pre-requisites: Computer Aided Engineering Graphics course of first year of study.
Course Objectives: To learn

1. To provide basic concepts in engineering drawing. To develop the abilityof visualization of objects through technical drawings
2. To impart knowledge about standard principles of orthographic projection of objects.
3. To draw projections of solids and pictorial views of solids and to draw surfaces development
   of solid for prisms, pyramids, cone and cylinder.
4. To draw isometric views of solids and orthographic projections of solids.
5. To acquire computer drafting skill for communication of concepts, ideas in the design of engineering products.

Course outcomes:

After completion of this course, the students will be able to:

1. Applycomputer aided drafting tools to sketch the conventions and the methods of drawings, engineering curves and scales
2. Identifyand draw the projections of points, lines and planes in different types of projections. manuallyand byusing computer aided drafting tools
3. Analyze the need of projections of solids (prisms, pyramids, cone and cylinder) manually and byusing computer aided drafting tools.
4. Evaluate and interpret engineering drawings for development of surfaces to Right Regular Solids-prism, manuallyand byusing computer aided drafting tool.
5. Change the conversion of orthographic projection into isometric view and vice versa manually and byusing computer aided drafting tool.

UNIT- I: INTRODUCTION TO ENGINEERING DRAWING [12 Lectures]

Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid. Scales – Plain and Diagonal. Introduction to CAD Software commands and practice.

UNIT -II: ORTHOGRAPHIC PROJECTIONS [12 Lectures]

Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. manually and by using computer aided drafting

UNIT –III: PROJECTIONS OF SOLIDS [12 Lectures]

Projections of Regular Solids – Prism, Cylinder, Pyramid and Cone. manually and by using computer aided drafting.

UNIT- IV: DEVELOPMENT OF SURFACE [12 Lectures]

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone. manually and by using computer aided drafting

UNIT –V: ISOMETRIC PROJECTIONS: [12 Lectures]

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions –Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non-isometric lines. Conversion of Isometric Views to Orthographic Views and Vice-versa. manually and by using computer aided drafting

Note: - Internal exam and The End Semester Examination will be conducted by using Auto Cad Software.

TEXTBOOKS:

1. N.D. Bhatt / Charotar, Engineering Drawing, Publisher: ***Charotar*** Publishing House · GenreJanuary 2019.
2. T. Jeyapoovan, Vikas: Engineering Drawing and graphics Using AutoCAD Third Edition S. Chand and company Ltd. January 2010.
3. N. S. Parthasarathyand Vela Murali/ Engineering Drawing/Oxford publications. 12th june 2015.
4. K Balaveera Reddy et al –Computer Aided Engineering Drawing, CBS Publishers. 2015.

REFERENCE BOOKS:

1. M. B. Shah, B.C. Rane / Engineering Drawing, Pearson. 2009
2. K Balaveera Reddy et al – Computer Aided Engineering Drawing, CBS Publishers. 2015
3. Basant Agrawal and C M Agrawal, Engineering Drawing, Third Edition McGraw Hil.2019
4. K Balaveera Reddy et al – Computer Aided Engineering Drawing -CBS Publishers. 2015.

WEBLINKS:

1. https://www.youtube.com/watch?v=ANEvQyt3PnU
2. https://www.youtube.com/watch?v=rp3swbAYZJU
3. https://www.youtube.com/watch?v=ga1ud9yQl4I
4. http://www.digimat.in/nptel/courses/video/105104148/L04.html
5. https://engineeringvideolectures.com/course/758

Engineering Chemistry Laboratory

B. Tech. II Semester **L T P C**

Subject Code: 22CH206BS **0 0 2 1**

Pre-requesities : To bring adaptabilityto new developments in engineering chemistrylab and acquire the knowledge in practical skills

Course Objectives:

The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

1. Estimation of hardness of water to checkits suitability for drinking purpose.
2. To perform estimations of acids and bases using conductometry and potentiometry methods.
3. To prepare polymers such as Bakelite and nylon-6.6 in the laboratory.
4. Learn skills related to the lubricant properties such as saponification value,surface tension and viscosity of oils.
5. Applythe skills in rate of corrosion to solve engineering problems.

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

1. Determination of parameters like hardness of water and rate of corrosion of mild steel in various conditions.
2. Perform methods such as conductometry and potentiometry in order to find out the concentrations or equivalence points of acids and bases.
3. prepare polymers like bakelite and nylon-6.6
4. Estimations of saponification value, surface tension and viscosity of lubricant oils.
5. Find the rate of corrosion of mild steel in various conditions.

List of Experiments:

I. **Volumetric Analysis:** Estimation of Hardness of water by EDTA Complexometrymethod.

II. **Conductometry:** Estimation of the concentration of anacid by Conductometry.

III. **Potentiometry:** Estimationof the concentration of an acid by Potentiomentry Estimation of the amount of Fe^{+2} by Potentiomentry.

I. Preparations:

1. Preparation of Bakelite.
2. Preparation Nylon – 6.6

II. Lubricants:

1. Estimation of acid value of given lubricant oil.
2. Estimation of Viscosity of lubricant oil using Ostwald's Viscometer.

III. Corrosion: Determination of rate of corrosion of mild steel in the presenceand absence of inhibitor.

IV. **Virtual lab experiments**

1. Construction of Fuel cell and it's working.
2. Smart materials for Biomedical applications
3. Batteries for electrical vehicles.
4. Functioning of solar cell and its applications.

REFERENCE BOOKS:

1. B. Ramadevi and P. Aparna, Engineering chemistry Lab manual for by S ChandPublications, New Delhi (2022).
2. Vogel's text book of practical organic chemistry 5th edition.
3. A.I. Vogel, Inorganic Quantitative analysis by ELBS Publications.
4. V.K. Ahluwalia, College Practical Chemistry by Narosa Publications Ltd. New Delhi (2007).

Web Links

1. www.youtube.com/watch?v=FCQ26RQBZLg
2. https://www.youtube.com/watch?v=-GS6uoFf3qQ
3. https://www.youtube.com/watch?v=Y48UgKi33Ps
4. https://www.youtube.com/watch?v=TC1M-XDHfDI

Data Structure Laboratory

B. Tech. II Semester **L T P C**

Subject Code: 22CS207ES **0 0 2 1**

Prerequisites: A Course on "Programming for problem solving".

Course Objectives:

1. It provides an understanding of linear data structures such as stacks and queues.
2. It provides an understanding of non linear data structures like tress and graphs.
3. It provides an understanding of linear and binarysearch algorithms.
4. It provides an understanding of sorting algorithms.

Course Outcomes:

After completion of this course, the students will be able to:

1. Implement various linear data structures.
2. Implement various non linear data structures.
3. Compare various searching and sorting algorithms.
4. Abilityto implement trees and graphs traversals.

LIST OF EXPERIMENTS

1. Write a program that uses functions to perform the following operations on single linked list.
   i) Creation ii) Insertion iii) Deletion iv) Traversal

2. Write a program that uses functions to perform the following operations on double linked list.
   i) Creation ii) Insertion iii) Deletion iv) Traversal

3. Write a program that uses functions to perform the following operations on circular linked list.
   i) Creation ii) Insertion iii) Deletion iv) Traversal

4. Write a program that implement stack (its operations) using
   i) Arrays ii) Pointers

5. Write a program that implement Queue (its operations) using
   i) Arrays ii) Pointers

6. Write a program that implements the following sorting methods to sort a given list of integers in ascending order
   i) Bubble sort ii) Selection sort iii) Insertion sort

7. Write a program that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers:
   i) Linear search ii) Binary search

8. Write a program to implement the tree traversal methods.

9. Write a program to implement the graph traversal methods.

TEXT BOOKS:

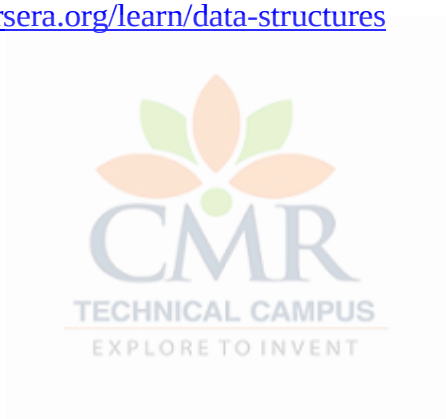
1. E. Horowitz, S. Sahni and Susan Anderson Freed, *Universities Press*. Fundamentals of Data Structures in C, 2nd Edition,2008.
2. A. S. Tanenbaum, Y. Langsam, and M. J.Augenstein,PHI/Pearson Education. Data Structures using C ,2004.

REFERENCE BOOKS:

1. R. F. Gilberg and B.A. Forouzan, Cengage *Learning.* Data Structures: A Pseudocode Approach with C, 2nd Edition,2016.

WEB LINKS:

1. https://nptel.ac.in/courses/106102064
2. https://www.programiz.com/dsa/data-structure-types
3. https://www.coursera.org/learn/data-structures



Basic Electrical & Electronics Engineering Lab

B.Tech. II Semester	L	T	P	C
Subject Code 22EC208ES	0	0	2	1

Prerequisites: Mathematics
Corequisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. To Analyze a given network byapplying various electrical laws.
2. To Analyze the performance of single phase transformers.
3. To Analyze the performance of transformers, DC and AC machines.
4. To introduce the concepts of diodes and transistors.
5. To impart the knowledge of various types of Rectifiers.

Course Outcomes:

After completion of this course, the students will be able to:

1. Verifythe Ohms law, KCL, KVL with practical approach.
2. Estimate the performance calculations of single phase transformers.
3. Analyze the Performance characteristics of DC and AC machines through various testing methods.
4. Compare the characteristics of different types of diodes and transistors.
5. Evaluate the performance of Rectifiers with and without filters.

SECTION A: ELECTRICAL ENGINEERING:

1. Verification of Ohm's law.
2. Verification of KCL and KVL.
3. Brake test on DC Shunt motor.
4. Brake test on 3-phase Induction motor.
5. Load Test on Single-Phase Transformer.
6. Measurement of Voltage, Current and Real Power in Primary and Secondarycircuits of a Single Phase Transformer.
7. No Load Characteristics of 3 phase Alternator.

SECTION B: ELECTRONICS ENGINEERING:

1. 1. Studyand operation of
   (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies iv) CRO
2. PN Junction Diode Characteristics A)Forward bias B) Reverse bias
3. Zener Diode CharacteristicsA)Forward bias B) Reverse bias
4. Input and Output characteristics of BJT in CE Configuration.
5. Half wave Rectifier without and with Filters .
6. Full wave Rectifier without and with Filters .
7. Note: Total 10 experiments are to be conducted.

(Minimum Five experiments from PART-A, Five experiments from PART-B)

TEXT BOOKS:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019.

2. MS Naidu and S Kamakshaiah, “Basic Electrical Engineering”, Tata McGraw Hill, 2nd Edition, 2008.

REFERENCE BOOKS:

1. P. Ramana, M. Suryakalavathi, G.T.Chandrasheker,”Basic Electrical Engineering”, S. Chand, 2 nd Edition, 2019.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
3. M. S. Sukhija, T. K. Nagsarkar, “Basic Electrical and Electronics Engineering”, Oxford, 1st Edition, 2012.
4. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, “Basic Electrical Engineering”, 2nd Edition, McGraw Hill, 2021.

Web links: -

1. .https://www.youtube.com/watch?v=Ki60DB0I3W4&list=PLwymdQ84KI-x0T05PcG6D_2rhbWV_O93B&index=2
2. https://www.youtube.com/watch?v=W-AqhZLm7h4
3. https://www.youtube.com/watch?v=UkH4CaAsG6Q
4. https://www.youtube.com/watch?v=Hfkd7UFSIF0
5. https://www.youtube.com/watch?v=i9wbWYtm2cI
6. https://www.youtube.com/watch?v=UdaATCmDfYU
7. https://www.youtube.com/watch?v=1IZIjIf3NDw
8. https://www.youtube.com/watch?v=X-i1MevYcpM
9. https://www.youtube.com/watch?v=syZgyPLHyp8
10. https://www.youtube.com/watch?v=QGawHsg4NpQ

Environmental Science

B. Tech. II Semester **L T P C**

Subject Code: 22CH209MC **3 0 0 0**

Prerequisites: None

Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understanding the environmental policies and regulations

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

1. Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Analyze and synthesize scientific data to characterize and evaluate the status of atleast one type of ecological system and apply skills of measurement, spatial orientation, sampling, and data analysis to characterize natural resource phenomena
3. Create awareness on the basic philosophyof science, concepts and scope.
4. Evaluate consequences of human exposure to pollution and its impacts to environmental quality.
5. Comprehending the statutoryand regulatorymechanisms pertaining to environment in India and understanding judicial response to environmental issues in India.

UNIT-I **[10 Lectures]**

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnifications, ecosystem value, services and carrying capacity, Field visits.

UNIT-II. **[7 Lectures]**

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: useand over utilization of surface and ground water, floods and droughts, Dams: benefits and problems.Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energysource, case studies.

UNIT-III [**7 Lectures**]

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV [**10 Lectures**]

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of

modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater

Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and MontréalProtocol. NAPCC-GoIInitiatives.

UNIT-V [**8 Lectures**]

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wildlife Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. **EIA:** EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects.Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Footprint, Life Cycle assessment (LCA), Lowcarbon lifestyle.

TEXTBOOKS:

1. Erach Bharucha , Textbook of Environmental Studies for Undergraduate Courses, The Orient Black swan, 2nd edition , 1 January2015.
2. R. Rajagopalan, Environmental Studies , Oxford UniversityPress,3rd edition, April, 2015

REFERENCE BOOKS:

1. Richard T. Wright, Environmental Science: towards a sustainable future , Benjamin Cummings Pub Co,13th edition, 17 January2016.
2. Gilbert M. Masters and Wendell P. Ela, Environmental Engineering and science, Pearson, 3rd edition, 15 December 2006.
3. Daniel B. Botkin & Edward A. Keller, Environmental Science , Wiley publishing,8th edition,2012.
4. Anubha Kaushik, Environmental Studies , New age international publishers, 4th Edition, 1 January2012
5. Dr. M. AnjiReddy, Textbook of Environmental Science and Technology ,BS Publications, 31 october 2014.
6. Y. Anjaneyulu , Introduction to Environmental Science , BS.Publications, 1 January 2004

Web links:

1. https://onlinecourses.nptel.ac.in
2. https://archive.nptel.ac.in
3. https://onlinecourses.swayam2.ac.in
4. https://onlinecourses.nptel.ac.in
5. https://onlinecourses.nptel.ac.in

Electronic Devices and Circuits

B.Tech. III Semester.

L	T	P	C
3	0	0	3

Subject Code: 22EC301PC

Pre-requisite: Basic Electrical and Electronics Engineering

Course Objectives:

1. To know about Special purpose devices and it's applications.
2. To introduce biasing, stabilization concepts and compensation technique.
3. To analyze the Small Signal low frequency BJT Amplifiers.
4. To Estimate parameter ofmultistage amplifiers of BJT and high frequency analysis of BJT.
5. To know the types of JFET characteristics, it's applications and to analyze various FET amplifiers.

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

1. IllustrateSpecial purposedevices, characteristics and its applications.
2. Applythe concepts of biasing, stabilization and compensation techniques for transistor.
3. Identifyh-parameter for thesinglestageamplifiers of BJT at its low frequency.
4. Estimatethe parameter of multistage amplifiers of BJT and Analyze BJT at high frequency.
5. Evaluate the various configuration of JFET and analyze its amplifier.

UNIT – I **[8 Lectures]**

Special purpose devices: Principle of operation- SCR, Tunnel Diode, UJT and UJT as Relaxation oscillator, Photo diode, LED and Varactor diode.

UNIT – II **[8 Lectures]**

Transistor Biasing and Stabilization: Need for biasing, DC and AC load lines, operating point, fixed bias, collector to base bias, self-bias techniques for stabilization, stabilization factors (S, S',S''), Thermal runaway and thermal stability.

UNIT – III **[8 Lectures]**

Analysis of Small Signal low frequency Amplifiers: Transistor Hybrid model, Typical values of h- parameters in CE, CB and CC configurations, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of CE Amplifier- effect of coupling and bypass capacitors.

UNIT – IV **[10 Lectures]**

Multistage Amplifiers: Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers- Cascade RC Coupled amplifiers and Darlington pair.

Transistor at High Frequency: Hybrid PI- model of Common Emitter transistor model, CE short circuit current gain ($f\alpha$), CE short circuit current gain with load and Gain-bandwidth product.

UNIT – V **[8 Lectures]**

Field Effect Transistor: JFET- Construction, Principle of operation, Pinch-off Voltage, Volt-Ampere Characteristics, Comparison of BJT and FET, Biasing of FET, FET as Voltage Variable Resistor. MOSFET Characteristics in Enhancement and Depletion mode, Basic Concepts of MOS Amplifiers.

FET Amplifiers: Small Signal Model**,** Analysis of JFET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers.

TEXT BOOKS:

1. Jacob Millman, ElectronicDevices andCircuits,McGraw Hill Education, 4th Edition,2015 .
2. Robert L. Boylestead, Louis Nashelsky, Electronic Devices and Circuits theory, Pearson, 11th Edition, 2009.

REFERENCE BOOKS:

1. Horowitz, The Art of Electronics, Cambridge UniversityPress, 3rd Edition, 2015.
2. David A. Bell, Electronic Devices and Circuits, Oxford, 5th Edition, 2008.

Web Links:

1. https://www.electronics-tutorials.ws/diode/diode_2.html
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11 by Dr. Chitralekha Mahanta, IIT Guwahati.

Digital System Design

B.Tech. III Semester.

L	T	P	C
3	0	0	3

Subject Code: 22EC302PC

Pre-requisite: Basic Electrical and Electronics Engineering

Course Objectives:

1. To Compare common forms ofnumber representation in logic circuits.
2. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
3. To Distinguish the concepts of combinational logic circuits and sequential circuits.
4. To Realize LogicGates usingDiodes &Transistors.

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

1. Compare the numerical information in different forms and Boolean Algebra theorems.
2. Applythe varioussimplification methods to Simplifythe given Boolean function, Analyze and design various combinational logic circuits.
3. Learns Concepts of Sequential circuits, Simplyand design various Registers and Counters
4. Buildthe various sequential state machines.
5. Illustrate logic families with logic gates Using Diodes & Transistors.

UNIT - I **[8 Lectures]**

Number Systems: Number systems, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Paritycheck code and Hamming code.

Boolean Algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, UniversalGates, Multilevel NAND/NOR realizations.

UNIT – II **[8 Lectures]**

Minimization of Boolean functions: Karnaugh map method, don’tcare map entries, tabular method.

Combinational Logic Circuits: Adders, subtractors, multiplexers, de multiplexers, encoders, decoders and code converters.

UNIT – III **[10 Lectures]**

Sequential Circuits Fundamentals: Basic Architectural comparison Of Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Conversion from one type of Flip-Flop to another.

Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Applications of Shift Registers - Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters, Synchronous Modulo N – Counters.

UNIT – IV **[8 Lectures]**

Sequential Machines: Finite State Machines, Synthesis of Synchronous Sequential Circuits-Serial Binary Adder, Sequence Detector, Parity-bit Generator, Finite state machine-capabilities and limitations, Mealyand Moore models.

UNIT – V [8 Lectures]

Realization of Logic Gates Using Diodes & Transistors: AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its comparison, Classification of Integrated circuits, comparison of various logic families, standard TTLNAND Gate, TTLopen collector O/Ps, Tristate TTL.

TEXT BOOKS:

1. ZviKohavi & Niraj K. Jha, Switching and Finite Automata Theory,Cambridge, 3rd Edition 2010.
2. R. P. Jain, Modern Digital Electronics,Tata McGraw-Hill, 3rd Edition, 2007.

REFERENCE BOOKS:

1. Morris Mano, Digital Design, PHI, 4th Edition, 2006, .
2. Fredriac J. Hill, Gerald R.Peterson, Introduction to Switching Theoryand Logic Design, John Wiley& Sons Inc., 3rd Ed, 2009.
3. Charles H. Roth, Fundamentals of Logic Design,Cengage Learning, 5th Edition, 2004.
4. A Anand Kumar, Switching Theoryand Logic Design,PHI, 3rd edition, 2016.

WEB LINKS:

1. http://nptel.ac.in/courses/117/106/117106086/ (By Prof. Goutam Saha, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur).
2. www.nptelvideos.in/2012/12/digital-circuits-and-systems.html(By Prof. Santanu Chattopadhyay, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur).
3. https://www.smartzworld.com/notes/switching-theory-and-logic-design-stld/.

Signals and Systems

B. Tech. III Semester.

L	T	P	C
3	0	0	3

Subject Code: 22EC303PC

Pre-requisite: Basic Electrical and Electronics Engineering

Course Objectives:

1. To learn signal analysis and the use of Sampling theorem.
2. To represent a given signal in frequencydomain.
3. To gain proficiencyin using Laplace transforms on continuous signals or systems.
4. To study Z-transforms and its properties.
5. To obtain the response of linear systems and remove noise byusing correlation technique.

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

1. Distinguish various signals and understand sampling theorem.
2. Express periodic signals in terms of Fourier series and non-periodic signals by Fourier transform.
3. Able to use Laplace transforms for continuous time signals and systems.
4. Apply Z- transforms for analysis of discrete- time signals and systems
5. Understand the signal transmission through linear systems.

UNIT – I **[8 Lectures]**

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Classification of Signals.

Sampling theorem: Statement and proof of sampling theorem for band limited Signals, Nyquist rate, Effect of under sampling – Aliasing, Sampling Techniques: Impulse Sampling, Natural sampling, and Flat Top Sampling.

UNIT – II **[8 Lectures]**

Fourier series: Trigonometric Fourier Series, Exponential Fourier Series, Dirichlet's conditions, Fourier series representation of standard periodic signals.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Properties of Fourier Transform, Fourier Transform of standard and arbitrary signals, Hilbert Transform.

UNIT – III **[8 Lectures]**

Laplace Transform: Laplace Transform, Inverse Laplace Transform, concept of Region of Convergence (ROC) for Laplace Transforms, Properties of ROC, Properties of Laplace Transform, Relation between L.T and F.T of a signal, Laplace Transform of standard signals.

UNIT – IV **[8 Lectures]**

Z–Transform: Concept of Z- Transform of a Discrete Sequence, Inverse Z-transform, Distinction between Laplace and Z Transforms, Relation between Z transform and Fourier transform of a discrete sequence. Region of Convergence in Z-Transform, Properties of ROC, Properties of Z- transforms.

UNIT – V **[8 Lectures]**

Signal Transmission through Linear Systems: Introduction to systems, properties of systems, Linear time invariant (LTI) system, Impulse response, Transfer Function, Distortion less transmission through a linear system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, BPF and BSF characteristics, Causality and Paley-Wiener criterion for physical realization, Concept of convolution in Time domain and Frequency domain.

TEXT BOOKS:

1. B.P. Lathi,Signals, Systems & Communications, BSP, 2nd Edition,2003.
2. A.V. Oppenheim, A.S. Willskyand S.H. Nawabi, Signals and Systems, Pearson, 2ndEd, 2015.

REFERENCE BOOKS:

1. Simon Haykin and Van Veen, Signals and Systems, Wiley, 2nd Ed, 2021.
2. A. Rama Krishna Rao, 2008, Signals and Systems, TMH.
3. Michel J. Robert, Fundamentals of Signals and Systems, MGH International Edition, 1st edition, 2008.
4. C. L. Philips, J.M.Parr and Eve A.Riskin, Signals, Systems and Transforms, PE, 3rd Ed., 2004.
5. K. Deergha Rao, Signals and Systems, Birkhauser, 1st Edition, 2018.

WEB LINKS:

1. https://freevideolectures.com/course/3540/signals-and-systems-i
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/
3. https://nptel.ac.in/courses/108/104/108104100/by Prof. Aditya K.Jagannatham, Department of Electrical Engineering, IIT Kanpur.

Probability Theoryand Stochastic Processes

B. Tech. III Semester

L	T	P	C
3	0	0	3

Subject Code: 22EC304PC

Pre-requisite: Mathematics

Course Objectives:

1. This gives basic understanding of random signals and processing
2. Utilization of Random signals and systems in Communications and Signal Processing areas.
3. To knowthe Spectral and temporal characteristics of Random Process.
4. To Learn the Basic concepts of Noise sources.

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

1. Define the concepts of probability, theorems, density and distribution functions of various distributions.
2. Determine moments about the origin and central moments of random variables, know the significance of Central Limit Theorem.
3. Evaluate the temporal characteristics of Random processes.
4. Estimate the spectral characteristics of Random processes and characterize the response of linear systems to random signals.
5. Describe various noise sources in communication systems and acquire the knowledge of information theory.

UNIT – I **[8 Lectures]**

Probability & Random Variable: Probability Definitions and Axioms, Random Experiments and Sample spaces, Events, Baye's Theorem and its proof, Random Variable - Definition, Conditions for a function to be a random variable, Distribution Function - Properties, Density Function - Properties. Vector Random Variables: Joint Distribution Function - Properties, Joint Density Function - Properties, Marginal Distribution and Density Functions, Statistical Independence.

UNIT – II **[10 Lectures]**

Operations On Single & Multiple Random Variables – Expectations: Expected Value of a Random Variable, Moments about the origin: Mean, Variance, and Correlation. Central Moments: Variance, and Covariance. Moment Generating Function – Properties, Characteristic Function - Properties, Random Variable Distributions: Gaussian Distribution, Uniform Distribution, Binomial Distribution, and Poisson Distribution. Sum of Two Random Variables, Central Limit Theorem. Linear Transformations of Gaussian Random Variables.

UNIT – III **[8 Lectures]**

Stochastic Processes – Temporal Characteristics: The Stochastic Process Concept and defintions, Classification of Stochastic Processes, Stationarity, Wide Sense Stationarity, Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function -Properties, Cross Correlation Function - Properties, Gaussian Random Process, Poisson Random Process.

UNIT – IV **[8 Lectures]**

Stochastic Processes Spectral Characteristics: The power Density Spectrum, Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross- Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function, Average Power of a Random Process.

UNIT – V **[8 Lectures]**

Noise Sources & Information Theory: Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature and Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties. Entropy, Mutual Information, Source coding: Huffman coding, Shannon Fano coding. Channel capacity Theorem.

TEXT BOOKS:

1. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, TMH, 4th Edition,2001.
2. Taub and Schilling, Principles ofCommunication systems, TMH, 3rd Edition, 2007.

REFERENCE BOOKS:

1. BruceHajck, Random Processes for Engineers, Cambridge unipress, 1st Edition, 2015.
2. Athanasios Papoulis and S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, PHI, 4th Edition, 2002.
3. K. Murugesan, P. Guruswamy, Probability, Statistics & Random Processes, AnuradhaAgencies, 3rd Edition, 2003.
4. B.P. Lathi,Signals, Systems &Communications, BSP, 2nd Edition,2003.
5. S.P Eugene Xavier, Statistical Theory of Communication, New Age Publications, 1st Edition, 2003.

Web Links:

1. http://nptel.ac.in/courses/117105085/ - byProf.M.Chakraborthy, IIT Khargpur.
2. https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-spring-2015/Offered byMIT
3. https://onlinecourses.nptel.ac.in/noc19_ma30/preview - by Prof. S. Dharmaraja, IIT Delhi.

Network Analysis

B.Tech. III Semester

L	T	P	C
3	1	0	4

Subject Code: 22EC305ES

Pre-Requisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. To explain the basic concepts of RLC circuits, network theorems and it's frequency domain analysis.
2. To understand the basics of magnetic circuits and network topology.
3. To know the behavior of the steady states and transient states in RLC circuits.
4. To study the transfer function and network functions in S domain.
5. To Apply the two port network parameters.

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

1. Illustrate the circuit using various theorems and frequency domain analysis of RLC series resonance circuit.
2. Analyze the knowledge of magnetic circuits and network topology.
3. Asses the Steady state and transient states of RLC Circuits.
4. Interpret the network functions in S domain.
5. Design and analyze the knowledge of characteristics of the two port network parameters.

UNIT – I **[10 Lectures]**

Network Theorems (DC Circuits only): Super position theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem.

Frequency Domain Analysis: Series and parallel Resonance - Resonance curves, Bandwidth, quality factor.

UNIT – II **[8 Lectures]**

Magnetic Circuits: Self and Mutual inductances, co-efficient of coupling, dot convention, coupled circuits, equivalent T for Magnetically coupled circuits.

Network Topology: Definition, Incident matrix, loop matrix, Basic cut-set and tie set matrices for planar networks and network equilibrium equations.

UNIT – III **[8 Lectures]**

Transient and Steady State analysis: RC, RL and RLC Circuits, Circuits with switches, step response, 2nd order RLC Circuits, Root locus, damping factor, over damped, under damped, critically damped cases.

UNIT – IV **[8 Lectures]**

Network Analysis using Laplace transform techniques - RC, RL and RLC circuit response for step, impulse exponential excitation and periodic excitation.

UNIT –V **[8 Lectures]**

Two port network parameters: Z, Y, ABCD, h and g parameters, network function, driving point and transfer functions – using transformed (S) variables, Poles and Zeros.

TEXT BOOKS:

1. Van Valkenburg, Network Analysis, Pearson, 3rd Edition, 2016,.
2. William Hayt and Jack E Kemmerly, Engineering Circuit Analysis, MGH, 8th Edition,1993.

REFERENCE BOOKS:

1. J. Edminister and M. Nahvi, Electric Circuits, Schaum's Outlines, McGraw Hill Education, 7th Edition, 2017.
2. JDRyder, Networks, Lines and Fields, PHI, 2nd Edition,1999.
3. Ravish R Singh, Network Analysis and Synthesis, McGraw Hill education, 1st Edition, 2017.

Web Links:

1. https://nptel.ac.in/courses/108/105/108105159/ by Prof. Tapas Kumar Bhattacharya
2. http://ocw.mit.edu
3. www.allaboutcircuits.com
4. www.analyzethat.net

Electronic Devices and Circuits Lab

B.Tech. III Semester

L	T	P	C
0	0	3	1.5

Subject Code: 22EC306PC

Co-requisite: ElectronicDevices andCircuits

Course Outcomes:

Upon Completion of the course, students will be able to

1. Examine the performance of UJT.
2. Analyze the Q-Point in BJT and design of self-bias circuit.
3. Estimatethe characteristics of BJT and its applications.
4. Evaluate the JFET characteristics and amplifiers.
5. Design and analyze the multistage amplifiers.

Listof Experiments: ***Perform any twelve experiments*****.**

1. UJT Characteristics and UJT as Relaxation Oscillator.
2. Perform an experiment to choose Q-point for a Transistor that operate in active region and observe the effect of external Load resistance on Q-point.
3. Design a Self-bias Circuit and determine the Q-point of the Transistor and its Stability factor byboth simulation and realization with hardware components.
4. Obtain the I/O Characteristics of CB Configuration and calculate its h-parameters.
5. Obtain the I/O Characteristics of CE Configuration and calculate its h-parameters.
6. Verifyfrequency response of Common Emitter Amplifier Circuit.
7. Verifyfrequencyresponse of Emitter Follower Circuit.
8. Obtain the Drain and Transfer characteristics of CS Configuration of JFET
9. Verifyfrequencyresponse of CS amplifiers of JFET.
10. Verifyfrequencyresponse of two stage RC Coupled amplifier
11. Practicallyprove that the Darlington pair has high input impedance.

MajorEquipment required forLaboratories:

1. Regulated Power Suppliers,0-30V
2. 20 MHz, Dual Channel Cathode RayOscilloscopes.
3. Functions Generators-Sine and Square wave signals
4. Multi meters
5. Electronic Components

Digital SystemDesign Lab

B.Tech. III Semester.

L	T	P	C
0	0	2	1

Subject Code: 22EC307PC

Co-requisite: Digital System Design

Course Outcomes: On Completion of the course, students will be able to

1. Realization of Boolean Expressions using Gates and universal gates using appropriate experimentation setup.
2. Compare Various Adder & Subtractor using appropriate experimentationsetup. Combinational Circuits.
3. Design and realization of Various Mux & Comparator Combinational Circuits using appropriate experimentation setup.
4. Build a Synchronous and Asynchronous counter using flip-flops using appropriate experimentation setup.
5. Create sequence detector-a finite state machine using appropriate experimentation setup.

Note: Implement using digital ICs, all experiments to becarried out. List of Experiments -

1. Realization of Boolean Expressions using Gates
2. Design and realization logic gates usinguniversal gates
3. Generation ofclock using NAND / NOR gates
4. Design a 4 – bit Adder /Sub tractor Using Gates
5. Design and realization ofa 4 – bit grayto Binaryand Binaryto GrayConverter
6. Design and realization of an 8-bit parallel load and serial out shift register using flip-flops.
7. Design and realization ofa Synchronous and Asynchronous counter using flip-flops
8. Design and realization ofAsynchronous counters using flip-flops
9. Design and realization of8x1 MUX using 2x1MUX
10. Design and realization of4-bitcomparator
11. Design and Realization ofa sequence detector-a finite state machine

MajorEquipment's required forLaboratories:

1. 5 V Fixed Regulated Power Supply/ 0-5V ormoreRegulated Power Supply.
2. 20 MHz Oscilloscope with Dual Channel.
3. Bread board and components/ Trainer Kit.
4. Multi meter.

Basic Simulation Lab

B. Tech. III Semester.

L	T	P	C
0	0	3	1.5

Subject Code: 22EC308PC

Co-requisite: Signals & Systems

Course Outcomes: Upon completing this course, the students will be able to

1. Relate matrix operations, signals generation, convolution and correlation techniques, and perform various operations on signals/sequences.
2. Obtain the Response of Linear System and Verifyits Properties.
3. Examine Gibbs Phenomenon, and Sampling Theorem.
4. Evaluate Fourier Transform, Laplace Transform and plot Pole-Zero Plot.
5. Determine Gaussian noise parameters, Analyze correlation techniques for noise removal, Periodic Signal Extraction, Wiener Khinchine Relations, and Wide Sense Stationarityof Random Processes.

Note:

- All the experiments areto be simulated using MATLAB or equivalent software

Listof Experiments:

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Even and Odd Parts, Real and Imaginary Parts, Energy, and Average Power.
4. Convolution andCorrelation of Signals and sequences.
5. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI system and verifying its linearity, Time Invariance, physical realizabilityand stability properties.
6. Gibbs Phenomenon Simulation.
7. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
8. Waveform Synthesis using Laplace Transform.
9. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane forthe given transfer function.
10. Generation of Gaussian noise (Real and Complex), Computation of its mean, M.S. Value and its Skew, Kurtosis, and PSD, ProbabilityDistribution Function.
11. Verification ofSampling Theorem.
12. Removal ofnoise byAutocorrelation / Cross correlation.
13. Extraction ofPeriodic Signal masked bynoise using Correlation.
14. Verification ofWeiner-Khintchine Relations.
15. Checking a Random Process for Stationarityin Widesense.

MajorEquipment's required forLaboratories:

1. Computer System with latest specifications connected
2. Window XP or equivalent
3. Simulation software-MATLAB or anyequivalent simulation software

Gender Sensitization Lab

B.Tech. III Semester.

L	T	P	C
0	0	2	0

Subject Code: 22EN309MC

Course Objectives:

1. To develop students' sensibilitywith regard to issues of gender in contemporary India.
2. To introduce students to information about some keybiological aspects of genders.
3. To expose the students to debates on the politics and economics of work.
4. To help students reflect criticallyon gender violence.
5. To expose students to more egalitarian interactions between men and women

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

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
3. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
4. Men and women students and professionals will be better equipped to work and live together as equals.
5. Students will develop a sense of appreciation of women in all walks of life.

UNIT-I: UNDERSTANDING GENDER [4 Lectures]

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT-II: GENDER ROLES AND RELATIONS [4 Lectures]

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender RolesGender Roles and Relationships Matrix-Missing Women-Sex Selection and Its ConsequencesDeclining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT-III: GENDER AND LABOUR [4 Letures]

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. - Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming.

UNIT – IV: GENDER - BASED VIOLENCE [4 Lectures]

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu". Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT-V: GENDER AND CULTURE [4 Lectures]

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature-Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa ParksThe Brave Heart

TEXT BOOKS:

Writers: A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu
Published by: Telugu Academy, Telangana Government
Year: 2015

REFERENCE BOOKS:

1. Dr Rajpal Singh, Dr Anupama Sihag, Gender Sensization: Issues and Challenges, Raj Publications 2019.

WEB LINKS:

2. http://ncw.nic.in/sites/default/files/Booklet-%20Gender%20Sensitization_0.pdf
3. 2.http://gmmrcg.in/Content/284_464_7.1.1%20weblink%20annual%20gender%20sensitization%20action%20plan.pdf

Analog and Digital Communications

B. Tech. IV Semester	L	T	P	C
	3	0	0	3

Subject Code: 22EC401PC

Prerequisite: Probability theoryand Stochastic Processes

Course Objectives:

1. To develop ability to analyze system requirements of analog and digital communication systems.
2. To understand the generation, detection of various analogand digital modulation techniques.
3. To acquiretheoretical knowledge of each block in AM, FM transmitters and receivers.
4. To understand the concepts of base band transmissions.

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

Illustrates of various Amplitude modulation and demodulation techniques.

1. Explain various angle modulation and demodulation techniques
2. Acquire the knowledge about AM, FM Transmitters and Receivers
3. Evaluate the various Pulse Modulation Techniques.
4. Distinguish the concepts of Digital Modulation Techniques and Baseband transmission.

UNIT – I **[8 Lectures]**

Amplitude Modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves - Balanced Modulators, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, SSB modulation - time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, Demodulation of SSB Waves, principle of Vestigial side band modulation.

UNIT – II **[8 Lectures]**

Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Comparison of FM and AM., Concept of Pre-emphasis and de- emphasis.

UNIT – III **[8 Lectures]**

Transmitters: Classification of Transmitters, AM Transmitters, FM Transmitters

Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, super heterodyne receiver, Intermediate frequency, Image frequency, AGC, Comparison of AM and FM Receivers.

Pulse Modulation: Types of Pulse modulation-PAM, PWM and PPM. Comparison of FDM and TDM.

UNIT – IV **[10 Lectures]**

Pulse Code Modulation: PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noisein PCM and DM.

UNIT – V **[10 Lectures]**

Digital Modulation Techniques: ASK- Modulator, Coherent ASK Detector, FSK- Modulator, Non- Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM, Probabilityof Error.

Baseband Transmission of Digital Signal: A Baseband Signal Receiver, ISI, Eye Diagrams.

TEXTBOOKS:

1. Simon Haykin, An Introduction to Analog and Digital Communications, John Wiley, 2nd Edition, 2015.
2. WayneTomasi, Electronics Communication Systems-Fundamentals through Advanced, PHI, 5th Edition, 2009.

REFERENCE BOOKS:

1. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, McGraw-Hill, 3rd Edition, 2008,.
2. Dennis Roddyand John Coolean, Electronic Communications, PEA, 4th Edition, 2004,.
3. George Kennedyand Bernard Davis, Electronics & Communication System, TMH, 5th Edition, 2011.
4. K. Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt Ltd, . 1st Edition, 2017.

Web Links:

1. http://nptel.ac.in/courses/117102059/ Prof. Surendra Prasad.
2. https://ict.iitk.ac.in/wp-content/uploads/EE320A-Principles-Of-Communication-CommunicationSystems-4ed-Haykin.pdf.
3. http://bayanbox.ir/view/9144090835198890 86/Book-Modern-Digital-And-AnalogCommunication-Systems-4th-edition-by-Lathi.pdf.
4. https://soaneemrana.org/onewebmedia/ELECTRONICS%20COMMUNICATION%20SYSTEM%20BY%20GEORGE%20KENNEDY.pdf

Numerical Methods and Complex Variables

B. Tech. IV Semester

L	T	P	C
3	0	0	3

Subject Code: 22MA402BS

Pre-requisites: Mathematics courses of first year of study.

Course Objectives: To learn

1. Expressing periodic function byFourier series and a non-periodic function by Fourier transforms
2. Various numerical methods to find roots of an equation and concept of finite differences and to estimate the value for the given data using interpolation.
3. Howto solve ordinarydifferential equations and integrals using numerical techniques
4. Differentiation and integration of complex valued functions.
5. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.

Course outcomes: After learning the contents of this paper the student must be able to

1. Express anyperiodic function in terms of sine and cosine
2. Find the root of a given polynomial and transcendental equations and Estimate the value for the given data using interpolation
3. Find the numerical solutions for a given first order ODE's
4. Analyze the complex function with reference to their analyticity.
5. Complex integration using Cauchy's integral and residue theorems.

UNIT-I: Fourier Series & Fourier Transforms: 10 Lectures

Fourier series - Dirichlet's Conditions - Half-range Fourier series - Fourier Transforms: Fourier Sine and cosine transforms - Inverse Fourier transforms.(CO1,T1,R1)

UNIT-II: Numerical Methods-I 10 Lectures

Solution of polynomial and transcendental equations: Bisection method, Iteration Method, Newton- Raphson method and Regula-Falsi method.

Finite differences: forward differences, backward differences, central differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae, Lagrange's method of interpolation.(CO2,T2)

UNIT-III: Numerical Methods-II 8 Lectures

Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8th rules.

Ordinary differential equations: Taylor's series, Picard's method, Euler method and Runge-Kutta method of fourth order for first order ODE(CO3,T2)

UNIT-IV: Complex Differentiation 10 Lectures

Limit, Continuity and Differentiation of Complex functions. Cauchy-Riemann equations (without proof), Milne-Thomson methods, analytic functions, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties. (All theorems without Proofs)(CO4,T1,T3)

UNIT-V: Complex Integration: 10 Lectures

Line integrals, Cauchy's theorem, Cauchy's Integral formula, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem.(CO5,T1,T3)

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. S.S. Sastry, Introductorymethods of numerical analysis, PHI, 4th Edition, 2005.
3. T.K.V.Iyengar, B.Krishna Gandhi, Engineering Mathematics,S.Chand Publishers.

REFERENCE BOOKS:

1. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations, New Age International publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004.

Electronic Circuit Analysis

B.Tech. IV Semester

L	T	P	C
3	0	0	3

Subject Code: 22EC403PC

Pre-requisite: Electronic Devices and Circuits

Course Objectives:

1. To define concepts of various types of amplifiers using feedback techniques and analyze its characteristics.
2. To explain working principle of oscillator and working of their types.
3. To estimate parameter of large signal amplifiers and tuned amplifiers.
4. To learn the Concepts of Non-Linear wave shaping.
5. To construct various multi vibrators and understand the concepts of various sweep circuits. .

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

Compare and Analyze Various Feedback Amplifiers.

1. Distinguish various types of LC, RC oscillators.
2. Evaluate Power and Tuned Amplifiers.
3. Design various circuits like Clippers and Clampers.
4. Create Multi vibrators and sweep generators.

UNIT – I **[8 Lectures]**

Feedback Amplifiers: Concepts of feedback – Classification of feedback amplifiers – General Characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current Shunt Feedback configurations.

UNIT – II **[8 Lectures]**

Oscillators: Condition for Oscillations, RC type Oscillators-RC phase shift and Wein-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators, Frequencyand amplitude stabilityof Oscillators, Crystal Oscillator.

UNIT – III **[10 Lectures]**

Large Signal Amplifiers: Class A Power Amplifier- Series fed and Transformer coupled, Conversion Efficiency, Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency, Principle of operation of Class AB and Class –C Amplifiers.

Tuned Amplifiers: Introduction, Single Tuned Amplifier-Quality factor, frequency response of tuned amplifier, Concepts of Stagger Tuned and Synchronous Tuning.

UNIT – IV **[7 Lectures]**

Non-Linear Wave Shaping: Clipping circuits with diodes, clipping at two independent levels, transfer characteristics of clippers, Clamper- Types of Clampers, Operation, clamping circuit theorem.

UNIT-V **[9 Lectures]**

Multivibrators: Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.

Time Base Generators: General features of a Time base Signal, Methods of Generating Time Base Waveform, concepts of Transistor Miller and Bootstrap Time Base Generator, Methods of Linearityimprovement.

TEXT BOOKS:

1. Jacob Millman, ChristosCHalkias, Integrated Electronics, McGraw Hill Education, 2nd Edition, 2017.
2. Thomas L. Floyd 2015, Electronic Devices Conventional and current version, Pearson.
3. Jacob Millman, Herbert Taub, 3rd Edition, Pulse, Digital and Switching Waveforms, McGraw Hill.

REFERENCE BOOKS:

1. David A. Bell, Pulse, Switchingand Digital Circuits, Oxford UniversityPress, 5th Edition, 2015.
2. David A. Bell, ElectronicDevices and Circuits, Oxford UniversityPress, 5th Edition, 2015.
3. Robert L. Boylestead, Louis Nashelsky, Electronic Devices and Circuits theory, Pearson, 11th Edition, 2009.
4. Saliva Hanan, Electronic Devices and Circuits, PHI, 3rd Edition, 2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_ee89/preview by By Prof. Shouribrata Chatterjee, IIT, Delhi.
2. https://nptel.ac.in/courses/108/102/108102095 byProf. S.C.Dutta Roy, IIT, Delhi.
3. http://www.iitg.ac.in/apvajpeyi/ph218.html

Electromagnetic Waves and Transmission Lines

B.Tech. IV Semester	L	T	P	C
	3	0	0	3

Subject Code: 22EC404PC

Pre-requisite: Applied Physics

Course Objectives:

1. To learn the Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields, and applythem to solve physics and engineering problems.
2. To distinguish between static and time-varying fields, and understand thesignificance and utility of Maxwell's Equations and Boundary Conditions, and gain abilityto provide solutions to communication engineering problems.
3. To analyze the characteristics of Uniform Plane Waves (UPW), determine their propagation parameters and estimatethe same for dielectric and dissipative media.
4. To study the propagation, reflection and transmission of plane waves in bounded and unbounded media.

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

Learn and Evaluate the problems of electrostatic fields.

1. Solve the problems of magneto static fields and boundary condition using Maxwell's equations.
2. Applythe concept of electromagnetic wave propagation in different media.
3. Evaluatethe concept oftransmission lines and their applications.
4. Design and analyze various impedance matching techniques.

UNIT – I **[8 Lectures]**

Electrostatics: Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density. Convection and Conduction Currents, Dielectric Constant, Isotropic and HomogeneousDielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors.

UNIT – II **[10 Lectures]**

Magneto statics: Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Forms, Conditions at a Boundary Surface - Dielectric-Dielectric and Dielectric-Conductor Interfaces.

UNIT – III **[8 Lectures]**

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definitions, Relation between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization. Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem.

UNIT – IV **[8 Lectures]**

Transmission Lines - I: Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Equivalent Circuit, Characteristic Impedance, Propagation Constant, Phaseand Group Velocities, Infinite Line Concepts, Lossless / Low Loss Characterization, Types of Distortion, Condition for Distortion less line, Minimum Attenuation, Loading - Types of Loading.

UNIT – V **[8 Lectures]**

Transmission Lines – II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. λ/4, λ/2, λ/8 Lines – Impedance Transformations, Smith Chart – Configuration and Applications, Single Stub Matching.

TEXTBOOKS:

1. Matthew N.O. sadiku and S.V. Kulkarni, Principles of Electromagnetics, Oxford UniversityPress, Aisan Edition, 6th Edition, 2015.
2. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, PHI, 2nd Edition, 2000.
3. Umesh Sinha, Satya Prakashan, Transmission Lines and Networks, (Tech. India Publications), New Delhi, 2001.

REFERENCE BOOKS:

1. William H. Hayt Jr. and John A. Buck, Engineering Electromagnetics McGrawHill, 8th Edition 2014.
2. Nathan Ida, Engineering Electromagnetics, Springer (India) Pvt. Ltd, New Delhi 2nd Edition,2005.
3. G.Sashibhushana Rao, Electromagnetic field theory and transmission lines, Wiley India, 2nd Edition, 2012.
4. JD Ryder, Networks, Lines and Fields, PHI, 2nd edition, 1999.

Web Links:

1. https://nptel.ac.in/courses/108106157NPTEL Course on “Transmission lines and electromagnetic waves”,IIT Madras, Dr. Ananth Krishnan.
2. https://nptel.ac.in/courses/117101056NPTEL Course on “Transmission Lines and EM Waves”, IITBombay, Prof. R.K. Shevgaonkar.
3. https://nptel.ac.in/courses/117103065 NPTEL Course on “Electromagnetic fields” , IIT Guwahati, Dr.RatnajitBhattacharjee.

Fundamentals of Database Management Systems

B.Tech. IV Semester

L	T	P	C
3	0	0	3

Subject Code: 22EC405PC

Course Objectives:

1. To understand the basic concepts and the applications of data base systems.
2. To master the basics of SQLand construct queries using SQL.
3. Topics include data models, database design, relational model, relational algebra, transaction control, concurrencycontrol, storage structures and access techniques.

Course Outcomes: Upon completing this course, the student will be able to

1. Gain knowledge of fundamentals of DBMS and its applications.
2. Understand the concepts of relational models.
3. Master the basics of SQL for retrieval and management of data.
4. Be acquainted with the basics of transaction processing and concurrency Control.
5. Familiaritywith database storage structures and access techniques.

UNIT – I: **[8 Lectures]**

Database System Applications: A Historical Perspective, File Systems versus a DBMS**,** the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS.

Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design with the ER Model.

UNIT – II: **[8 Lectures]**

Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical data base design, introduction to views, destroying/altering tables and views, Relational Algebra**,** Tuple relational Calculus, Domain relational calculus.

UNIT – III: **[10 Lectures]**

SQL: Queries, Constraints, Triggers: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active databases.

Schema Refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal form.

UNIT – IV: **[8 Lectures]**

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions.

UNIT – V: **[8 Lectures]**

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

1. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, Tata Mc GrawHill 3rd Edition, 2007.
2. Silberschatz, Korth, Database System Concepts, Mc Graw hill, 5th edition, 2005.

REFERENCE BOOKS:

1. Peter Rob & Carlos Coronel, Database Systems design, Implementation, and Management, Thomson/Course Technology, 7th Edition, 2007.
2. Elmasri Navrate, Fundamentals of Database Systems, Pearson Education, 6th Edition, 2007.
3. C. J. Date, Introduction to Database Systems, Pearson Education, 8th Edition, 2003.
4. S.Shah and V. Shah, Oracle for Professionals, The X Team SPD, 1st Edition, 2008.
5. Shah, Database Systems Using Oracle: A Simplified guide to SQLand PL/SQL, PHI, 1st Edition, 2001.
6. M. L. Gillenson, Fundamentals of Database Management Systems, Wiley Student Edition, 2nd Edition, 2012.

Web Links:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://www.geeksforgeeks.org/introduction-to-nosql/
3. https://www.youtube.com/watch?v=wkOD6mbXc2M
4. https://beginnersbook.com/2015/05/normalization-in-dbms/

Analog and Digital Communications Lab

B.Tech. IV Semester	L	T	P	C
	0	0	2	1

Subject Code: 22EC406PC

Co-requisite: Analog and Digital Communications

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

1. Examine different AM and FM Modulation & Demodulation Technique using appropriate experimentation setup.
2. Design Multiplexing and De Multiplexing Techniques using appropriate experimentation setup.
3. Distinguish different Pulse Modulation Techniques using appropriate experimentation setup.
4. Create and analyze different Shift Keying Techniques using appropriate experimentation setup
5. Build and analyze Quadrature Shift Keying Techniques using appropriate experimentation setup.

Note:

- Minimum 12 experiments should be conducted:

Listof Experiments:

1. (i) Amplitude modulationand demodulation (ii) Spectrum analysis of AM
2. (i) Frequencymodulation and demodulation (ii) Spectrum analysis of FM
3. DSB-SC Modulator &Detector
4. SSB-SC Modulator &Detector (Phase Shift Method)
5. FrequencyDivision Multiplexing & De multiplexing
6. Pulse Amplitude Modulation &Demodulation
7. PulseWidth Modulation&Demodulation
8. PulsePosition Modulation &Demodulation
9. PCM Generation and Detection
10. Delta Modulation
11. FrequencyShift Keying: Generation and Detection
12. BinaryPhase Shift Keying: Generation and Detection
13. Generation and Detection (i) DPSK (ii) QPSK

MajorEquipment's required forLaboratories:

1. CROs:20MHz
2. Function Generators:2MHz
3. Spectrum Analyzer
4. Regulated Power Supplies:0-30V
5. Trainer Kits

Electronic Circuits Analysis Lab

B.Tech. IV Semester	L	T	P	C
	0	0	2	1

Subject Code: 22EC407PC

Co-requisite: Electronic Circuits Analysis

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

1. Analyze, design to extend and comprehend the concepts of circuit modeling to design linear & non-linear wave shaping.
2. Implement analog electronic circuits using BJT and observed the application.
3. Estimate performance of power amplifiers such as class-A and Class-Bpower amplifiers.
4. Design time base generators using BJTs.
5. Compare multi vibrators for various applications.

Note:

- Minimum 12 experiments should be conducted on hardware and ***** Marked experiments must be simulated on Software.

List of Experiments:

1. Current Shunt Feedback Amplifier Circuit **(*)**
2. Voltage Series Feedback Amplifier Circuit **(*)**
3. RC phase shift oscillator *****
4. Hartleyand Colpitts oscillators
5. Class BComplementary& SymmetryPower Amplifiers *****
6. RC high pass circuit as differentiator (Square wave input) *****
7. RC low pass circuit as integrator (Square wave input)
8. Types ofClippers at different reference voltages
9. Types of Clampers at different reference voltages
10. Bistable Multi vibrator.
11. Design a Monostable Multi vibrator
12. Design an Astable Multivibrator
13. Theoutput voltage waveformofMiller Sweep Circuit*****

MajorEquipment required for Laboratories:

1. Regulated Power Suppliers,0-30V
2. 20 MHz, Dual Channel Cathode RayOscilloscopes.
3. Functions Generators-Sine and Square wave signals
4. Multimeters
5. Electronic Components/Trainer Kits.
6. Computer System
7. Simulation Software-Multisim or anyequivalent simulation software

Database Management Systems Lab

B.Tech. IV Semester	L	T	P	C
	0	0	2	1

Subject Code: 22EC408PC

Co-requisite: Database Management Systems

Course Outcomes:

1. Design the database with E-R Model.
2. Analyze Normalization and DDL, DML Commands.
3. Design the database schema using SQL commands.
4. Analyze the use of Triggers.
5. Applyprocedures cursors and triggers using SQL.

LIST OF EXPERIMENTS:

1. Concept design with E-R Model
2. Relational Model
3. Normalization
4. Practicing DDL commands
5. Practicing DML commands
6. Querying(using ANY, ALL, IN, Exists, NOT EXISTS, UNION, INTERSECT,Constraints etc.)
7. Queries using Aggregate functions, GROUPBY, HAVING and Creation and droppingof Views.
8. Triggers (Creation of insert trigger, delete trigger, update trigger)
9. Procedures
10. Usage of Cursors

Constitution of India

B.Tech. IV Semester

L	T	P	C
3	0	0	0

Subject Code: 22EN410MC

Prerequisites: None

Course Objectives:

1. Introduction of constitution and it's evolution.
2. To know the fundamentals of Constitution
3. To analyse the fundamental rights and duties of Indian constitution
4. To know the governance of government and administration
5. To appraise the role organs of government.

Course Outcomes: After Completion of this course, the students will be able to:

1. Outline the evolution of Constitution.
2. Relate constitutional fundamentals with the present Era.
3. Analyse Liberalism Federalism and Socialism.
4. Infer the knowledge of Administration and Governance.
5. Appraiseandaddresstheroleof governments.

UNIT-1 **[5 Lectures]**

Historyof Making of the Indian Constitution-Historyof Drafting Committee.

UNIT- 2 **[5 Lectures]**

Philosophyof the Indian Constitution-Preamble Salient Features

UNIT- 3 **[3 Lectures]**

Contours of Constitutional Rights&Duties-FundamentalRights

- Rightto Equality
- RighttoFreedom
- Rightagainst Exploitation
- RighttoFreedomofReligion
- CulturalandEducationalRights
- RighttoConstitutionalRemedies
- DirectivePrinciplesofStatePolicy
- FundamentalDuties

.

UNIT-4 **[6 Lectures]**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powersand Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications , Powers and Functions

UNIT -5 **[6 Lectures]**

Local Administration: District's Administration head: Role and Importance, Municipalities:Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO ZilaPanchayat: Position androle. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grassroot democracy, Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Reading:

1. Dr. M.V. Pylee India's Constitution, 16th Edition, S. Chand 2016.
2. Dr. S. N.Busi, Dr.B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P.Jain, Indian Constitutional Law, 7thEdn., Lexis Nexis, 2018.
4. D.D. Basu, Introduction to the Constitution of India, 23rd Edn Lexis Nexis,2018.

Web Links:

1. https://youtu.be/4tI4QXhzqNUhttps://youtu.be/TXhSrKJ1ahk
2. https://www.youtube.com/live/0FAdfh6NVtA?feature=share
3. https://youtu.be/vq2Q1_v6TNU

MICROCONTROLLERS AND FUNDAMENTALS OF IOT

B. Tech. V Semester **L T P C**
Subject Code: 22EC501PC **3 1 0 4**
Pre-requisites: Digital System Design

Course Objectives:

1. To familiarize the architecture of microprocessors and micro controllers
2. To provide the knowledge about interfacing techniques of bus & memory.
3. To understand the concepts of ARM architecture
4. To study the basic concepts of Advanced ARM processors

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

1. Learn the internal architecture, organization and assembly language programming of 8086 processors.
2. Analyze the internal architecture, organization and assembly language programming of 8051/controllers
3. Learn the interfacing techniques to 8086 and 8051 based systems.
4. Explore the Evolution of IoT, Its Growth and Applications
5. Know the differences and similarities between IoT and M2M.

UNIT – I **[12 Lectures]**

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT – II **[10 Lectures]**

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

UNIT – III **[12 Lectures]**

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232, USB.

UNIT – IV **[10 Lectures]**

IOT introduction: Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, enabling technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

UNIT – V **[12 Lectures]**

IOT and M2M: M2M to IoT- A Basic Perspective– Introduction, Differences and similarities between M2M and IoT, SDN and NFV for IoT,M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, international driven global value chain and global information monopolies.

TEXT BOOKS:

1. A. K. Ray and K. M. Bhurchandani -Advanced Microprocessors and Peripherals, TMH, 2nd Edition 2006.
2. David Hanes, Gonzalos algueiro, Patrick Grossetete, Robbarton, Jerome henry-IoT Fundamentals Networking Technologies, Protocols and Use cases for IoT", Cisco Press, 2017.

REFERENCE BOOKS:

1. Kenneth.J.Ayala-The 8051Microcontroller, Cengage Learning, 3rd Ed, 2004.
2. K.Uma Rao, Andhe Pallavi-The 8051Microcontrollers, Architecture and Programming and Applications, Pearson, 2009.
3. Arshdeep Bahga, Vijay Madisetti-Internet of Things A Hands-on approach, Universities Press, 2015.
4. Sudip Misra, Anandarup Mukherjee, Arijit Roy-Introduction to IOT, Cambridge University Press, 2022.

WEB LINKS:

1. http://www.engineersgarage.com
2. www.comtechdoc.org
3. www.emu8086.com
4. www.microcontroller.com
5. www.newelectronics.co.uk/electronics
6. http://nptel.ac.in/courses/108107029/
7. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
8. https://nptel.ac.in/courses/106108052/:

CONTROL SYSTEMS

B. Tech. V Semester **L T P C**
Subject Code: 22EC502PC **3 1 0 4**

Pre-requisites: Linear Algebra and Calculus, Ordinary Differential Equations and Multivariable Calculus Laplace Transforms, Numerical Methods and Complex variables

Course objectives:

1. To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response
2. To assess the system performance using time domain analysis and methods for improving.
3. To assess the system performance using frequency domain analysis and techniques for improving the performance
4. To design various controllers and compensators to improve system performance

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

1. Analyze the modeling of linear-time-invariant systems using transfer function.
2. Apply the concept of stability and Analyze stability for linear-time invariant systems in Time domain.
3. Make use of the concept of Frequency domain representation and Analyze Stability in Frequencydomain
4. Identify the needs of different types of controllers and design of PID controllers
5. Analyze Concepts of State space models.

UNIT – I **[12 Lectures]**

Introduction to Control Problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

UNIT – II **[12 Lectures]**

Time Response Analysis of Standard Test Signals: Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second- order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

UNIT – III **[10 Lectures]**

Frequency-Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion–gain and phase margin. Closed-loop frequency response.

UNIT – IV **[12 Lectures]**

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation designs.

UNIT – V **[10 Lectures]**

State Variable Analysis and Concepts of State Variables: State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

TEXT BOOKS:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education,1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall,1995.

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

WEB LINKS:

1. https://swayam.gov.in/nd1_noc20_ee62/preview

LINEAR AND DIGITAL IC APPLICATIONS

B. Tech. V Semester **L T P C**
Subject Code: 22EC503PC **3 0 0 3**
Pre-requisites: Electronic Devices and Circuits

Course Objectives: The main objectives of the course are:

1. To Understand basic Op-AMP working and Applications
2. To study the timers and PLL applications
3. To understand the data converters-ADC and DAC
4. To understand the concepts of Digital IC's
5. To introduce some special function ICs for Sequential logic and Memories

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

1. Explore the operational amplifiers with linear integrated circuits.
2. Attain the knowledge of functional diagrams and design applications of IC555 and IC565.
3. Acquire the knowledge and design the Data converters.
4. Analyze the different families of digital integrated circuits and their characteristics.
5. Choose the proper digital integrated circuits by knowing their characteristics

UNIT – I **[10 hours]**

Operational Amplifier: Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Modes of Operation-Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT – II **[10 hours]**

Op-Amp, IC-555 & IC565 Applications: Introduction to Active Filters, Characteristics of Bandpass, Band-reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer-Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL-Block Schematic, principle and Applications.

UNIT – III **[10 hours]**

Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs – Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

UNIT – IV **[8 hours]**

Combinational Logic ICs: Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Priority Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT – V **[8 hours]**

Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs - All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers. Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

TEXT BOOKS:

1. Ramakanth A. Gayakwad - Op-Amps & Linear ICs, PHI, 2003.
2. Floyd and Jain- Digital Fundamentals, 8th Ed., Pearson Education, 2005.

REFERENCE BOOKS:

1. D. Roy Chowdhury – Linear Integrated Circuits, New Age International(p) Ltd, 2nd Ed., 2003.
2. John. F. Wakerly – Digital Design Principles and Practices, 3rd Ed., Pearson, 2009.
3. Salivahana -Linear Integrated Circuits and Applications, TMH, 2008.
4. William D.Stanley- Operational Amplifiers with Linear Integrated Circuits, 4th Ed., Peason Education India, 2009.

WEB LINKS:

1. https://www.nptel.ac.in
2. https://www.svecw.edu.in
3. https://www.smartzworld.com
4. https://www.crectirupati.com http:// web.stanford.edu/class

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B. Tech. V Semester **L T P C**
Subject Code: 22MB504HS **3 0 0 3**
Pre-requisites: NIL

Course Objective:
1. Understand the basic Business types, the impact of the Economy Businesses and Firms specifically.
2. Learn the market demand and supply.
3. Gain knowledge of the production theories and cost analysis while dealing with the concept of BEA.
4. Analyze the Business from the Financial Perspective.
5. Interpret the performance of the business with the help of ratios.

Course Outcomes: After completion of this course, the students will be able to:
1. Analyze the various Forms of Business and the impact of economic variables on the Business.
2. Comprehend the demand and supply analysis.
3. Explore the usage of pricing strategies in PLC.
4. Maintaining the financial accounts of a firm or company.
5. Monitoring the business operations through ratios.

UNIT – I **[10 Lectures]**

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 of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II **[8 Lectures]**

Demand and Supply Analysis

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function and Law of Supply.

UNIT- III **[10 Lectures]**

Production, Cost, Market Structures & Pricing

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly and Monopolistic Competition.
Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis.

UNIT – IV **[10 Lectures]**

Financial Accounting: Accounting concepts and Conventions, AccountingEquation, Double-

Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

UNIT-V **[8 Lectures]**

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

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, "Business Economics - Theory and Applications", International Book House Pvt. Ltd., 2013.
2. Dhanesh K Khatri, "Financial Accounting", Tata Mc –Graw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, "Managerial Economics", 2e, Tata Mc Graw Hill Education Pvt. Ltd. 2012.

REFERENCE BOOKS:

1. Paresh Shah, "Financial Accounting for Management", 2nd edition, Oxford Press, 2015.
2. S.N.Maheshwari, Sunil K Maheshwari,Sharad K Maheshwari, "Financial Accounting",5th edition ,Vikas Publications, 2013.

WEB LINKS:

1. https://nptel.ac.in/courses/110101005
2. https://www.coursera.org/specializations/managerial-economics-business-analysis
3. https://www.udemy.com/course/engineering-economics-take-decision-between-alternatives/
4. https://www.classcentral.com/course/youtube-mefa-managerial-economics-financial-analysis-91420
5. https://www.emerald.com/insight/publication/issn/1569-3759

COMPUTER ORGANIZATION & OPERATING SYSTEMS

(Professional Elective - I)

B. Tech. V Semester **L T P C**
Subject Code: 22EC511PE **3 0 0 3**
Pre-requisites: Digital System Design

Course Objectives:

1. To understand the structure of a computer and its operations.
2. To understand the RTL and Micro-level operations and control in a computer.
3. Understanding the concepts of I/O and memory organization and operating systems.

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

1. Learn the basics structure of the computer, Register Transfer Language and Micro Operations the organization of different blocks in a computer.
2. Explore the Micro Programmed Control and Memory System
3. Analyze the communication between input output devices.
4. Describes use of Operating systems in a computer.
5. Enumerate the file structure in Operating systems in a computer.

UNIT – I **[10 Lectures]**

Basic Structure of Computers: Computer Types, Functional Unit, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating – Point Representation.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions– Instruction Cycle, Memory – Reference Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

UNIT – II **[9 Lectures]**

Micro Programmed Control: Control Memory, Address Sequencing, Micro program Examples, Design of Control Unit, Hard Wired Control, Micro programmed Control

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories Secondary Storage, Introduction to RAID.

UNIT – III **[10 Lectures]**

Input-Output Organization: Peripheral Devices, Input-Output Interface, AsynchronousData Transfer Modes, Priority Interrupt, Direct Memory Access, Input –Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE 1394.

UNIT – IV **[10 Lectures]**

Operating Systems Overview: Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating Systems Generation

Memory Management: Swapping, Contiguous Memory Allocation, Paging, Structure of The Page Table, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows

Principles of Deadlock: System Model, Deadlock Characterization, Deadlock Prevention,

Detection and Avoidance, Recovery from Deadlock.

UNIT – V **[9 Lectures]**

File System Interface: The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

File System Implementation: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

TEXT BOOKS:

1. "Computer Organization" – Carl Hamacher, Zvonks Vranesic, Safea Zaky, Vth Edition, McGraw Hill, 2011.
2. "Computer Systems Architecture" – M. Moris Mano, IIIrd Edition, Pearson, 2017.
3. "Operating System Concepts"- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley, 2017.

REFERENCE BOOKS:

1. "Computer Organization and Architecture" – William Stallings Sixth Edition, Pearson, 2002.
2. "Structured Computer Organization" – Andrew S. Tanenbaum, 4th Edition, PHI, 1998.
3. "Fundamentals of Computer Organization and Design" - Sivaraama Dandamudi , Springer Int. Edition, 2002,
4. "Operating Systems" – Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
5. "Modern Operating Systems", Andrew S Tanenbaum 2nd Edition, PHI, 2009.
6. "Principles of Operating Systems", B.L. Stuart, Cengage Learning, Indian Edition, 2008.

WEB LINKS:

1. https://www.classcentral.com/course/swayam-computer-organization-andarchitecture-a-pedagogical-aspect-9824
2. https://onlinecourses.nptel.ac.in/noc20_cs64/
3. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/ & Other google searched sites

DATA COMMUNICATIONS AND COMPUTER NETWORKS

(Professional Elective-I)

B. Tech. V Semester **L T P C**
Subject Code: 22EC512PE **3 0 0 3**
Pre-requisite: Digital Communications

Course Objectives:

1. To introduce the Fundamentals of data communication networks
2. To demonstrate the Functions of various protocols of Data link layer.
3. To demonstrate Functioning of various Routing protocols.
4. To introduce the Functions of various Transport layer protocols.
5. To understand the significance of application layer protocols

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

1. Analyze the Categories and functions of various Data communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer
4. Analyze the significance of various Flow control and Congestion control Mechanisms
5. Apply the Functioning of various Application layer Protocols.

UNIT - I **[10 Lectures]**

Introduction to Data Communications: Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet – A Brief History, The Internet Today, Protocol and Standards Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11Architecture.

UNIT – II **[12 Lectures]**

Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols.

UNIT – III **[10 Lectures]**

The Network Layer: Introduction, Forwarding and Routing, Network Service Models,Virtual Circuit and Datagram Networks –Virtual - Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP),IPv6.

UNIT - IV **[12 Lectures]**

Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP

Checksum, Principles of Reliable Data Transfer - Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go- Back - N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round - Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management.

UNIT – V **[10 Lectures]**

Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the

File Transfer: FTP, FTP Commands and Replies, Electronic Mail in the Internet - STMP, Comparison with HTTP, DNS – The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

TEXTBOOKS:

1. Computer Networking A Top-Down Approach–Kurose James F, Keith W,6th edition, Pearson, 2017.
2. Data Communications and Networking Behrouz A. Forouzan 4th McGraw Hill Education, 2017.

REFERENCES:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education, 2018.
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning, 2003.

Web Links:

1. https://nptel.ac.in/courses /106106091
2. https://ncert.nic.in/textbook/pdf/lecs111.pdf
3. Learn Wireshark – Computer Networking Tutorial (freecodecamp.org)
4. https://www.youtube.com/playlist?_list=PLUtfVcb-iqn8dG1-Cn7NTEdILR3hRVgcN

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

(Professional Elective - I)

B. Tech. V Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC513PE	**3**	**0**	**0**	**3**

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. It provides an understanding of various measuring system functioning and metrics for performance analysis.
2. Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
3. Understanding the concepts of various measuring bridges and their balancing conditions.
4. Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

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

1. Analyze the basic definition of measuring parameters and different meters
2. Enumerate various types of signal generators, signal analyzers for generating and analyzing various real-time signals.
3. Describe the Operation of an Oscilloscope to measure various signals.
4. Explain the principle of transducer and its types to Measure various physical parameters
5. Apply the principle of Various Bridges and its types to Measure various physical parameters

UNIT – I **[10 Lectures]**

Block Schematics of Measuring Systems: Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Errr, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D'Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multi meters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT – II **[10 Lectures]**

Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse andSquare wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

UNIT – III **[9 Lectures]**

Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

UNIT – IV **[9 Lectures]**

Transducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

UNIT – V **[10 Lectures]**

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

TEXT BOOKS:

1. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W. D. Cooper: PHI 5th Edition 2003.
2. Electronic Instrumentation: H. S. Kalsi – TMH, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Electrical and Electronic Measurement and Measuring Instruments – A K Sawhney, Dhanpat Rai & Sons, 2013.
2. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
3. Industrial Instrumentation: T.R. Padmanabham Springer, 2009.
4. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education, 2010.

WEB LINKS:

1. https://www.vssut.ac.in/lecture_notes/lecture1423813026.pdf
2. fmcet.in/ECE/EC2351_uw.pdf
3. https://books.askvenkat.com/tag/measurement-and-instrumentation-lecture-notes-pdf
4. https://www.jntubook.com/electronics-measurements-instrumentation-textbook-free-d

MICROCONTROLLERS LAB

	L	T	P	C
B. Tech. V Semester				
Subject Code: 22EC505PC	**0**	**0**	**2**	**1**

Co-requisites: Microcontrollers and fundamentals of IoT, DSD

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

1. Write assembly language programs and implement on 8086.
2. Write assembly language programs and implement on 8051
3. Interface the I/O devices with 8051 microcontrollers
4. Design Microprocessors / Microcontrollers-based systems.
5. Write assembly language programs and implement on 8051 for waveform generation.

Using 8086 Processor Kits and/or Assembler Using 8051 Microcontroller Kit Interfacing I/O Devices to 8051

Assembly Language Programs to 8086 to Perform

1. Arithmetic, Logical Operations on16 Bit and 32-Bit Data.
2. String Operations on16 Bit and 32-Bit Data.
3. Bit level Logical Operations, Rotate, Shift, Swap
4. Branch Operations.

Assembly Language Programs to 8051 to Perform

1. Assembly Language Programs to Perform Arithmetic (Both Signed and Unsigned) 16 Bit Data Operations, Logical Operations (Byte and Bit Level Operations), Rotate Shift, Swap and Branch Instructions.
2. Time delay Generation Using Timers of 8051.
3. Serial Communication from/to 8051 to/from I/O devices.
4. Program Using Interrupts to Generate Square Wave 10 KHZ Frequency on P2.1 Using Timer 0 8051in 8 bit Auto reload Mode and Connect a1HZ Pulse to INT1 pin and Display on Port 0. Assume Crystal Frequency as 11.0592 MHZ
5. 7 Segment Display to 8051.
6. Matrix Keypad to 8051.
7. Sequence Generator Using Serial Interface in 8051.
8. 8-bit ADC Interface to 8051.
9. Triangular Wave Generator through DAC interfaces to 8051.

TEXT BOOKS:

1. A. K. Ray and K. M. Bhurchandani -Advanced Microprocessors and Peripherals, TMH, 2nd Edition 2006.

REFERENCE BOOKS:

1. Kenneth.J.Ayala-The 8051Microcontroller, Cengage Learning, 3rd Ed, 2004.
2. K.Uma Rao, Andhe Pallavi-The 8051Microcontrollers, Architecture and Programming and Applications, Pearson, 2009.

IOT LAB

	L	T	P	C
B. Tech. V Semester				
Subject Code: 22EC506PC	**0**	**0**	**2**	**1**

Pre-requisites: Microcontrollers and fundamentals of IoT

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

1. Utilize the different sensors like room temperature, DHT, Humidity etc.,
2. Interface the sensors and processor for transmission of data.
3. Capture the images and process it on Arduino/NodeMCU/RaspberryPi.
4. Apply the utilization of various protocols like I2C, UART communication etc.,
5. Design and analyze various devices for the applications.

List of Experiments:

1. Demonstrate blinking of an LED at every 5 seconds and to control the brightness of an LED.
2. Read Humidity and Room Temperature using DHT sensor and display the readings.
3. Send the recorded values of Temperature/Humidity to the Internet via GSM module using Arduino/NodeMCU/Raspberry Pi.
4. Demonstrate Interfacing NodeMCU/Raspberry Pi with the Cloud using REST API and MQTT protocol.
5. Demonstrate Switching lights on /off remotely using Arduino/NodeMCU/Raspberry Pi.
6. Voice-based Home Automation for switching lights on/off using Google Assistant, IFTTT and MQTT.
7. Interfacing DHT11 sensor with Raspberry pi/equivalent and upload temperature and humidity values to the cloud.
8. Design an obstacle detection unit using ultrasonic sensor.
9. Capture images from web camera using Raspberry Pi/equivalent and apply filters in increase image quality.
10. Access a remote computer from Raspberry Pi and display the remote screen.
11. Design an automatic water sprinkler based on soil moisture using Arduino/NodeMCU/Raspberry Pi.
12. Design an RFID based attendance system using Arduino/NodeMCU/Raspberry Pi.
13. Write an arduino program to demonstrate interrupts
14. Write an arduino program to demonstrate UART communication protocol
15. Write an arduino program to demonstrate I2C communication protocol
16. Write an arduino program to demonstrate SPI communication protocol

TEXT BOOKS:

1. David Hanes, Gonzalos algueiro, Patrick Grossetete, Robbarton, Jerome henry-IoT Fundamentals Networking Technologies, Protocols and Use cases for IoT", Cisco Press, 2017.
2. Arshdeep Bahga, Vijay Madisetti-Internet of Things A Hands-on approach, Universities Press, 2015.
3. Sudip Misra, Anandarup Mukherjee, Arijit Roy-Introduction to IOT, Cambridge University Press, January 2022.

LINEAR AND DIGITAL IC APPLICATIONS LAB

B. Tech. V Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC507PC	**0**	**0**	**2**	**1**

Co-requisites: Electronic Circuits, Digital System Design, Linear And Digital IC Applications

Note: Any **SIX** of the following experiments from each part are to be conducted (Total 12)

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

1. Analyze different Modes of Operation of Op Amp using appropriate experimentation setup
2. Design and analyze different applications of Op Amp
3. Design and analyze different Active filter and IC 555 timer applications
4. Design and analyze Voltage Regulator of Op Amp Circuits using appropriate experimentation setup
5. Design and verification of various combinational logic circuit using Verilog HDL

PART-A

1. Design an Inverting and Non-inverting Amplifier using Op Amp and calculate gain.
2. Design a Comparator using Op Amp and draw the comparison results of A=B, A<B, A>B.
3. Design an Integrator and Differentiator Circuits using IC741 and derive the required condition practically.
4. Design an Active LPF, HPF cutoff frequency of 2 KHZ and find the roll off of it.
5. Construct Mono-stable Multivibrator using IC555 and draw its output waveform.
6. Construct Astable Multivibrator using IC555 and draw its output waveform and also find its duty cycle.
7. Design a Schmitt Trigger Circuit and find its LTP and UTP.
8. Design VoltageRegulatorusingIC723, IC 7805/7809/7912 and find its load regulation factor.

PART-B

1. Design Verilog HDL module for Logic gates
2. Design Verilog HDL module for Half and Full adders
3. Design Verilog HDL module for Half and Full subtractors
4. Design Verilog HDL module for Comparators
5. Design Verilog HDL module for Multiplexer and Demultiplexers
6. Design Verilog HDL module for Encoders and Decoders
7. Design Verilog HDL module for Binary to gray and vice versa
8. Design Verilog HDL module for any combinational logic circuit with 3 Modelling styles

Laboratory Equipment/Software/Tools Required

1. Discrete IC components/Trainer Kits can be used for Deign and Implementations of PART A Experiments
2. Computer installed with operating system, Xilinx Vivado Design Suite/Mentor Graphics/Cadence Digital Design Tools or any other equivalent Software for PART B Experiments.

TEXT BOOKS:

1. Ramakanth A. Gayakwad - Op-Amps & Linear ICs, PHI, 2003.
2. Floyd and Jain- Digital Fundamentals, 8th Ed., Pearson Education, 2005.

REFERENCE BOOKS:

1. D. Roy Chowdhury – Linear Integrated Circuits, New Age International(p) Ltd, 2nd Ed., 2003.
2. John. F. Wakerly – Digital Design Principles and Practices, 3rd Ed., Pearson, 2009.
3. Salivahana -Linear Integrated Circuits and Applications, TMH, 2008.
4. William D.Stanley- Operational Amplifiers with Linear Integrated Circuits, 4th Ed., Peason Education India, 2009.

WEB LINKS:

1. https://www.nptel.ac.in
2. https://www.svecw.edu.in
3. https://www.smartzworld.com
4. https://www.crectirupati.com http:// web.stanford.edu/class

INTELLECTUAL PROPERTY RIGHTS

B. Tech. V Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC508MC	**3**	**0**	**0**	**0**

Pre-requisites: NIL

Course Objectives

1. To explore intellectual property rights.
2. To outline the basics of trademarks.
3. To describe the copyrights and its laws.
4. To understand the nature of trade secrets and unfair competition.
5. To define the new developments of intellectual property rights.

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

1. Interpret intellectual property rights.
2. Identify different types of trademarks and related laws.
3. Explore copyrights and their laws.
4. Differentiate the trade secrets and unfair competition.
5. Impart the rules, laws, and properties of intellectual property rights.

UNIT – I **[7 Lectures]**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II **[7 Lectures]**

Trademarks: Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trademark registration processes.

UNIT – III **[10 Lectures]**

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV **[8 Lectures]**

Trade Secrets: Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, and protection for submission, trade secretes litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V **[8 Lectures]**

New development of intellectual property: new developments in trademark law; copyright law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copyright law, international patent law, and international development in trade secrets law.

TEXT BOOKS:

1. Deborah E. Bouchoux, Intellectual Property: The Law Of Trademarks Copyrights Patents And Trade Secrets, 4Th Edn, Cengage India, 2015.
2. Prabuddha ganguli, Intellectual property right – Unleashing the knowledge economy, McGraw Hill Education, 1st edition, 2017.

REFERENCE BOOKS:

1. William M. Landes, Richard A. Posner, The Economic Structure of Intellectual Property Law, Belknap Press, Illustrated edition, 2003.
2. Rami M. Olwan, Intellectual Property and Development: Theory and Practice, Springer-Verlag Berlin and Heidelberg GmbH & Co. K, 2013th edition, 2015.
3. V K Ahuja, Law Relating To Intellectual Property Rights, Lexis Nexis, Third edition, 2017.

WEB LINKS:

1. https://onlinecourses.nptel.ac.in/noc22_hs59/preview
2. https://www.coursera.org/learn/introduction-intellectual-property
3. https://www.udemy.com/topic/intellectual-property/
4. https://allea.org/intellectual-property-rights/
5. https://www.stopfakes.gov/Online-Intellectual-Property-Training-Module

ANTENNAS AND WAVE PROPAGATION

B. Tech. VI Semester	L	T	P	C
Subject Code: 22EC601PC	3	0	0	3

Pre-requisites: Electromagnetic Theory and Transmission Lines

Course Objectives:

1. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.
2. To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To analyze the characteristics and design relations of UHF, VHF and Microwave Antennas.

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

1. Analyze the mechanism of radiation, definitions of different antenna characteristic parameters and establish their mathematical relations.
2. Apply the concept of radiation Mechanism to Antenna arrays and arrange a setup to carry out the antenna far Field pattern and gain measurements in the laboratory
3. Design the antennas based on frequency, configure the geometry and establish the radiation patterns of VHF and UHF antennas.
4. Design the antennas based on frequency, configure the geometry and establish the radiation patterns of Microwave antennas.
5. Analyze the different wave propagation mechanisms, determine the characteristic features of different wave propagations, and estimate the parameters involved.

UNIT– I [10 Lectures]

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems Radiation, Retarded Potentials – Helmholtz Theorem.

Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole–Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas - Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small Loops (Qualitative Treatment).

UNIT– II [10 Lectures]

Antenna Arrays: Point Sources – Definition, Patterns**,** and arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, and Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods)

UNIT-III **[10 Lectures]**

VHF, UHF and Microwave Antennas - I: Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Mono filar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns.

UNIT–IV **[10 Lectures]**

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations Rectangular Patch Antennas– Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

UNIT–V **[10 Lectures]**

Wave Propagation - Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts,

Ground Wave Propagation – Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections.

Space Wave Propagation – Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Troposphere Propagation.

Sky Wave Propagation – Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

TEXT BOOKS:

1. Antennas and Wave Propagation–J.D.Kraus, R.J.Marhefka and Ahmad S.Khan,TMH, New Delhi, 4th ed., (Special Indian Edition),2010.
2. Electromagnetic Waves and Radiating Systems–E.C.Jordan and K.G.Balmain, PHI, 2nd ed., 2000.

REFERENCE BOOKS:

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.
3. Radio Engineering Handbook- Keith Henney, 3rd edition , TMH, 1951.
4. Antenna Engineering Handbook –John Leonidas Volakis, 3rd edition, 2007.

WEBLINKS

1. https://search.worldcat.org/title/antennas-and-wave-propagation/oclc/911063717?referer=di&ht=edition
2. https://books.google.co.in/books?id=icy-_fN8vVsC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
3. https://digital-library.theiet.org/content/books/10.1049/pbte038e_ch5
4. https://ietresearch.onlinelibrary.wiley.com/journal/17518733

DIGITAL SIGNAL PROCESSING

B. Tech. VI Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC602PC	**3**	**0**	**0**	**3**

Pre-requisites: Signals and Systems

Course Objectives:

1. To provide background and fundamental material for the analysis and processing of digital signals.
2. To understand the fast computation of DFT and appreciate the FFT processing.
3. To studythe designs and structures of digital (IIR and FIR) filters and analyze and synthesize for a given specifications.
4. To acquaint in Multi-rate signal processing techniques and finite word length effects.

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

1. Familiarized with the LTI system characteristics and Multirate signal processing.
2. Illustrate the inter-relationship between DFT and various transforms.
3. Design a digital IIR Digital Filters for a given specification.
4. Design a digital FIR Digital Filters for a given specification.
5. Design of multirate systems and analyze the effects of round off errors.

UNIT - I **[12 Lectures]**

Introduction: Introduction to Digital Signal Processing, Applications and advantages of DSP. Applications of Z-transform: Solution of Linear Constant Coefficient Difference Equations, System function, Frequency Domain Representation of Discrete Time Signals and Systems.

Discrete Fourier series: DFS representation of periodic sequences, Relation between Z-transform and DFS.

UNIT - II **[12 Lectures]**

Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DFS, DFT and Z- Transform.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

UNIT – III **[10 Lectures]**

IIR Digital Filters: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

Realization of IIR Filters: Direct, Canonic, Cascade, Parallel, Lattice and Ladder forms.

UNIT – IV **[9 Lectures]**

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters.

Realization of FIR Filters: Direct form, cascade realization and Linear phase Realization

UNIT – V **[9 Lectures]**

Multirate Digital Signal Processing: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion.

Finite Word Length Effects: Limit cycles, Overflow oscillations, Round-off noise in IIR digital filters, Computational output round off noise, Methods to prevent overflow.

TEXT BOOKS:

1. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI,2009.
2. Digital Signal Processing, Principles, Algorithms, and Applications John G.Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.

REFERENCE BOOKS:

1. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008.
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson,2007.
3. Digital Signal Processing – S. Salivahanan, A. Vallavaraj and C. Gnanapriya, TMH,2009.
4. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education,2009.

WEBLINKS:

1. https://kp.kiit.ac.in/pdf_files/02/LECTURE-NOTES_6th-ETC_-DSP_A-Pradhan.pdf
2. https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/pages/study-materials/
3. https://www.mathworks.com/help/signal/ug/iir-filter-design.html

CMOS VLSI DESIGN

B. Tech. VI Semester **L T P C**
Subject Code: 22EC603PC **3 0 0 3**
Pre-requisites: Electronic Circuit Analysis, Switching Theory and Logic Design

Course Objectives: The objectives of the course are to:

1. Give exposure to different steps involved in the fabrication of ICs.
2. Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters
1. designed with various loads.
2. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
3. Provide design concepts to design building blocks of data path of any system using gates.
4. Understand basic programmable logic devices and testing of CMOS circuits.

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

1. Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.
2. Draw the layout of any logic circuit which helps to understand and estimate parasitic effect of any logic circuit
3. Design alternative CMOS circuits and Pass transistor logic
4. Design building blocks of data path systems, memories and simple logic circuits using PLA, PAL, FPGA and CPLD.
5. Explore different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

UNIT – I **[10 hours]**

Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS
Basic Electrical Properties: Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT – II **[10 hours]**

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

UNIT – III **[9 hours]**

Gate Level Design: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out.

UNIT – IV **[10 hours]**

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.
Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories.

UNIT – V **[9 hours]**

Programmable Logic Devices: Design Approach – PLA, PAL, Standard Cells FPGAs, CPLDs.
CMOS Testing: CMOS Testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

TEXT BOOKS:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell - Essentials of VLSI circuits and systems, PHI, 2005
2. Neil H. E Weste, David Harris, Ayan Banerjee - CMOS VLSI Design – A Circuits and Systems Perspective, 3rd Edition, Pearson, 2009.

REFERENCE BOOKS:

1. Ming-BO Lin - Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, 2011
2. John. P. Uyemura - CMOS logic circuit Design, Springer, 2007.
3. Wayne Wolf - Modern VLSI Design, 3rd Edition, Pearson Education, 1997.
4. K. Lal Kishore, V. S. V. Prabhakar -VLSI Design, I.K International, 2009.

WEB LINKS:

1. http://dspace.mit.edu/handle/1721.1/93776
2. http://dspace.mit.edu/handle/1721.1/75650
3. https://engineering.purdue.edu/~vlsi/ECE559_Fall09/?_ga=2.120672008.1227662350.1573631317 316737531.1573631317
4. Class Notes: http://cobweb.ecn.purdue.edu/~vlsi/ECE559_Fall09

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

(Professional Elective – II)

	L	T	P	C
B. Tech. VI Semester				
Subject Code: 22EC621PE	**3**	**0**	**0**	**3**

Pre-requisites: Programming for Problem Solving

Course Objectives:

1. Introduces object oriented programming concepts using the java language
2. Introduces the principles of inheritance and polymorphism; and demonstrates how they relate to the design of abstract classes.
3. Introduces the implementation of packages and interfaces.
4. Introduces exception handling, event handling and multi threading.
5. Introduces the design of graphical user interface using applets and swings.

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

1. Defines object oriented programming concepts using the java language
2. Apply the principles of inheritance and polymorphism; and demonstrates how they relate to the design of abstract classes.
3. Analyze the concepts of exception handling and multithreading.
4. Implement the concepts of event handling.
5. Design simple graphical user interface applications.

UNIT – I **[10 hours]**

Object Oriented Thinking and Java Basics: Need for OOP Paradigm, Summary of OOP Concepts, Coping with Complexity, Abstraction Mechanisms, A Way of Viewing World – Agents, Responsibility, Messages, Methods, History of Java, Java Buzzwords, Data Types, Variables, Scope and Life Time of Variables, Arrays, Operators, Expressions, Control Statements, Type Conversion and Casting, Simple Java Program, Concepts of Classes, Objects, Constructors, Methods, Access Control, This Keyword, Garbage Collection, Overloading Methods and Constructors, Method Binding, Inheritance, Overriding and Exceptions, Parameter Passing, Recursion, Nested and Inner Classes, Exploring String Class.

UNIT – II **[12 hours]**

Inheritance, Packages and Interfaces: Hierarchical Abstractions, Base Class Object, Subclass, Subtype, Substitutability, Forms of Inheritance- Specialization, Specification, Construction, Extension, Limitation, Combination, Benefits of Inheritance, Costs of Inheritance. Member Access Rules, Super Uses, Using Final with Inheritance, Polymorphism-Method Overriding, Abstract Classes, The Object Class.

Defining, Creating and Accessing a Package, Understanding Classpath, Importing Packages, Differences between Classes and Interfaces, Defining an Interface, Implementing Interface, Applying Interfaces, Variables in Interface and Extending Interfaces, Exploring Java.IO.

UNIT – III **[12 hours]**

Exception Handling and Multithreading: Concepts of Exception Handling, Benefits of Exception Handling, Termination or Resumptive Models, Exception Hierarchy, Usage of Try, Catch, Throw, Throws and Finally, built in Exceptions, Creating Own Exception Sub Classes. String Handling, Exploring Java. Util, Differences between Multi-Threading and Multitasking, Thread Life Cycle, Creating Threads, Thread Priorities, Synchronizing Threads, Inter thread Communication, Thread Groups, Daemon Threads.

Enumerations, Auto boxing, Annotations, Generics.

UNIT – IV **[8 hours]**

Event Handling: Events, Event Sources, Event Classes, Event Listeners, Delegation Event Model, Handling Mouse and Keyboard Events, Adapter Classes.

The AWT Class Hierarchy, User Interface Components- Labels, Button, Canvas, Scrollbars, Text Components, Check Box, Check Box Groups, Choices, Lists Panels – Scroll pane, Dialogs, Menu bar, Graphics, Layout Manager – Layout Manager Types – Border, Grid, Flow, Card and Grid Bag.

UNIT – V **[10 hours]**

Applets: Concepts f Applets, Differences between Applets and Applications, Life Cycle of an Applet, Types of Applets, Creating Applets, Passing Parameters to Applets.

Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing- J applet, J frame and J component, Icons and Labels, Text Fields, Buttons – The J button Class, Check Boxes, Radio Buttons, Combo Boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

TEXT BOOKS:

1. Java the Complete Reference, 7th Edition, Herbert Schildt, TMH, 2017
2. Understanding OOP with Java Updated Edition, T. Budd, Pearson Education, 2000.

REFERENCE BOOKS:

1. An Introduction to Programming and OO Design using Java, J. Nino and F.A. Hosch, John Wiley & Sons, 2007.
2. An Introduction to OOP, Third Edition, T. Budd, Pearson Education, 2001.
3. Introduction to Java Programming, Y. Daniel Liang, Pearson Education, 1998.
4. An Introduction to Java Programming and Object-Oriented Application Development, R.A. Johnson-Thomson, 2012.
5. Core Java 2,Vol1,Fundamentals, Cay.S.Horstmann and Garyn Cornell, Eighth Edition, Pearson Education, 2007.
6. Core Java 2, Vol 2, Advanced Features, Cay. S. Horstmann and Gary Cornell, eighth Edition, Pearson Education, 2008.

WEB LINKS:

1. http://www.javatpoint.com/java-tutorial
2. http://www.javatutorialpoint.com/introduction-to-java/

MOBILE COMMUNIATIONS AND NETWORKS

(Professional Elective - II)

B. Tech. VI Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC622PE	**3**	**0**	**0**	**3**

Pre-requisites: Analog and Digital Communications

Course Objectives:

1. To provide the student with an understanding of the cellular concept, frequency reuse, hand- off strategies.
2. To provide the student with an understanding of Co-channel and Non-Co-Channel interferences.
3. To give the student an understanding of cell coverage for signal and traffic, diversity techniques and channel assignment
4. To give the student an understanding types of handoff.
5. To understand challenges and application of Adhoc wireless Networks.

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

1. Discuss the evolution of cellular and mobile communication system.
2. Explore the Co-Channel and Non-Co-Channel interferences.
3. Understand impairments due to multipath fading channel and how to overcome the different fading effects.
4. Familiar with cell coverage for signal and traffic, diversity, techniques, frequency management, Channel assignment and types of handoff.
5. Learn the difference between cellular and Adhoc Networks and design goals of MAC Layer protocol.

UNIT – I **[12 Lectures]**

Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone Systems. Basic Cellular Mobile System, First, Second, Third and Fourth Generation Cellular Wireless Systems. Uniqueness of Mobile Radio Environment-Fading-TieDispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.

Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co- Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I from a Normal Case in a Omni Directional Antenna System, System Capacity Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring, Microcell Zone Concept.

UNIT – II **[12 Lectures]**

Co-Channel Interference: Measurement of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and their effects, diversity techniques-space diversity, polarization diversity, frequency diversity, time diversity.

Non Co-Channel Interference: Adjacent Channel Interference, Near end far end interference, cross talk, effects on coverage and interference by power decrease, antenna height decrease, effects of cell site components.

UNIT – III **[10 Lectures]**

Cell Coverage for Signal and Traffic: Signal Reflections in flat and Hilly Terrain, effects of Human Made Structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation, path loss from a point to point prediction model in different conditions, merits of Lee model.

Frequency Management and Channel Assignment: Numbering and Grouping, Setup Access and Paging Channels, Channel Assignments to Cell Sites and Mobile Units.

UNIT – IV **[10 Lectures]**

Handoffs and Dropped Calls: Handoff Initiation, types of Handoff, Delaying Handoff, advantages of Handoff, Power Difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoff, Intersystem handoff, Introduction to Dropped Call Rates and their Evaluation.

UNIT – V **[9 Lectures]**

Ad Hoc Wireless Networks: Introduction, Cellular and Ad Hoc wireless Networks, Applications and Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet, MAC Protocols for Ad Hoc Wireless, Introduction, issues in designing AMAC Protocol for Ad Hoc wireless Networks, Design Goals of AMAC protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols.

TEXT BOOKS:

1. Mobile Cellular Telecommunications-W.C.Y. Lee, McGraw Hill, 2nd Edn., 1989.
2. Wireless Communications - Theodore. S. Rapport, Pearson Education, 2nd Edn., 2002.

REFERENCE BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols-C. Siva ram Murthy and B.S. Manoj, 2004, PHI.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
4. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005.

WEB LINKS:

1. https://archive.nptel.ac.in/courses/108/106/106106167/
2. https://archive.nptel.ac.in/courses/106/105/106105160/
3. https://easyengineering.net/ec8702-ad-hoc-and-wireless-sensor-networks-notes/
4. https://www.pearsonhighered.com/assets/samplechapter/0/1/3/0/0130422320.pdf

EMBEDDED SYSTEM DESIGN

(Professional Elective -II)

B. Tech. VI Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC623PE	**3**	**0**	**0**	**3**

Pre-requisites: Microprocessors and Microcontrollers; Computer Organization and OperatingSystems

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.
4. To learn the methods of interfacing and synchronization for tasking.

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

1. Analyze the selection procedure of Processors in the embedded domain.
2. Design Procedure for Embedded Firmware.
3. Visualize the role of Real time Operating Systems in Embedded Systems.
4. Evaluate the Correlation between task synchronization and latency issues.
5. Explore the Task Communication/Synchronization Issues.

UNIT – I **[8 hours]**

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT – II **[10 hours]**

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS),Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT – III **[8 hours]**

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT – IV **[10 hours]**

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT – V **[10 hours]**

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, **Task Synchronization:** Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

TEXT BOOK:

1. Introduction to Embedded Systems - Shibu K.V, 2nd Edition, McGraw Hill, 2017.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH, 2003.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley, 2006.
3. Embedded Systems – Lyla, Pearson, 2013.
4. An Embedded Software Primer - David E. Simon, Pearson Education, 2002,

WEB LINKS:

1. https://www.iitk.ac.in/tkic/workshop/sensors-and-actuators/ppt/sandeep.pdf
2. http://www.artistembedded.org/docs/Events/2006/ChinaSchool/1_ESIntroduction.pdf
3. http://web.cecs.pdx.edu/~mperkows/temp/hardware-software-codesign.pdf\
4. http://www.inf.ed.ac.uk/teaching/courses/es/PDFs/RTOS.pdf
5. http://www.vtt.fi/inf/pdf/publications/2004/P526.pdf

DIGITAL SIGNAL PROCESSING LAB

	L	T	P	C
B. Tech. VI Semester				
Subject Code: 22EC604PC	**0**	**0**	**2**	**1**

Co-requisites: Signals and Systems and Digital signal processing**.**

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

1. Perform Time, Frequency and Z- transform analysis on signals and systems.
2. Apply Z-transform, DTFT, DFT and FFT to analyze and design DSP systems.
3. Implementation of Decimation Process and Interpolation Process
4. Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital filters.
5. Design Multi-rate filters for various applications of DSP.

The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent) and Hardware (Using TI / Analog Devices / Motorola / Equivalent DSP processors).

Note: - Minimum of 12 experiments has to be conducted.

List of Experiments:

1. Generation of Sinusoidal Waveform / Signal based on Recursive Difference Equations
2. Histogram of White Gaussian Noise and Uniformly Distributed Noise.
3. To find DFT / IDFT of given DT Signal
4. To find Frequency Response of a given System given in Transfer Function/ Differential equation form.
5. Obtain Fourier series coefficients by formula and using FET and compare for half sine wave.
6. Implementation of FFT of given Sequence
7. Determination of Power Spectrum of a given Signal(s).
8. Implementation of LP FIR Filter for a given Sequence/Signal.
9. Implementation of HP IIR Filter for a given Sequence/Signal
10. Generation of Narrow Band Signal through Filtering
11. Generation of DTMF Signals
12. Implementation of Decimation Process
13. Implementation of Interpolation Process
14. Implementation of I/D Sampling Rate Converters
15. Impulse Response of First order and Second Order Systems.

TEXT BOOKS:

3. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI,2009.
4. Digital Signal Processing, Principles, Algorithms, and Applications John G.Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.

REFERENCE BOOKS:

5. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008.
6. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson,2007.
7. Digital Signal Processing – S. Salivahanan, A. Vallavaraj and C. Gnanapriya, TMH,2009.
8. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education,2009.

WEBLINKS:

1. https://kp.kiit.ac.in/pdf_files/02/LECTURE-NOTES_6th-ETC_-DSP_A-Pradhan.pdf
2. https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/pages/study-materials/
3. https://www.mathworks.com/help/signal/ug/iir-filter-design.html

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

B. Tech. VI Semester	**L**	**T**	**P**	**C**
Subject Code: 22EN605HS	**0**	**0**	**2**	**1**

Co-requisites: Basic English

Course Objectives

1. To improve the students' fluency in English, through a well-developed vocabulary.
2. To read and comprehend texts in different contexts.
3. To communicate their ideas relevantly and coherently in writing.
4. To make students' industry ready.
5. To acquire behavioural skills for their personal and professional life.

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

1. Interpret the vocabulary to improve the fluency in English.
2. Comprehend effectively in different contexts.
3. Develop proficiency in academic reading and writing.
4. Increase possibilities of job prospects.
5. Communicate effectively in formal and informal contexts.

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language –Role Play indifferent situations & Discourse Skills-using visuals-Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations &usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading &effective goggling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/e- mails/assignments etc.

5. **Activities on Group Discussion and Interview Skills** – Dynamics of group

discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8GHZ
- T. V, a digital stereo &Camcorder
- Headphones of High quality

SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's keyto the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. M Asharaf Rizvi, Effective Technical Communication, McGraw Hill Education, Second edition,2017.
2. Stephen Bailey, Academic Writing: A Handbook for International Students, Routledge, 5th edition, 2017.

REFERENCE BOOKS:

1. V. Hemalatha Nagarajan, Shiv K.Kumar, Learn Correct English – Grammar, Composition and Usage, Pearson, 1st edition, 2005.
2. Aruna Koneru, Professional Communication, McGraw Hill Education (India) Pvt. Ltd, 2017.
3. Meenakshi Raman & Sangeeta Sharma, Technical Communication, 3rd edition, Oxford University Press, 2015.
4. Paul V. Anderson, Technical Communication, 9th edition, Cengage Learning pvt Ltd, New Delhi, 2017.
5. 5. Michael McCarthy, Felicity O'Dell, English Vocabulary in Use Elementary Book with Answers and Enhanced eBook: Vocabulary Reference and Practice, Cambridge University Press, 3rd edition, 2017.
6. David A. McMurrey & Joanne Buckley, Handbook of Technical Communication, Cengage, 1st edition, 2012.
7. Leena Sen, Communication Skills, PHI, 2nd Revised edition, 2007.
8. Colm Downes, Cambridge English for Job-hunting, Cambridge University Press, 1st edition, 2008.
9. Aysha Vishwamohan, English for Technical Communication for Engineering Students, McGraw Hill Education, 1st edition, 2008.

WEB LINKS:

1. https://nptel.ac.in/courses/109104031
2. https://www.udemy.com/topic/english-conversation/?p=3
3. https://www.coursera.org/specializations/business-english
4. (99+) advanced english communication skills lab: syllabus advanced english
5. communication skills lab | rock rishi - academia.edu

CMOS VLSI DESIGN LABORATORY

B. Tech. VI Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC606PC	**0**	**0**	**2**	**1**

Co-requisites: Digital System Design

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

1. Verify the functionality of Different latch and flip-flops Using Verilog HDL
2. Verify different counters using Verilog HDL.
3. Verify RAM and ROM Verilog HDL.
4. Analyse Layout, physical verification, timing analysis of Basic logic Gate using Backend tools Layout, physical verification, timing analysis of combinational Circuits.
5. Design a Verilog HDL module for Finite State Machine Design.

Note:

1. Any **SIX** of the following experiments from each part are to be conducted (Total 12)
2. Xilinx Vivado Design Suite/Mentor Graphics/Cadence Digital Design Tools or any other equivalent Software can be used

Part - I

All the following experiments have to be implemented using HDL

1. Develop Verilog HDL modules for SR latch
2. Develop Verilog HDL modules for flip flops: SR, D, JK, T
3. Develop Verilog HDL modules for synchronous counters
4. Develop Verilog HDL modules for asynchronous counters
5. Develop Verilog HDL modules for shift registers
6. Design a Verilog HDL module for sequence detector
7. Design a Verilog HDL module for ROM and RAM
8. Design a Verilog HDL module for Finite State Machine Design

Part - II

Layout, physical verification, placement & route for complex design, static timing analysis, IR drop analysis and crosstalk analysis for the following:

1. Basic logic gates
2. CMOS inverter
3. CMOS NOR/ NAND gates
4. CMOS XOR and MUX gates
5. Static / Dynamic logic circuit (register cell)
6. Latch
7. Pass transistor
8. Layout of any combinational circuit (complex CMOS logic gate).

TEXT BOOKS:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell - Essentials of VLSI circuits and systems, PHI, 2005
2. Neil H. E Weste, David Harris, Ayan Banerjee - CMOS VLSI Design – A Circuits and Systems Perspective, 3rd Edition, Pearson, 2009.

REFERENCE BOOKS:

1. Ming-BO Lin - Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, 2011
2. John. P. Uyemura - CMOS logic circuit Design, Springer, 2007.
3. Wayne Wolf - Modern VLSI Design, 3rd Edition, Pearson Education, 1997.
4. K. Lal Kishore, V. S. V. Prabhakar -VLSI Design, I.K International, 2009.

WEB LINKS:

1. http://dspace.mit.edu/handle/1721.1/93776
2. http://dspace.mit.edu/handle/1721.1/75650
3. https://engineering.purdue.edu/~vlsi/ECE559_Fall09/?_ga=2.120672008.1227662350.1573631317 316737531.1573631317
4. Class Notes: http://cobweb.ecn.purdue.edu/~vlsi/ECE559_Fall09

ENVIRONMENTAL SCIENCE

	L	T	P	C
B. Tech. VI Semester				
Subject Code: 22CH608MC	**3**	**0**	**0**	**0**

Pre-requisites: Nil

Course Objectives:

1. To recognize the importance of environment, self-sustain eco systems.
2. To understand various natural resources – their importance, over exploitation, effects, and mitigation measures.
3. To create basic knowledge about different biotic resources and their need for conservation.
4. To be aware of the impacts of developmental activities and mitigation measures.
5. To know various environmental policies, legislation, and regulations.

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

1. Explore harmonious co-existence of nature and human beings.
2. Recognize conservation of natural resources particularly alternate sources of energy.
3. Evaluate and develop technologies for conservation of biodiversity in a sustainable manner.
4. Generate ideas and implement technologies to solve environmental problems associated with air, water, and soil.
5. Develop technologies based on ecological principles and environmental regulations which helps in sustainable developments.

UNIT – I **[10 Lectures]**

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II **[8 Lectures]**

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT – III **[8 Lectures]**

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV **[7 Lectures]**

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution.

Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards.

Water pollution: Sources and types of pollution, drinking water quality standards.

Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil.

Noise Pollution: Sources and Health hazards, standards,

Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management.

Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation.

Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V **[8 Lectures]**

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects AirAct-1981, Water Act, Forest Act, Wildlife Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio- economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon lifestyle.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T.Wright. 2008, PHI Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Textbook of Environmental Science and Technology - Dr.M.Anji Reddy, 2007, BS Publications.

WEB LINKS:

1. https://www.youtube.com/watch?v=mOwyPENHhbc
2. https://www.youtube.com/watch?v=_mgvsPnCYj4
3. https://www.youtube.com/watch?v=L5B-JMnBIyQ

PROFESSIONAL PRACTICE, LAW AND ETHICS

B. Tech. VII Semester	**L**	**T**	**P**	**C**
Subject Code: 22MB701HS	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

1. To Understand the types of roles they are expected to play in the society.
2. To develop some ideas of the legal and practical aspects of their profession.
3. To be aware of alternative dispute resolution system
4. To know arbitration agreements
5. To understand the law relating to intellectual property

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

1. Practice ethics and rule of the land in their profession
2. Follow the principles and elements of legal contracts
3. Able to resolve disputes pertaining to arbitration, reconciliation
4. Aware of intellectual property loss.
5. Discuss the Law relating to Intellectual property

UNIT–I **[10 Lectures]**

Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stakeholders

UNIT–II **[8 Lectures]**

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

UNIT–III **[9 Lectures]**

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration;

UNIT–IV **[9 Lectures]**

Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

UNIT–V **[9 Lectures]**

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India

Digital Rights Management (DRM): Importance of DRM, Working of DRM, DRM Use cases, Benefits of DRM, Key functions of DRM software.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ravinder Kaur, Legal Aspects of Business, 4e, Cengage Learning, 2016.

REFERENCE BOOKS:

1. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
2. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House.
3. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.
4. B.K. Jain , Digital Rights Management Imperatives and Innovative Opportunities , 2nd Ediition, Global Vision Publishing house, 2019.

ARTIFICIAL NEURAL NETWORKS

(Professional Elective – III)

B. Tech. VII Semester | **L T P C**
Subject Code: 22EC731PE | **3 0 0 3**
Pre-requisites: Basic Programming Skills

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithms
3. To know the issues of various feed forward and feedback neural networks.
4. To explore the Neuro dynamic models for various problems.

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

1. Identify the similarity of Biological networks and Neural networks
2. Perform the training of neural networks using various learning rules.
3. Analyze the concepts of forward and backward propagations.
4. Explore the concepts of Self-Organization Maps.
5. Identify and construct the Hopfield models.

UNIT – I **[8 hours]**

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.

UNIT – II **[12 hours]**

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment.

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.

UNIT – III **[10 hours]**

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

UNIT – IV **[9 hours]**

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification.

UNIT – V **[10 hours]**

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

Hopfield Models – Hopfield Models, restricted boltzmen machine.

TEXT BOOKS:

1. "Neural Networks a Comprehensive Foundations", Simon S Haykin, 2nd edition, PHI Education, 2001.
2. "Introduction to Artificial Neural Systems", Jacek M. Zurada, JAICO Publishing House Ed. 2006.

REFERENCE BOOKS:

1. Neural Networks in Computer Intelligence, Li Min Fu TMH, 2003.
2. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
3. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd., 2005.

WEB LINKS:

1. https://www.tutorialspoint.com/genetic_algorithms/
2. http://freevideolectures.com/Course/2348/Intelligent-Systems-and-Control/16
3. https://www.geeksforgeeks.org/pattern-recognition-introduction

CMOS ANALOG IC DESIGN

(Professional Elective – III)

	L	T	P	C
B. Tech. VII Semester				
Subject Code: 22EC732PE	**3**	**0**	**0**	**3**

Pre-requisites: Analog Electronics

Course Objectives:

Analog circuits play a very crucial role in all electronic systems and due to continued miniaturization, many of the analog blocks are not getting realized in CMOS technology.

1. To understand most important building blocks of all CMOS analog Ics.
2. To study the basic principle of operation, the circuit choices and the tradeoffs involved in the MOS transistor level design common to all analog CMOS ICs.
3. To understand specific design issues related to single and multistage voltage, current and differential amplifiers, their output and impedance issues, bandwidth, feedback and stability.
4. To understand the design of differential amplifiers, current amplifiers and OP AMPs.
5. To understand and study of Characterization of Comparators

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

1. Design basic building blocks of CMOS analog ICs.
2. Implement the design of single and two stage operational amplifiers and voltage references.
3. Determine the device dimensions of each MOSFETs involved.
4. Design various amplifiers like differential, current and operational amplifiers.
5. Design of comparators based on CMOS VLSI

UNIT I **[10 hours]**

MOS Devices and Modeling The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small- Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT II **[8 hours]**

Analog CMOS Sub-Circuits MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors- Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT III **[8 hours]**

CMOS Amplifiers Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

UNIT IV **[8 hours]**

CMOS Operational Amplifiers Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT V **[8 hours]**

Comparators Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS:

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

REFERENCES:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2013.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, McGraw Hill 2nd Edition, 2017.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI, 1997.

WEB LINKS:

1. http://www.aicdesign.org/OnLineLectures.html
2. http://nptel.ac.in/courses/117106030/
3. www.mentor.com 4. www.cadence.com

DIGITAL IMAGE PROCESSING

(Professional Elective – III)

B. Tech. VII Semester **L T P C**

Subject Code: 22EC733PE **3 0 0 3**

Pre-requisites: Digital Signal Processing, Probability Theory

Course Objectives:

1. To provide a approach towards image processing and introduction about 2Dtransforms
2. To expertise about enhancement methods in time and frequency domain
3. To expertise about segmentation and compression techniques
4. To understand the Morphological operations on an image

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

1. Explore the fundamental relations between pixels and utility of 2-D transforms in image processer.
2. Analyze the enhancement, segmentation and restoration processes on an image.
3. Implement the various Morphological operations on an image.
4. Learn the need of compression and evaluation of basic compression algorithms.
5. Identify the Morphological operations on an image.

UNIT - I **[9 Lectures]**

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.

Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

UNIT - II **[10 Lectures]**

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

UNIT - III **[8 Lectures]**

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT - IV **[9 Lectures]**

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

UNIT - V **[9 Lectures]**

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000Standards.

TEXT BOOKS:

1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- TMH, 2010.

REFERENCE BOOKS:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools - Scotte Umbaugh, 2nd Ed, CRC Press, 2011.
2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, TMH, 2010.
3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008.
4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2nd Edition, BS Publication,2008.

WEB LINKS

1. www.imageprocessingplace.com
2. www.cviptools.com
3. www.dspguru.com
4. www.mathworks.com/imageprocessing

MULTIMEDIA DATABASE MANAGEMENT SYSTEMS
(Professional Elective – IV)

	L	T	P	C
B. Tech. VII Semester				
Subject Code: 22EC741PE	**3**	**0**	**0**	**3**

Pre-requisites: DBMS

Course Objectives:

1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. Topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

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

1. Gain knowledge of fundamentals of DBMS, database design and normal forms
2. Master the basics of SQL for retrieval and management of data.
3. Acquainted with the basics of transaction processing and concurrency control.
4. Familiarity with database storage structures and access techniques
5. Explore the file organization, sequential access methods.

UNIT – I **[8 hours]**

Database System Applications: A Historical Perspective, File Systems versus a DBMS**,** the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS

Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design with the ER Model

UNIT – II **[10 hours]**

Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical data base design, introduction to views, destroying/altering tables and views.

Relational Algebra**,** Tuple relational Calculus, Domain relational calculus.

UNIT – III **[10 hours]**

SQL: Queries, Constraints, Triggers: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active data bases.

Schema Refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal form.

UNIT – IV **[10 hours]**

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions.

UNIT – V **[10 hours]**

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, *Mc Graw Hill* 3rd Edition, 2003.
2. Database System Concepts, Silberschatz, Korth, *Mc Graw hill*, 5th edition, 2005.

REFERENCE BOOKS:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition, 2006.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education, 7th edition, 2017.
3. Introduction to Database Systems, C. J. Date, Pearson Education, 2004.
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, *SPD*, 2008.
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL, Shah, *PHI*, 2001.
6. Fundamentals of Database Management Systems, M. L. Gillenson, *Wiley Student* Edition, 2012.

(Professional Elective – IV)

B. Tech. VII Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC742PE	**3**	**0**	**0**	**3**

Pre-requisites: foundation in mathematics and computer science

Course Objectives:

1. Understand the basic concept of Cryptography and Network Security, their mathematical models.
2. To understand the necessity of network security, threats/vulnerabilities to networks and counter measures.
3. To understand Authentication functions with Message Authentication Codes and Hash Functions.
4. To provide familiarity in Intrusion detection and Firewall Design Principles.

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

1. Explore network security fundamental concepts and principles.
2. Create Encrypted and decrypted messages using block ciphers and network security technology and protocols.
3. Analyze key agreement algorithms to identify their weaknesses.
4. Identify and assess different types of threats, malware, spyware, viruses, and vulnerabilities.
5. Learn IP security and firewall.

UNIT – I **[10 hours]**

Security Services, Mechanisms and Attacks, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques. **Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

UNIT – II **[10 hours]**

Encryption: Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block Ciphers. Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

UNIT – III **[9 hours]**

Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

UNIT – IV **[10 hours]**

Message Authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

Hash and Mac Algorithms: MD-5, Message digests Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards.

Authentication Applications: Kerberos, Electronic Mail Security: Pretty Good Privacy, SIME/MIME.

UNIT – V **[9 hours]**

IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction.

Intruders, Viruses and Worms: Intruders, Viruses and Related threats.

Fire Walls: Fire wall Design Principles, Trusted systems.

TEXT BOOKS:

1. "Cryptography and Network Security: Principles and Practice", William Stallings, Pearson Education, 2017.
2. "Network Security: The complete reference", Robert Bragg, Mark Rhodes,TMH, 2004.

REFERENCE BOOKS:

1. "Network Security Essentials (Applications and Standards)", William Stallings Pearson Education, 6th edition, 2016.
2. "Fundamentals of Network Security", Eric Maiwald (Dream tech press), 2004.
3. "Principles of Information Security", Whitman, Thomson, course technology Inc, 6th edition, 2017
4. "Introduction to Cryptography", Buchmann, Springer.2nd edition, 2004.

SATELLITE COMMUNICATIONS

(Professional Elective – IV)

B. Tech. VII Semester **L T P C**
Subject Code: 22EC743PE **3 0 0 3**
Pre-requisites: Analog and Digital Communications

Course Objectives:

1. To acquired foundation in orbital mechanics and launch vehicles for the satellites.
2. To provide basic knowledge of link design of satellite.
3. To understand multiple access systems and earth station technology.
4. To understand the concepts of satellite navigation and GPS.

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

1. Explore basic concepts and frequency allocations for satellite communication, orbital mechanics and launch vehicles.
2. Envision the satellite sub systems and design satellite links for specified C/N.
3. Analyze the various multiple access techniques for satellite communication systems and earth station technologies.
4. Enumerate the concepts of LEO, GEO Stationary Satellite Systems and satellite navigation.
5. Learn mapping the geospatial features.

UNIT – I **[10 hours]**

Introduction: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

Orbital Mechanics and Launchers: Orbital Mechanics, Look Angle determination, Orbital Perturbations, Orbit determination, Launches and Launch vehicles, Orbital Effects in Communication Systems Performance.

UNIT – II **[8 hours]**

Satellite Subsystems: Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.

UNIT – III **[10 hours]**

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design Of Satellite Links For Specified C/N, System Design Examples.

Multiple Access: Frequency Division Multiple Access (FDMA), Inter modulation, Calculation of C/N, Time Division Multiple Access (TDMA), Frame Structure, Examples, Satellite Switched TDMA Onboard Processing, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception.

UNIT – IV **[8 hours]**

Earth Station Technology: Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods.

UNIT – V **[9 hours]**

Low Earth Orbit and Geo-Stationary Satellite Systems: Orbit Considerations, Coverage and Frequency Consideration, Delay & Throughput Considerations, System Considerations, Operational NGSO Constellation Designs.

Overview of Satellite Navigation & Global Positioning System: Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, GPS Receiver Operation, GPS C/A Code Accuracy, Differential GPS.

TEXT BOOKS:

1. "Satellite Communications", Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. "Satellite Communications Engineering", Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCE BOOKS:

1. "Satellite Communications: Design Principles", M.Richharia, BS Publications, 2nd edition,2003.
2. "Satellite Communication", D.C Agarwal, Khanna Publications, 5th edition.
3. "Fundamentals of Satellite Communications", K.N. Raja Rao, PHI, 2004.
4. "Satellite Communications", Dennis Roddy, McGraw Hill, 4th edition, 2009.

MICROWAVE ENGINEERING

B. Tech. VII Semester	**L**	**T**	**P**	**C**
Subject Code: 22EC702PC	**3**	**1**	**0**	**4**

Pre-requisites: Antennas and Wave Propagation and Electromagnetic Theory and Transmission Lines

Course Objectives:

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies and Analysis of wave guide.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. Realize the need for solid state microwave sources and understand the principles of solid state devices
4. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications
5. To impart the knowledge of Scattering Matrix, its formulation and utility and establish the S-Matrix for various types of microwave junctions and measurement.

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

1. Analyze completely the rectangular waveguides, their mode characteristics, and design
2. Explore power generation at microwave frequencies and derive the performance characteristics.
3. Realize the need for solid state microwave sources and understand the principles of solid state.
4. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications.
5. Implement the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.

UNIT– I **[12 Lectures]**

Waveguides: Electromagnetic Spectrum and Bands. Rectangular Waveguides – Solution of Wave Equations in Rectangular Coordinates, TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Phase and Group Velocities, Wavelengths and Impedance Relations, Equation of Power Transmission, Impossibility of TEM Mode . Micro strip Lines –Z_o Relations, Effective Dielectric Constant.

UNIT– II **[12 Lectures]**

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M-Type Classifications, O-type Tubes: 2Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons– Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics.

Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

UNIT– III **[10 Lectures]**

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics,

Microwave Solid State Devices: Introduction, Classification, Applications. TEDs– Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation – Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT– IV **[12 Lectures]**

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities–Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators–Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide, Phase Shifters Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees, Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components– Gyrator, Isolator.

UNIT–V **[12 Lectures]**

Scattering matrix: Scattering Matrix Properties, Directional Couplers–2Hole, Bethe-Hole, [s] Matrix of Magic Tee and Circulator.

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity-Q, Impedance Measurements.

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems - Wayne Tomasi, Pearson, 5th Edition, 2008.

REFERENCE BOOKS:

1. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.
2. Microwave Engineering – David M.Pozar, John Wiley & Sons (Asia) Pvt. Ltd., 3rd Ed, 2011, Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System – George Kennedy, 6th Ed., McGraw Hill, 2017.

WEB LINKS:

1. http://www.amanogawa.com/antenna.html
2. http://falstad.com/wavebox/
3. http://nptel.ac.in/courses/117107035/byDr. Amalendu Patnaik
4. http://www.radio-electronics.com/info/antennas/
5. http://www.radartutorial.eu/index.en.html
6. https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_measurement_devices.htm

MICROWAVE ENGINEERING LAB

B. Tech. VII Semester **L T P C**
Subject Code: 22EC703PC **0 0 2 1**
Pre-requisites: Electromagnetic waves and Transmission Lines, Antennas and wave propagation
Co-requisites: Microwave Engineering

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

1. Explore the characteristics of various microwave Tubes.
2. Analyze the various parameters of microwave devices.
3. Distinguish between H plane, E plane and Magic Tee.
4. Examine Isolation, Coupling factor and Directivity of directional couplers.
5. Analyze the characteristics of horn Antenna

Note: Minimum of 12 experiments to be conducted.

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Directional Coupler Characteristics
4. VSWR Measurement of Matched load
5. VSWR measurement of with open and short circuit loads
6. Measurement of Waveguide Parameters
7. Measurement of Impedance of a given Load
8. Measurement of Scattering Parameters of a E plane Tee
9. Measurement of Scattering Parameters of a H plane Tee
10. Measurement of Scattering Parameters of a Magic Tee
11. Measurement of Scattering Parameters of a Circulator
12. Attenuation Measurement
13. Microwave Frequency Measurement
14. Antenna Pattern Measurements.

TEXT BOOKS:

3. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
4. Electronic Communications Systems - Wayne Tomasi, Pearson, 5th Edition, 2008.

REFERENCE BOOKS:

5. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.
6. Microwave Engineering – David M.Pozar, John Wiley & Sons (Asia) Pvt. Ltd., 3rd Ed, 2011, Reprint.
7. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
8. Electronic Communication System – George Kennedy, 6th Ed., McGraw Hill, 2017.

WEB LINKS:

1. http://www.amanogawa.com/antenna.html
2. http://falstad.com/wavebox/
3. http://nptel.ac.in/courses/117107035/byDr. Amalendu Patnaik
4. http://www.radio-electronics.com/info/antennas/
5. http://www.radartutorial.eu/index.en.html
6. https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_measurement_devices.htm

RADAR SYSTEMS

(Professional Elective – V)

B. Tech. VIII Semester **L T P C**
Subject Code: 22EC851PE **3 0 0 3**
Pre-requisites: Analog and Digital Communications

Course Objectives:

1. To explore the concepts of radar and its frequency bands.
2. To understand Doppler effect and get acquainted with the working principles of CW radar, FM- CW radar.
3. To impart the knowledge of functioning of MTI and Tracking Radars.
4. To explain the designing of a Matched Filter in radar receivers.

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

1. Explore the basic concepts of Radar and derive complete radar range equation.
2. Learn the need and functioning of CW, FM-CW and MTI Radars
3. Analyze various Tracking methods.
4. Analyze and derive the matched filter response characteristics for radar receivers.
5. Examine detection of radar signals in noise.

UNIT – I **[10 hours]**

Basics of Radar: Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation.
Radar Equation: SNR, Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment).

UNIT – II **[10 hours]**

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.
FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter.

UNIT – III **[10 hours]**

MTI and Pulse Doppler Radar: Principle, MTI Radar - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

UNIT – IV **[10 hours]**

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one and two - coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT – V **[10 hours]**

Detection of Radar Signals in Noise Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non- Matched Filters, Matched Filter with Non-white Noise.

Radar Receivers – Noise Figure and Noise Temperature, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers, Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.

TEXT BOOKS:

1. "Introduction to Radar System", Merrill I. Skolnik, TMH Special Indian Edition, 2nd edition, 2007.

REFERENCE BOOKS:

1. "Radar: Principles, Technology, Applications", Byron Edde, Pearson Education,2004.
2. "Radar Principles", Peebles, Jr., P.Z., Wiley, New York, 1998.
3. "Principles of Modern Radar: Basic Principles", Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013.
4. "Radar Handbook", Merrill I. Skolnik, 3rd edition, McGraw Hill Education, 2008.

WIRELESS SENSOR NETWORKS

(Professional Elective – V)

B. Tech. VIII Semester **L T P C**
Subject Code: 22EC852PE **3 0 0 3**
Pre-requisites: Analog and Digital Communications

Course Objectives:

1. To acquire the knowledge about various architectures and applications of Sensor Networks.
2. To understand issues, challenges and emerging technologies for wireless sensor networks.
3. To learn about various routing protocols and MAC Protocols.
4. To understand various data gathering and data dissemination methods.
5. To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

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

1. Analyze and compare various architectures of Wireless Sensor Networks.
2. Design issues and challenges in Wireless Sensor Networks.
3. Design, Simulate and Compare the performance of various routing and MAC protocols.
4. Analyze and compare various data gathering and data dissemination methods.
5. Analyze the design Principles for WSNs and Role of Gateway.

UNIT – I **[8 Lectures]**

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks.

UNIT – II **[8 Lectures]**

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT – III **[8 Lectures]**

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT – IV **[8 Lectures]**

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT – V **[8 Lectures]**

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

TEXT BOOKS:

1. "Ad-Hoc Wireless Sensor Networks", C. Siva Ram Murthy, B. S. Manoj, Pearson, 2006.
2. "Principles of Wireless Networks", Kaveh Pah Laven and P. Krishna Murthy, PE, 2002.

REFERENCE BOOKS:

1. "Wireless Digital Communications:, Kamilo Feher, PHI, 1999.
2. "Wireless Communications", Andrea Gold smith, Cambridge University Press, 2005.
3. "Mobile Cellular Communication", Gottapu Sasibhushana Rao, Pearson Education, 2012.
4. "Wireless Communication and Networking", William Stallings, PHI, 2003.

WEB LINKS

1. https://www.sciencedirect.com/topics/engineering/wireless-sensor-network
2. https://www.slideshare.net/skumartarget/wsn-in-iot-61121038
3. https://www.slideshare.net/Jaddu44/basics-of-wireless-sensor-networks
4. https://www.mdpi.com/2571-5577/3/1/14

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LOW POWER VLSI DESIGN

(Professional Elective – V)

	L	T	P	C
B. Tech. VIII Semester				
Subject Code: 22EC853PE	**3**	**0**	**0**	**3**

Pre-requisites: VLSI design

Course Objectives:

1. Known the low power low voltage VLSI design.
2. Understand the impact of power on system performances.
3. Known about different Design approaches.
4. Identify suitable techniques to reduce power dissipation in combinational and sequential circuits.

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

1. Explore the need of Low power circuit design.
2. Examine the various architectural approaches.
3. Analyze Low-Voltage Low-Power combinational circuits.
4. Design Low-Voltage Low-Power combinational circuits
5. Design of Low-Voltage Low-Power Memories.

UNIT – I **[10 hours]**

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation –Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT – II **[9 hours]**

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining andParallel Processing Approaches.

Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask level Measures.

UNIT – III **[8 hours]**

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adders Architectures Ripple Carry Adders, Carry Look- Ahead Adders, Carry Select Adders, Carry Save Adders, Low- Voltage Low-Power Design Techniques –Trends of Technologyand Power Supply Voltage, Low- Voltage Low-Power Logic Styles.

UNIT – IV **[8 hours]**

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT – V **[8 hours]**

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics ofDRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOKS:

1. "CMOS Digital Integrated Circuits", Analysis and Design – Sung-MoKang, Yusuf Leblebici, TMH, 2011.
2. "Low-Voltage, Low-Power VLSI Subsystems", Kiat-Seng Yeo, KaushikRoy, TMH Professional Engineering, 2004.

REFERENCE BOOKS:

1. "Introduction to VLSI Systems: A Logic, Circuit and SystemPerspective", Ming- BO Lin, CRC Press, 2011.
2. "Low Power CMOS VLSI Circuit Design", Kaushik Roy, Sharat C.Prasad, John Wiley & Sons, 2000.
3. "Practical Low Power Digital VLSI Design", Gary K. Yeap, KluwerAcademic Press, 2002.
4. "Leakage in Nanometer CMOS Technologies", Siva G. Narendran,Anatha Chandrakasan, Springer, 2005.

BIOMEDICAL INSTRUMENTATION

(Professional Elective – IV)

	L	T	P	C
B. Tech. VIII Semester				
Subject Code: 22EC861PE	**3**	**0**	**0**	**3**

Pre-requisites: EMI

Course Objectives

1. Identify significant biological variables at cellular level and ways to acquire different bio-signals.
2. Elucidate the methods to monitor the activity of the heart, brain, eyes and muscles.
3. Introduce therapeutic equipment for intensive and critical care.
4. Outline medical imaging techniques and equipment for certain diagnosis and therapies.

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

1. Explore bio systems and medical systems from an engineering perspective.
2. Identify the techniques to acquire record and primarily understand physiological activity of the human body through cell potential, ECG, EEG, BP and blood flow measurement and EMG.
3. Analyze the working of various medical instruments and critical care equipment.
4. Identify the imaging techniques including CT, PET, SPECT and MRI used in diagnosis of various medical conditions.
5. Examine about therapeutic Equipment.

UNIT – I **[10 hours]**

Bio-Potential Signals and Electrodes: Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials. Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems. Bio-potential electrodes– Body surface recording electrodes, Internal electrodes, micro electrodes. Bio-chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes.

UNIT – II **[9 hours]**

Cardiovascular Instrumentation: Heart and cardiovascular system Heart electrical activity, blood pressure and heart sounds. Cardiovascular measurements electro cardiography – electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

UNIT – III **[8 hours]**

Neurological Instrumentation: Neuronal communication, electro encephalogram (EEG), EEG Measurements EEG electrode-placement system, interpretation of EEG, EEG system Block diagram, preamplifiers and amplifiers, EMG block diagram and Stimulators.

UNIT – IV **[8 hours]**

Equipment for Critical Care: Therapeutic equipment-Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation - Mechanism of respiration, Spirometry, Pneumotachograph, Ventilators.

UNIT – V **[9 hours]**

Principles of Medical Imaging: Radiography, computed Radiography, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Ultrasonography, Introduction to Telemedicine.

TEXT BOOKS:

1. "Hand-book of Biomedical Instrumentation", R.S. Khandpur, McGraw-Hill, 2003.
2. "Medical Instrumentation, Application and Design", John G. Webster, John Wiley, 2009.

REFERENCE BOOKS:

1. "Biomedical Instrumentation and Measurements", Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, PHI, 1990.
2. "Principles of Applied Biomedical Instrumentation", L.A.Geoddes and L.E.Baker, John Wiley and Sons, 2008.
3. "Introduction to Biomedical equipment technology", Joseph Carr and Brown, 2000.

SYSTEM ON CHIP ARCHITECTURE
(Professional Elective – VI)

	L	T	P	C
B. Tech. VIII Semester				
Subject Code: 22EC862PE	**3**	**0**	**0**	**3**

Pre-requisites: Embedded System Design

Course Objective:

1. To introduce the architectural features of system on chip.
2. Understand the features of SOC processors.
3. To understand the different Models of Simple Processor – memory interaction.
4. To imbibe the knowledge of customization using case studies.
5. To study and understand Reconfiguration Technologies.

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

1. Analyze SOC Architectural features.
2. Acquire the knowledge on processor selection criteria and limitations.
3. Acquire the knowledge of memory architectures on SOC.
4. Explore the interconnection strategies and their customization on SOC.
5. Learn about reconfigurable devices.

UNIT – I **[10 hours]**

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT – II **[8 hours]**

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT – III **[8 hours]**

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I , and D – Caches , Multilevel Caches, Virtual to real translation, SOC Memory System , Models of Simple Processor – memory interaction.

UNIT – IV **[8 hours]**

Interconnect Customization: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time, SOC Customization.

UNIT – V **[8 hours]**

Configuration: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

TEXTBOOK:

1. Computer System Design System-on-Chip by Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd., 2011.
2. ARM System on Chip Architecture – Steve Furber –2nd Ed. Addison Wesley Professional, 2000.

REFERENCE BOOKS:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., Springer, 2004.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM, 2004.
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers, 2000.

5G AND BEYOND COMMUNICATIONS

(Professional Elective – VI)

B. Tech. VIII Semester **L T P C**
Subject Code: 22EC863PE **3 0 0 3**
Pre-requisites: Mobile Communications and Networks

Course Objectives:

1. To provide the student with an understanding of the Various Cellular Technologies from 2G and 2.5 G
2. To provide the student with an understanding of Cellular Technologies with 3G
3. To give the student an understanding of concepts in 4G and New Technologies
4. To give the student concept understanding in 5G Technology and it's Evolution
5. To understand 5G Architecture and it's Performance

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

1. Enlist the Cellular Evolution from 1G to 2.5G
2. Analyze the 3GPP Network Architecture and CDMA 2000
3. Explore New Technologies in Cellular Data Networks
4. Analyze the Evolution from LTE to 5G
5. Examine 5G Technology Components

UNIT - I **[10 Lectures]**

Second Generation (2G) and (2.5G): Overview, Enhancements over 1G Systems, Integration with Existing 1G Systems, GSM, IS-136 System Description, IS-95 System Description, iDEN (Integrated Dispatch Enhanced Network), CDPD, Enhancements over 2G, Technology Platforms, General Packet Radio Service, (GPRS), Enhanced Data Rates for Global Evolution (EDGE), High-Speed Circuit Switched Data (HSCSD), CDMA2000 (1XRTT), WAP, Migration Path from 2G to 2.5G to 3G.

UNIT - II **[10 Lectures]**

Third Generation (3G): Universal Mobile Telecommunications Service (UMTS), UMTS Services, The UMTS Air Interface, Overview of the 3GPP Release 1999 Network Architecture, Overview of the 3GPP Release 4 Network Architecture, Overview of the 3GPP Release 5 All-IP Network Architecture, Overview CDMA2000, Commonality Between, DMA/CDMA2000/CDM.

UNIT - III **[8 Lectures]**

Fourth Generation (4G): 4G evolution, objectives of the projected 4G, advantages of 4G network technology over 3G, application s of 4G,4G Technologies, Smart antenna technique, 4G software, new technologies in cellular data networks.

UNIT - IV **[10 Lectures]**

5G Targets and Standardization: Introduction, 5G Targets, 3 5G Technology Components, 5G Spectrum, 5G Capabilities, 5G Capacity Boost, 5G Standardization and Schedule, 5G Use Cases, Evolution Path from LTE to 5G, Mobile Data Traffic Growth. Introduction, ITU, NGMN, 3GPP Schedule and Phasing.

UNIT - V **[12 Lectures]**

5G Technology Components & 5G Architecture: Introduction, Spectrum Utilization, Beamforming, Flexible Physical Layer and Protocols, Network Slicing, Dual Connectivity with LTE, Radio Cloud and Edge Computing, Introduction, 5G Architecture Options, 5G Core Network Architecture, 5G RAN Architecture, Network Slicing.

5G Performance: Introduction, Peak Data Rates, Practical Data Rates, Latency, Link Budgets, Coverage for Sub-6-GHz Band, Massive MIMO and Beamforming Algorithms, Packet Scheduling

Algorithms, Spectral Efficiency and Capacity, Network Energy Efficiency, Traffic and Device Density.

TEXT BOOKS

1. 3G Wireless Networks- Clint Smith, P.E. Daniel Collins, 2nd Ed., 2013.
2. 5G Technologies :3 GPP New Radio Harri Holma, Antti Toskala, Takehiro Nakamura, 2019.

REFERENCES

1. 3G Networks Architecture- Protocols and Procedures- Sumith Kaseara, Nishit Narang, MGH, 2004.
2. Mobile Cellular Communication, Gottapu Sasibhuhsana Rao, PEARSON, 2013.

WEB LINKS:

1. https://archive.nptel.ac.in/courses/108/105/108105134/
2. https://www.researchgate.net/publication/348488654_Introduction_to_5G
3. https://nptel.ac.in/courses/117104099
4. https://www.gsma.com/wp-content/uploads/2019/04/The-5G-Guide_GSMA_2019_04_29_compressed.pdf