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**Semester – I**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18BSBH01 | Mathematics – I | 3 | 1 | 0 | 4 |
| 2 | 18BSBH14 | Applied Physics | 3 | 0 | 00 | 3 |
| 3 | 18ES0501 | Problem solving using C | 3 | 1 | 0 | 4 |
| 4 | 18HSBH01 | Technical English | 3 | 0 | 0 | 3 |
| 5 | 18BSBH11 | Physics Lab | 0 | 0 | 3 | 1.5 |
| 6 | 18HSBH02 | English Language& Communication Skills Lab | 0 | 0 | 3 | 1.5 |
| 7 | 18ES0502 | Problem solving using C Lab | 0 | 0 | 3 | 1.5 |
| | | **Total** | **12** | **2** | **6** | **18.5** |

**Semester – II**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18BSBH02 | Mathematics-II | 2 | 1 | 0 | 3 |
| 2 | 18BSBH12 | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 3 | 18ES0201 | Electrical Circuits | 3 | 0 | 0 | 3 |
| 4 | 18PC0501 | Data Structures | 3 | 0 | 0 | 3 |
| 5 | 18ES0301 | Engineering Graphics & Design | 2 | 0 | 4 | 4 |
| 6 | 18BSBH13 | Engineering Chemistry lab | 0 | 0 | 3 | 1.5 |
| 7 | 18ES0202 | Electrical Circuits lab | 0 | 0 | 3 | 1.5 |
| 8 | 18ES0302 | Engineering & IT Workshop Practice | 0 | 0 | 3 | 1.5 |
| 9 | 18MCBH02 | Environmental Science (Mandatory Course) | 0 | 0 | 0 | 0 |
| | | Total | **13** | **1** | **13** | **20.5** |

**Semester – III**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18BSBH03 | Mathematics -III | 2 | 1 | 0 | 3 |
| 2 | 18PC0201 | Electrical Machines - I | 3 | 0 | 0 | 3 |
| 3 | 18ES0403 | Analog Electronics | 3 | 0 | 0 | 3 |
| 4 | 18PC0202 | Electro Magnetic Fields | 3 | 0 | 0 | 3 |
| 5 | 18ES0208 | Network Theory | 3 | 0 | 0 | 3 |
| 6 | 18ES0404 | Analog Electronics Lab | 0 | 0 | 3 | 1.5 |
| 7 | 18PC0203 | Electrical Machines - I Lab | 0 | 0 | 3 | 1.5 |
| 8 | 18HSBH03 | Soft Skills | 0 | 0 | 2 | 1 |
| | | **Total** | **14** | **1** | **8** | **19** |
| 9 | 18MCBH03 | Indian Constitution | 0 | 0 | 0 | 0 |

**Semester – IV**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18BSBH06 | Mathematics - IV | 2 | 1 | 0 | 3 |
| 2 | 18PC0204 | Electrical Machines - II | 3 | 0 | 0 | 3 |
| 3 | 18PC0205 | Power Electronics | 3 | 0 | 0 | 3 |
| 4 | 18ES0405 | Digital Electronics | 3 | 0 | 0 | 3 |
| 5 | 18PC0402 | Signals & Systems | 3 | 0 | 0 | 3 |
| 6 | 18PC0206 | Power Electronics Lab | 0 | 0 | 3 | 1.5 |
| 7 | 18PC0207 | Electrical Machines - II Lab | 0 | 0 | 3 | 1.5 |
| 8 | 18PS0201 | Seminar - I | 0 | 0 | 2 | 1 |
| | | **Total** | **14** | **1** | **8** | **19** |
| 9 | 18MCBH04 | Essence of Indian Traditional Knowledge | 0 | 0 | 0 | 0 |

**Semester – V**
**Course / Branch: B.Tech-Electrical & Electronics Engineering(R-18)**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18M00112 | Managerial Economics And Financial Analysis | 3 | 0 | 0 | 3 |
| 2 | 18PC0208 | Power Systems –I | 3 | 0 | 0 | 3 |
| 3 | 18PC0209 | Control Systems | 3 | 0 | 0 | 3 |
| 4 | 18PC0210 | Measurement and Instrumentation | 3 | 0 | 0 | 3 |
| 5 | PEC-I | Program Elective Course- I | 3 | 0 | 0 | 3 |
| 6 | PEC-II | Program Elective Course- II | 3 | 0 | 0 | 3 |
| 7 | 18PC0211 | Control Systems & Simulation Lab | 0 | 0 | 3 | 1.5 |
| 8 | 18PC0212 | Measurement and Instrumentation Lab | 0 | 0 | 3 | 1.5 |
| 9 | 18BSQ402 | Quantitative Aptitude | 0 | 0 | 2 | 1 |
| | | **Total** | **18** | **0** | **8** | **22** |

| PEC-I | Program Elective Courses- I |
|---|---|
| 18PE0201 | Electrical Drives |
| 18PE0202 | Energy Auditing & Conservation |
| 18PE0203 | Sensors and Signal Conditioning |
| **PEC-II** | **Program Elective Course -II** |
| 18PE0204 | Power System Protection |
| 18PE0205 | Power Quality |
| 18PE0206 | Power System Dynamics and Control |

**Semester – VI**
**Course / Branch: B. Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18M00113 | Management Science | 3 | 0 | 0 | 3 |
| 2 | 18PC0425 | Basic Microprocessor and Microcontrollers | 3 | 0 | 0 | 3 |
| 3 | 18PC0213 | Power Systems – II | 3 | 0 | 0 | 3 |
| 4 | PEC-III | Program Elective Course -III | 3 | 0 | 0 | 3 |
| 5 | OEC_I | Open Elective Course | 3 | 0 | 0 | 3 |
| 6 | OEC_II | Open Elective Course | 3 | 0 | 0 | 3 |
| 7 | 18PC0418 | Microprocessor and Microcontrollers Lab | 0 | 0 | 3 | 1.5 |
| 8 | 18PC0214 | Power Systems Lab | 0 | 0 | 3 | 1.5 |
| 9 | 18BSBH16 | Logical Reasoning | 0 | 0 | 2 | 1 |
| 10 | 18PS0202 | Seminar - II | 0 | 0 | 2 | 1 |
| | | **Total** | **18** | **0** | **10** | **23** |

| PEC-III | Program Elective Course -III |
|---|---|
| 18PE0207 | Electrical and Hybrid Vehicles |
| 18PE0208 | Electrical Machine Design |
| 18PE0416 | Discrete Signal Processing |

| OEC_I | OPEN ELECTIVE COURSES | DEPARTMENT |
|---|---|---|
| 18OE0201 | Artificial Intelligence Applications For Electrical Systems | EEE |
| 18OE0501 | Operating System with Linux | CSE |
| 18OE0202 | Programmable Logic Controllers | EEE |

| OEC_II | OPEN ELECTIVE COURSES | DEPARTMENT |
|---|---|---|
| 18OE0203 | Electrical materials | EEE |
| 18OE0204 | Energy Conversion System | EEE |
| 18OE0316 | MICRO ELECTRO MECHANICAL SYSTEMS | MECH |

**Semester – VII**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | PEC-IV | Program Elective Course -IV | 3 | 0 | 0 | 3 |
| 2 | PEC-V | Program Elective Course -V | 3 | 0 | 0 | 3 |
| 3 | OEC-III | Open Elective Course | 3 | 0 | 0 | 3 |
| 4 | OEC-IV | Open Elective Course | 3 | 0 | 0 | 3 |
| 5 | 18PC0215 | Simulation Lab- I | 0 | 0 | 3 | 1.5 |
| 6 | 18PC0216 | Simulation Lab -II | 0 | 0 | 3 | 1.5 |
| 7 | 18PW0203 | Project (Phase – I ) | 0 | 0 | 8 | 4 |
| 8 | 18PW0204 | Mini Project | 0 | 0 | 0 | 1 |
| | | **Total** | **12** | **0** | **14** | **20** |

| **PEC-IV** | **Program Elective Course -IV** |
|---|---|
| 18PE0209 | FACTS Controllers |
| 18PE0210 | Industrial Electrical Systems |
| 18PE0211 | Power System Automation |
| **PEC-V** | **Program Elective Course -V** |
| 18PE0212 | HVDC Transmission Systems |
| 18PE0213 | Wind and Solar Energy System |
| 18PE0214 | Special Electrical Machines |

| **OEC_III** | **OPEN ELECTIVE COURSES** | **DEPARTMENT** |
|---|---|---|
| 18OE0402 | VLSI Design | ECE |
| 18OE0511 | Database Management Systems | CSE |
| 18OE0205 | Design and Estimation of Electrical Systems | EEE |
| **OEC_IV** | **OPEN ELECTIVE COURSES** | **DEPARTMENT** |
| 18OE0401 | Image Processing | ECE |
| 18OE0206 | Smart Grid Technologies | EEE |
| 18OE0509 | Computer Network | CSE |

**Semester – VIII**
**Course / Branch: B.Tech-Electrical & Electronics Engineering**

| S. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | PEC-VI | Program Elective Course -VI | 3 | 0 | 0 | 3 |
| 2 | OEC | Open Elective Course | 3 | 0 | 0 | 3 |
| 3 | OEC/MOOC | Open Elective Course | 0 | 0 | 0 | 3 |
| 4 | 18PW0205 | Project (Phase – II) | 0 | 0 | 18 | 9 |
| | | **Total** | 6 | 0 | 18 | **18** |

## CREDIT DISTRIBUTION

| S. No | Course | Hours | Credits |
|---|---|---|---|
| 1 | Theory Course (Core/Foundation/Elective) | 3/3+1 | 3/4 |
| 2 | Professional Core Courses | 3 | 3 |
| 3 | Professional Elective Courses | 3 | 3 |
| 4 | Open Elective Courses | 3 | 3 |
| 5 | Engineering Science courses (Engineering Graphics/Engineering Drawing) | 2L+4P | 4 |
| 6 | Engineering Science courses | 3 | 3 |
| 7 | Laboratory Courses | 3 | 1.5 |
| 8 | Soft Skills | 2 | 1 |
| 9 | Seminar - I | - | 1 |
| 10 | Quantitative Aptitude | 2 | 1 |
| 11 | Quantitative Aptitude | 2 | 1 |
| 12 | Seminar - I | - | 1 |
| 13 | MOOC Courses | 0 | 3 |
| 14 | Mandatory Courses | - | - |
| 15 | Min Project | - | 1 |
| 16 | Project Work, Seminar and Full Semester Internship in Industry (6 Months) | 0 | 13 |

## CATEGORY WISE DISTRIBUTION OF CREDITS

| S. No | Category | Subject Area and % of Credits | Average No. of Credits |
|---|---|---|---|
| 1 | Humanities and Social Sciences (HS),including Management. | HS (05% to 10%) | 11.5 |
| 2 | Basic Sciences (BS) including Mathematics, Physics and Chemistry. | BS (10% to 15%) | 24 |
| 3 | Engineering Sciences (ES), including Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Computer Engineering. | ES (10% to 16%) | 26 |
| 4 | Professional Subjects - Core (PC) relevant to the chosen specialization/branch. | PC (30% to 40%) | 49.5 |
| 5 | Professional Subjects - Electives (PE), relevant to the chosen specialization/branch. | PE (5% to 11%) | 18 |
| 6 | Open Electives Subjects / MOOCs - Electives (OE), from other technical and/or emerging subject areas. | OE (5% to 10%) | 15 |
| 7 | Project Work, Full Semester Internship, seminars and Summer Internships | 5% to 10% | 16 |
| 9 | Mandatory Courses(Induction Program, NCC/NSS, Constitution of India, Environmental Science, Social Valuesand Professional Ethics) | MC (0%) | 0 |
| **TOTAL** | | | **160** |

HOD

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## (18BSBH01) MATHEMATICS - I
**(Common to all branches)**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Objectives:** To learn
- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of eigen values and eigenvectors and to reduce the quadratic form to canonical form
- Concept of mean value theorems and their application to the mathematical problems, Finding maxima and minima of function of two and three variables.
- Concept of Sequence and series
- Concept of Fouries series

**UNIT-I: Matrices**

Matrices: Types of Matrices- Rank of a matrix by Echelon form and Normal form- System of linear equations- Homogeneous and Non-Homogeneous equations - Gauss elimination method- Gauss Seidel Method- Crout's triangularisation method - Solving system of Homogeneous and Non-Homogeneous equations.

**UNIT-II: Eigen values and Eigen vectors**

Eigen values and Eigen vectors and their properties- Cayley-Hamilton Theorem (without proof)- finding inverse by Cayley-Hamilton Theorem- Diagonalization of a matrix- finding power of a matrix - Quadratic forms: Reduction of Quadratic form to canonical form and their nature .

**UNIT-III: Differential Calculus and its applications**

Rolle's theorem- Lagrange's Mean value theorem- simple examples of Taylor's and Maclaurin's series –Functions of several variables- Jacobian–maxima and minima functions of two variables - Lagrange's method of multipliers with three variables.

**UNIT-IV: Sequences & Series**

Convergence of sequence and series- Tests for convergence - Geometric test- P- test- limit comparison test- D' Alember ratio test- Raabe's test- Cauchy's Integral test- Cauchy's root test- Logarithmic test- Power series - Taylor's series-series for exponential-trigonometric and logarithm functions.

**UNIT-V: Fourier Series**

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | Write the matrix representation of a set of linear equations and to analyses the solution of the system of equations | PO1,PO2,PO3 |
| CO2 | Find the Eigen values and Eigen vectors | PO1,PO2 |
| CO3 | Reduce the quadratic form to canonical form using orthogonal transformations | PO1,PO2 |
| CO4 | Solve the applications on the mean value theorems. | PO1,PO2 |
| CO5 | Analyses the nature of sequence and series.<br>• Gain knowledge to tackle engineering problems using the concepts of fourier series | PO1,PO2,PO3 |

**TEXTBOOKS:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Advanced Engineering Mathematics, by Erwin Kreyszig, 9th Edition, John Wiley & Sons,2006.
3. Calculus and Analytic geometry by G.B. Thomas and R.L. Finney, 9thEdition,Pearson, Reprint, 2002.

**REFERENCES:**

1. A text book of Engineering Mathematics by N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2008.
2. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
3. Engineering mathematics, volume-I&II, E.Rukmangadachari & E.Keshava Reddy Pearson Publishers.
4. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

**CO-PO Mapping**

| **PO / CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | -- | - | - | - | - |
| **CO2** | 3 | 3 | - | - | - | - | - | - | -- | - | - | - |
| **CO3** | 3 | 3 | - | - | - | - | - | - | -- | - | - | - |
| **CO4** | 3 | 3 | - | - | - | - | - | - | -- | - | - | - |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | -- | - | - | - |
| **Average** | **3** | **3** | **3** | **-** | **-** | **-** | **-** | **-** | **--** | **-** | **-** | **-** |

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# (18BSBH09)APPLIED PHYSICS

**( Common to EEE & ECE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Objectives:**

1. Will understand the basics of quantum mechanics

2. Will recognize the basic concepts and applications of lasers and optical fibers

3. Will understand the basic concepts of semiconductors, dielectrics, magnetic and nanomaterials.

## UNIT-I: Quantum mechanics

wave particle duality, de-Broglie's hypothesis, Davisson and Germer experiment, Heisenberg's Uncertainty principle, physical significance of wave function, Schrodinger's time dependent and independent wave equation, Particle in one dimensional potential box.

## UNIT-II: Lasers and Fibre Optics

Lasers: basic principle, characteristics, spontaneous and stimulated emission, Coherence, Principle and working of Laser, Population inversion, Pumping mechanism, Types of Lasers: Nd: YAG laser, He-Ne laser, Applications of laser.

Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Types of optical fibres: Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

## UNIT-III: Semiconductor Physics

Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Carrier transport: diffusion and drift, Hall effect, p-n junction diode, Zener diode and their V-I Characteristics.

## UNIT-IV Dielectrics and Magnetic Materials

Introduction: Dielectric constant- Dipole moment –Various types of polarization – Electronic –ionic and orientional polarization -Clausius-Mossotti equation-Measurement of Dielectric constant – Application of dielectrics.

Magnetisation, permeability and susceptibility, Classification of magnetic materials, Ferromagnetism and ferromagnetic domains, Hysteresis, Applications of magnetic materials.

## UNIT-V: Physics of Nano materials

Introduction of nano materials : Zero, one , two dimensional nano structures, surface to volume ratio– Quantum confinement –density of states and dependence of dimensionality – properties of nano materials - physical and electrical- Synthesis of nano materials: Top down process: Ball milling –Bottom up process –Sol gel method, Application of Nano materials .

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | The student would be able to learn the fundamental concepts on Quantum behavior of matter in its micro state. | PO1,PO2 |
| CO2 | The knowledge of fundamentals of Semiconductor physics, Nano materials,Lasersand fibre optics | PO1,PO2 |
| CO3 | Design, characterization and study of properties of material help the students to prepare new materials for various engineering applications | PO1,PO2,PO3 |
| CO4 | The course also helps the students to be exposed to the phenomena of exposure on magnetic materials and dielectric materials | PO1,PO2 |
| CO5 | To understand the Nano materials | PO1 |

**TEXT BOOKS:**

1. Engineering Physics-K.Thyagarajan,MCGrawHill Education Private Ltd, New Delhi.
2. Halliday and Resnick, Physics - Wiley.
3. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

**REFERENCES:**

1. Richard Robinett, Quantum Mechanics
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, Mc Graw-Hill inc. (1995)

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | -- | - | - | - | - | - | - |
| **CO2** | 2 | 3 | | - | - | -- | - | - | - | - | - | - |
| **CO3** | 2 | 2 | 2 | - | - | -- | - | - | - | - | - | - |
| **CO4** | 3 | 2 | - | - | - | -- | - | - | - | - | - | - |
| **CO5** | 3 | - | - | - | - | -- | - | - | - | - | - | - |
| **Average** | **2.6** | **2.25** | **2** | **-** | **-** | **--** | **-** | **-** | **-** | **-** | **-** | **-** |


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## (18ES0501) PROBLEM SOLVING USING 'C'
**( Common to EEE,ECE & CSE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES**:

- To Understand the Hardware of the computer and the General form of a C program.
- To Understand the Decision Making and Loop statements of C Language.
- To Understand the Arrays and String concept of C Language.
- To understand the concept of Functions and Pointers in C Language.
- To Understand about Structures, Unions and Files in C Language.

**UNIT-I**

Overview of Computers and Programming: Electronic Computers Then and Now, Computer Hardware, Computer Software, Computer Languages, Algorithm, Steps in an Algorithm, Flowchart, The Software Development Method, Applying The Software Development Method.
Introduction to C Programming: C Language Elements, Variable Declarations, Data Types, Executable Statements, General Form of a C program, Expressions, Precedence and Associativity, Operators, Type Conversion.

**UNIT-II**

Decision Making Statements- Simple **if** Statement, **if-else** Statement, Nested **if-else** Statement**,** **if-else-if** Ladder Statement**,** Example Programs.
Loop Control Statements- The "for" loop, the "while" loop, the "do-while" loop, Example Programs, **Break** Statement, **Continue** Statement, **go to** Statement, **Switch ()- Case** Statement

**UNIT-III**

Arrays- Definition, One-Dimensional Arrays- Declaration, Initialization, "for" loop for Sequential access, Example Programs. Two-Dimensional Arrays: Declaration, Initialization, Example Programs.
Strings- Introduction, Declaration and Initialization of String Variables, Reading Strings from Terminal, Writing Strings to screen, Arithmetic Operators on Characters, Putting Strings Together, Comparison of Two Strings, String Handling Functions, Table of Strings.

**UNIT-IV**

Functions- Elements of User-Defined Functions, Definition of Functions, category of Functions, Nested Functions, Recursion, Passing Arrays to Functions, Scope, Storage Classes, Type Qualifiers.

Pointers- Introduction, Understanding Pointers, Accessing the Address of a Variable, Declaring Pointer Variable, Initialization of Pointer Variables, Accessing a Variable through its Pointer, Chain of Pointers, Pointer Expression, Pointer Increments and Scale Factor, Pointers and Arrays, Array of Pointers, Pointers as Function Arguments.

**UNIT-V**

Structures- Defining a Structure, Declaring Structure Variables, Accessing Structure Members, Structure Initialization, Copying and Comparing Structure Variables, Operations on Individual Members, Arrays of Structures, Arrays within Structures, Unions, TYPEDEF, ENUM.

File Management in C- Introduction, Types of Files, Defining and Opening a File, Closing a File, Input/output Operation on Files, Error handling during I/O Operations, Random Access to Files, Command Line Arguments.

**COURSE OUTCOMES:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | Able to describe the Hardware components of a computer | PO1,PO2 |
| CO2 | Able to implement the 'if...else' statements and 'for', 'while', 'do…while' loop statements | PO1,PO2,PO3 |
| CO3 | Able to write programs using Arrays and Strings concept. | PO1,PO2 |
| CO4 | Able to implement Function and Pointer concepts on various applications. | PO1,PO2,PO4 |
| CO5 | Able implement File concepts of C Language. | PO1,PO2 |

**Text Books**

1. Programming In "C" and Data Structures- By Jeri. R. Hanly, Elliot. B. Koffman, Ashok Kamthane, A. Ananda Rao, 5th Edition, Pearson Publication. (Units I and II).
2. Programming In "C" and Data Structures- By E. Balagurusamy, McGraw Hill Publication (Units III, IV and V).

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | - | -- | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 3 | - | - | -- | - | - | - | - | - | - |
| **CO3** | 3 | 3 | - | - | - | -- | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | 3 | - | -- | - | - | - | - | - | - |
| **CO5** | 2 | 3 | - | - | - | -- | - | - | - | - | - | - |
| **Average** | **2.8** | **2.8** | **3** | **3** | **-** | **--** | **-** | **-** | **-** | **-** | **-** | **-** |

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# (18HSBH01) Technical English

**(Common to CE, EEE, MECH & ECE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To enable the students to communicate in English for academic and social purpose
- To enable the students to acquire structures and written expressions required for the profession
- To enhance the study skills of the students with emphasis on LSRW skills
- To encourage investigating questions of the humanities throw rhetorical study
- To develop and practice and evaluative reading

## UNIT – I

**Chapter entitled " MEDIA MATTERS" from Mindscapes English for Technologists and Engineers**

L - Techniques – Importance of Phonetics and Correct Pronunciation

S - Meet & Greet and Leave taking, Introducing Oneself and others (Formal and Informal situations)

R - Reading strategies - Skimming and Scanning

W - Writing strategies – Sentence structures

G - Parts of Speech – Noun -number, Pronoun- Personal Pronoun – Verb –analysis

V - Affixes – Prefix and Suffix – Root words, derivatives

## UNIT – II

**Chapter entitled "LESSONS FROM THE PAST" from Mindscapes English for Technologists and Engineers**

L - Listening to details: Types of Listening 1. Discriminative listening 2. Comprehension listening 3. Critical listening 4. Appreciative listening

S - Requesting, Making Polite Conversations and Role Play

R - Note Taking and Note Making Strategies

W - Paragraph Writing and Good qualities of Paragraph

G - Tenses – Present Tense, Past Tense and Future Tense
V - Homonyms, Homophones, Homographs, Synonyms and Antonyms

**UNIT – III**

**Chapter entitled "TRAVEL AND TOURISM" from Mindscapes English for Technologists and Engineers**

L - Listening to Speeches of Great leaders and Scientists
S - Accepting Invitations, Fixing a Time and Advising
R - Reading Tables, and Charts
W - Conversation, Role Play and autobiography
G - Types of Sentences (Simple, Complex and Compound)
V - Word formations and One –Word Substitutes

**UNIT – IV**

**Chapter entitled "THE LOST LEAF" from American stories by O. Henry**

L - Listening Dialogues and News
S - Expressing Ideas, Opinions and Telephone Skills
R - Reading Short Stories
W - Biography and Reporting Writing
G - Conditional Clauses and Voices
V - Fixed Expressions and Idioms

**UNIT – V**

**Chapter entitled "SUNITA WILLIAMS" A Star in Space: Puffin Lives Kindle Edition by Aravinda Anatharaman**

L - Types of Listening Speeches: Informative, Demonstrative, Persuasive , Entertaining
S - Making Presentations (Mime and Guess, Mono action, Autobiography and Biography)
R - Reading for Entertainment (Humorous short skits)
W – Resume, CV and Cover letter
G - Direct Speech & Indirect Speech
V - Phrasal Verbs and Collocations

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | Student can responding to a variety of situations and contexts calling for purposeful shifts in the voice, tone level of formality, design, medium and structure | PO1,PO10 |
| CO2 | Become effective in the use of different modes of written communication in professional environment | PO1,PO10,PO12 |
| CO3 | Well trained in LSRW skills and develop communicate competence | PO1,PO9 |
| CO4 | Use key rhetorical concepts through analyzing and composing a variety of text | PO1,PO12 |
| CO5 | Develop competence to apply different reading methods to evaluate a mass of data on the net and to glean the necessary information | PO1,PO6 |

**Text Book:**

1. Mindscapes English for Technologists and Engineers Published by Orient Black Swan
2. American stories by O. Henry
3. A Star in Space: Puffin Lives Kindle Edition by Aravinda Anatharaman

**References:**

1. A. Textbook of English Phonetics for Indian Students by T. Balasubramanian, 2012
2. Communication Skills, Sanjay Kumar & Pushpalatha Oxford University Press
3. Every Day Dialogues in English – Robert J. Dixson, Prentice Hall of India
4. Raymond Murphy's English Grammar with CD, Murphy, Cambridge University Press, 2012

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | 3 | - | - |
| **CO2** | 3 | - | - | - | - | - | - | - | - | 2 | - | 2 |
| **CO3** | 3 | - | - | - | - | - | - | - | 3 | - | - | - |
| **CO4** | 3 | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO5** | 3 | - | - | - | - | 3 | - | - | - | - | - | - |
| **Average** | **3** | **-** | **-** | **-** | **-** | **3** | **-** | **-** | **3** | **2.5** | **-** | **2.5** |

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# (18BSBH11) PHYSICS LAB

**( Common to CE,EEE,MECH & ECE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 1.5 |

**Course Description:**

it is meant for making the students to gain practical knowledge and skills to correlate with the theoretical studies.

**Course Objectives:**

**1.** Elucidate the concepts of Physics through involvement in the experiment by applying theoretical
knowledge.

**2.** Illustrate the basics of mechanics, waves and optics to analyze the behaviour and characteristics of various materials for its optimum utilization.

**3.** Develop an ability to apply the knowledge of physics experiments in the future studies.

**List of Experiments: (Any eight experiments to be performed in a semester)**

1. Determination of radius of curvature - Newton's Rings
2. Magnetic field along the axis of a current carrying coil - Stewart Gees' Apparatus
3. Determination of Energy gap of a material of p-n junction.
4. Dispersive power of prism – Spectrometer
5. Wavelength of a given laser source- Diffraction Grating
6. Optical fibre: Numerical Aperture and acceptance angle of an optical fibre
7. Diffraction grating: normal incidence method
8. Particle size determination -Laser
9. Study of B-H curve
10. Study of resonance – series and parallel LCR circuits

| COURSE OUTCOMES | |
|---|---|
| CO1 | Recognize the important radius of curvature - Newton's Rings (PO1, PO2) . (PO1, PO2,PO3) |
| CO2 | Acquired the practical application knowledge of optical fiber, resonance – series and parallel LCR circuits (PO1, PO2, PO3) |
| CO3 | Analyze the practical applications of dielectric and magnetic materials and crystal structure in various engineering feels. (PO1, PO2) |
| CO4 | Understand of practical laser by the study of their relative parameters. (PO1, PO2) |
| CO5 | Recognize power of prism – Spectrometer, material of p-n junction in various engineering tools (PO1,PO2,PO4) |
| CO6 | Follow the ethical principles in implementing the experiments (PO8) |
| CO7 | Do experiments effectively as an individual and as a team member in a group. (PO9) |
| CO8 | Communicate verbally and in written form, the understanding about the experiments. (PO10) |
| CO9 | Continue updating their skill related to optical fiber, p-n junction, laser and LCR circuits in implementing experiments in future. (PO12) |

**Reference books:**

1. Engineering Physics practical-NU Age Publishing House, Hyderabad
2. Engineering practical Physics – Cengage Learning, Delhi.

**CO-PO Mapping**

| PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | | | |
| CO2 | 2 | 3 | 3 | | | | | | | | | | | |
| CO3 | 2 | 3 | | | | | | | | | | | | |
| CO4 | 3 | 2 | | | | | | | | | | | | |
| CO5 | 3 | 2 | | 3 | | | | | | | | | | |
| CO6 | | | | | | | | 3 | | | | | | |
| CO7 | | | | | | | | | 2 | | | | | |
| CO8 | | | | | | | | | | 3 | | | | |
| CO9 | | | | | | | | | | | | 3 | | |
| **averag** | **2.6** | **2.4** | **3** | **3** | **-** | **-** | **-** | **3** | **2** | **3** | **-** | **3** | **2** | **3** |

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# (18HSBH02)ENGLISH LANGUAGE COMMUNICATION SKILS LAB

**(Common to CE, EEE, MECH & ECE)**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts

**Objectives:**

- To enable students to learn good pronunciation through stress on word accent, intonation and rhythm.
- To help the second language learners to acquire fluency in spoken English and neutralize mother tongue influence.
- To train students to use language appropriately for interviews, group discussion and public speaking.
- To enable students to read with correct pronunciation and Vocabulary development in day today life.

**UNIT – I**

LISTENING AND READING - PART

A. Reading – Vocabulary Development.

B. Listening – Speeches / Conversation/ Biographies.

**UNIT – II**

LISTENING AND READING - PART

A. Phonetics – Importance, Introduction to Sounds of English, Vowel and Consonants Sounds and Phonetic Transcription.

B. Word Stress, Syllabification, Rules of Word Stress, Intonation and Types of Intonations.

**UNIT – III**

WRITING - PART

A. Reports Writing and Types of Reports.

B. Resume/ CV and Cover Letter.

**UNIT – IV**

SPEAKING - PART

A. Self Introduction, Introducing the others, JAM and Role Play.

B. Describing objects/things/ places and people.

**UNIT – V**

PARTCIPATING - PART

A. Debate and Group Discussions.

B. Interview Skills (Basic types of Interviews, Do's & Don'ts in Interviews ).

| COURSE OUTCOMES | |
|---|---|
| CO1 | Understand the active participants in the learning process and acquire proficiency in spoken English. (PO1, PO8,PO10) |
| CO2 | Develop the Speak with clarity and confidence thereby enhances employability skills. (PO1, PO8, PO10) |
| CO3 | Second language learners can acquire fluency in spoken English and neutralize their mother tongue influence ( PO8, PO9, PO10) |
| CO4 | Develop language appropriately for interviews, Group discussions and Public speaking.(PO8,PO9,PO10) |
| CO5 | Understand the read with correct pronunciation and Develop Vocabulary.. (PO8, PO10, PO12). |
| CO6 | Follow the ethical principles in implementing the speaking skills. (PO8) |
| CO7 | Do discus effectively as an individual and as a team member in a group. (PO9) |
| CO8 | Communicate verbally and in written form, the understanding about the language. (PO10) |
| CO9 | Continue updating their skill related to pronunciation, vocabulary, intervies implementing skills in future. (PO12) |

**Suggested Software:**

1. Clarity Pronunciation Power - Part I - Part II ( Sky Pronunciation).
2. Walden Info Tech Software.

**References:**

1. A Course in Phonetics and Spoken English, Dhamija Sethi, Prentice –Hall of India Pvt.Ltd.
2. Speaking English Effectively, 2nd Edition Krishnn Mohan & NP Singh, 2011. (Macmillian).
3. A Hand book for English Laboratories, E.Suresh Kumar, P. Sreehari, Foundation Books, 2011.

**CO-PO Mapping**

| PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | 3 | | 2 | | | | |
| CO2 | | | | | | | | 3 | | 3 | | | | |
| CO3 | | | | | | | | 2 | 3 | 3 | | | | |
| CO4 | | | | | | | | 3 | 2 | 2 | | | | |
| CO5 | | | | | | | | 2 | | 3 | | 3 | | |
| CO6 | | | | | | | | 3 | | | | | | |
| CO7 | | | | | | | | | 2 | | | | | |
| CO8 | | | | | | | | | | 3 | | | | |
| CO9 | | | | | | | | | | | | 3 | | |
| **average** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2.5** | **2.3** | **2.6** | **-** | **3** | **2** | **2** |

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# (18ES0502) PROBLEM SOLVING USING 'C' LAB

**( Common to EEE,ECE & CSE)**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**List of Experiments/Tasks**

1. Practice programs: Finding the sum of three numbers, exchange of two numbers, maximum of two numbers, to read and print variable values of all data types of C language, to find the size of all data types, to understand the priority and associativity of operators using expressions, to use different library functions of C language.
2. Write a program to find the roots of a Quadratic equation.
3. Write a program to compute the factorial of a given number.
4. Write a program to check whether the number is prime or not.
5. Write a program to find the series of prime numbers in the given range.
6. Write a program to generate Fibonacci numbers in the given range.
7. Write a program to find the maximum and minimum of a set of numbers.
8. Write a program to reverse the digits of a number.
9. Write a program to find the sum of the digits of a number.
10. Write a program to find the sum of positive and negative numbers in a given set of numbers.
11. Write a program to check for number palindrome.
12. Write a program to generate Pascal Triangle.
13. Write a program to read two matrices and print their sum and product in the matrix form.
14. Write a program to read matrix and perform the following operations.
    i. Find the sum of Diagonal Elements of a matrix.
    ii. Print Transpose of a matrix.
    iii. Print sum of even and odd numbers in a given matrix.
15. Write a program to accept a line of characters and print the number of Vowels, Consonants, blank spaces, digits and special characters.
16. Write a program to insert a substring in to a given string and delete few characters from the string. Don't use library functions related to strings.
17. Write a program to split a „file" in to two files, say file1 and file2. Read lines into the file from standard input. File1 should consist of odd numbered lines and file2 should consist of even numbered lines.

18. Write a program to merge two files.
19. Write a program to read a set of strings and sort them in alphabetical order.
20. Write a program to read two strings and perform the following operations without using Built in string Library functions and by using your own implementations of functions.
    i. String length determination ii .Compare Two Strings
    ii. Concatenate them, if they are not equal iv. String reversing
21. Write programs using recursion for finding Factorial of a number, GCD, LCM, and solving Towers of Hanoi problem.
22. Write a program to exchange two numbers using pointers.
23. Write a program to read student records into a file. Record consists of roll no, name and Marks of a student in six subjects and class. Class field is empty initially. Compute the class of a student. The calculation of the class is as per JNTUA rules. Write the first class, second class, third class and failed students lists separately to another file.
24. A file consists of information about employee salary with fields employee id, name, Basic, HRA, DA, IT, other-deductions, Gross and Net salary. Initially only employee id, name, and basic have valid values. HRA is taken as 10% of the basic, DA is taken as 80% of basic, IT is 20% of the basic, other deductions are user specified. Compute the Gross and Net salary of the employee and update the file.
25. Write a program to perform Base (decimal, octal, hexadecimal,…) conversions.
26. Write a program to find the square root of a number without using built-in library function.
27. Write C program to convert a string to number.
28. Write C program to generate multiplication tables from 11 to 20.

| COURSE OUTCOMES | |
|---|---|
| CO1 | Design the algorithm and flowchart for the given problem. (PO1, PO2,PO3) |
| CO2 | Develop the programs on control statements and arrays. (PO1, PO2, PO3) |
| CO3 | Analyze the concepts on functions and strings. (PO1, PO2) |
| CO4 | Solve the memory access problems by using pointers and design the programs on structures and unions. (PO1, PO2, PO4) |
| CO5 | Analyze the basics of file handling mechanism that is essential for understanding the concepts of management systems. (PO1, PO2) |
| CO6 | Follow the ethical principles in implementing the programs (PO8) |
| CO7 | Do experiments effectively as an individual and as a team member in a group. (PO9) |
| CO8 | Communicate verbally and in written form, the understanding about the experiments. (PO10) |
| CO9 | Continue updating their skill related to loops, pointers and files implementing programs in future. (PO12) |

**References:**

1. "How to Solve it by Computer", R.G. Dromey, Pearson.
2. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, Pearson.
3. "Let us C", YeswantKanetkar, BPB publications
4. "Pointers in C", YeswantKanetkar, BPB publications.
5. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.AnandaRao,Pearson Education.

**CO-PO Mapping**

| PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | | | | | | | | | | |
| CO2 | 3 | 3 | 3 | | | | | | | | | | | |
| CO3 | 2 | 3 | | | | | | | | | | | | |
| CO4 | 3 | 2 | | 3 | | | | | | | | | | |
| CO5 | 3 | 3 | | | | | | | | | | | | |
| CO6 | | | | | | | | 3 | | | | | | |
| CO7 | | | | | | | | | 2 | | | | | |
| CO8 | | | | | | | | | | 3 | | | | |
| CO9 | | | | | | | | | | | | 3 | | |
| **AVEG** | **2.8** | **2.8** | **2.5** | **3** | **-** | **-** | **-** | **3** | **2** | **3** | **-** | **3** | **3** | **2** |

# (18BSBH02) MATHEMATICS-II

**(Common to all branches)**

**I B.Tech II Sem**

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Course Objectives:**

- Methods of solving the differential equations of first and higher order.
- Evaluation of method of integration and it's applications.
- The physical quantities involved in engineering field related to vector valued functions.
- The basic properties of vector valued functions and their applications to line Surface and volume integrals.
- To understand Z-Transforms and its applications.

**UNIT – 1: First Order O.D.E**

Exact - linear and Bernoulli's equations - Applications to Newton's law of cooling- Orthogonal trajectories. Equations of first order but not of first degree - equations solvable for p- equations solvable for y-equations solvable for x and Clairaut's type.

**UNIT –2: Ordinary Differential Equations of higher order**

Homogeneous and Non homogeneous linear differential equations of second and higher order with constant coefficients with RHS terms of type $e^{ax}$ - sin ax- cos ax- polynomials in x- $e^{ax}$ v(x) - xv(x).

**UNIT –3: Multiple integrals**

Multiple integral- double and triple integrals- change of order of integration. Applications to areas and volumes in Cartesian and polar coordinates using double and triple integral.

**UNIT –4: Vector Calculus**

Introduction-Vector differentiations-Vector differential operator- Gradient – Divergence-Curl and their properties - Vector integration - Line integral-Potential function – Area - Surface and volume integrals- Vector integrals theorems: Green's theorem - Stoke's and Gauss's Divergence theorem (without proof).

**UNIT –5: Z-TRANSFORMS**

Z-Transform - Inverse Z-transform- properties-Damping Rule – Shifting rule-Initial and Final value theorem - Convolution theorem –Introdution to difference equations -Solutions of difference equations by Z-transforms.

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | Identify whether the given differential equation of first order is exact or not. | PO1,PO2 |
| CO2 | Solve higher differential equation and apply the concept of differential equation to real world problems. | PO1,PO2 |
| CO3 | Evaluate the multiple integrals and apply the concept of find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelepiped. | PO1,PO2 |
| CO4 | Evaluate the line, surface and volume integrals and converting them from one to another. | PO1,PO2 |
| CO5 | Gain knowledge to tackle engineering problems using the concepts of Z-Transforms | PO1,PO2,PO3 |

**Text Books:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics Volume-I &II by T.K.V. Iyengar, S.Chand publication.

**Reference Books:**


1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11$^{th}$Reprint, 2010.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. Engineering Mathematics, volume-I&II, E. Rukmangadachari& E.Keshava Reddy Pearson Publishers.


**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - |
| **Average** | **3** | **3** | **3** | - | - | - | - | - | - | - | - | - |

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**(18BSBH12) ENGINEERING CHEMISTRY**
**(CSE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To provide the information regarding hardness of water, effects of hard water in boilers and treatment methods to avoid bad effect on human health. To check the parameters of various water samples by experimental techniques.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.
- To make students familiar with importance of electrochemical processes in nature and industry, like coating of objects with metals or metal oxides through electro deposition.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.

**UNIT – I: WATER QULAITY AND ITS TREATMENT**

**INTRODUCTION:** Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness –Numerical problems on estimation of hardness.

**CHEMICAL ANALYSIS OF WATER:** Estimation of hardness of water by EDTA method, acidity, alkalinity and dissolved oxygen (BOD & COD).

**BOILER TROUBLES:** scales and sludges, caustic embrittlement, boiler corrosion and priming and foaming.

**SOFTENING OF WATER: Internal Conditioning** - Phosphate Conditioning, Calgon Conditioning; **External Treatment -** Zeolite process and Ion-exchange process, advantages and applications.

**WATER FOR MUNICIPAL TREATMENT:** Disinfection, Chlorination – Breakpoint Chlorination**,** Ozonization, UV Treatment – Reverse Osmosis: Desalination of Brakish water by Electrodialysis.

**UNIT – II: MOLECULAR STRUCTURE & THEORIES OF BONDING:**

Atomic and Molecular orbitals, Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of $N_2$, $O_2$ and $H_2^+$ molecules. π molecular orbitals of 1,3 butadiene, $CO_2$ and benzene.

**CRYSTAL FIELD THEORY (CFT):** Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries (One Specific Example for Each)

**UNIT – III: ELECTRO CHEMISTRY AND CORROSION**

Electrochemistry and corrosion: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation, Electrochemical series

and its applications. Conductometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – Acid Batter and Lithium ion Batteries).

**FUEL CELLS**: $H_2$-$O_2$ fuel cell, Solid oxide fuel cell, PEM fuel cell – Principles, advantages and applications.

**SCIENCE OF CORROSION:** Definition, Types of Corrosion – Examples: Mechanism of Dry and Wet Corrosion, Factors influencing corrosion

Corrosion control- Cathodic protection – Sacrificial anodic and impressed current cathodic protection methods - Electroplating of (Cu & Cr) and Electro less Plating (Zn & Sn).

**UNIT-IV: STEREOCHEMISTRY, REACTION MECHANISM & SYNTHESIS OF DRUG MOLECULES:**

**STEREO CHEMISTRY:** Introduction to representation of 3-dimensional structures, Structural isomers and stereoisomers, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration.

**REACTION MECHANISM**: Substitution reactions: Nucleophilic substitution reactions: Mechanism of $SN^1$, $SN^2$ reactions. Electrophilic and nucleophilic addition reactions: Markownikoff and anti Markownikoff's additions. Elimination reactions: Dehydro halogenation of alkylhalides. Oxidation reactions: Oxidation of alcohols using $KMnO_4$. Reduction reactions: reduction of carbonyl compounds using $NaBH_4$.

**SYNTHESIS OF DRUG MOLECULES:** Structure, synthesis and pharmaceutical applications of Aspirin.

**UNIT – V: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS:**

Introduction – Basic principles of UV-Vis, FT-IR, $^1$HNMR, XRD –One Specific application for each Technique.

## Course Outcomes:

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | The understanding the problem of water and its treatments. | PO1,PO2,PO3 |
| CO2 | The knowledge of atomic, molecular and electronic changes, band theory related to conductivity. | PO1,PO2,PO3 |
| CO3 | The required principles and concepts of electrochemistry, corrosion | PO1,PO2,PO3,PO7 |
| CO4 | The knowledge of configurational and conformational analysis of molecules and reaction mechanisms. | PO1,PO2 |
| CO5 | The required skills to get clear concepts on basic spectroscopy and application to | PO1,PO2 |

**SUGGESTED TEXT BOOKS:**

1. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.

2. Fundamentals of Molecular Spectroscopy, by C.N. Banwell.

3. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.

4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

5. Physical Chemistry, by P. W. Atkins

6. Inorganic Chemistry by J.D.LEE.

**REFERENCES**

1. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

2. University Chemistry, by B.M. Mahan, Pearson IV Edition

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 3 | - | - | - | | - | - | - | - | - |
| **CO3** | 3 | 3 | 2 | -- | -- | -- | 3 | - | -- | - | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 2 | - | - | - | - | - | -- | - | - | - | - |
| **Average** | **3** | **2.2** | **2** | **-** | **-** | **-** | **3** | | **-** | **-** | **-** | **-** |

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**(18ES0201) ELECTRICAL CIRCUITS**
**(Only for EEE)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Objectives:**

To make the student learn about

1. Basic characteristics of R,L,C parameters
2. The concepts of real power, reactive power, complex power, phase angle and phase difference
3. Network reduction techniques, star to delta and delta to star transformations
4. How to measure active and reactive power in three phase circuits
5. Series and parallel resonances, bandwidth, current locus diagrams
6. Network theorems and their applications

**UNIT- I INTRODUCTION TO ELECTRICAL & MAGNETIC CIRCUITS**

**Electrical Circuits:** Circuit Concept, R, L and C Parameters - Independent and Dependent Voltage and Current Sources -Source Transformation, Voltage - Current Relationship for Passive Elements (For Different Input Signals: Square, Ramp, Saw Tooth, Triangular. Kirchhoff's Laws, Network Reduction Techniques: Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation. Examples

**Magnetic Circuits**: Faraday's Laws of Electromagnetic Induction, Concept of Self and Mutual Inductance, Dot Convention, Coefficient of Coupling, Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

**UNIT- II SINGLE PHASE A.C CIRCUITS**

R.M.S, Average Values and Form Factor for Different Periodic Wave Forms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power. Examples.

**UNIT-III: THREE PHASE A.C CIRCUITS**

Phase Sequence- Star and Delta Connection-Relation Between Line and Phase Voltages and Currents in Balanced Systems-Analysis of Balanced Three Phase Circuits- Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems. Analysis of Three Phase Unbalanced Circuits-Loop Method- Star Delta Transformation Technique – for balanced and unbalanced circuits, Measurement of Active and reactive Power.

**UNIT- IV LOCUS DIAGRAMS & RESONANCE**

Series R-L, R-C, R-L-C and Parallel Combination with Variation of Parameters. Resonance: Series, Parallel Circuits, Concept of Bandwidth and Q Factor.

**UNIT- V NETWORK THEOREMS**

Thevenin's, Norton's, Maximum Power Transfer, Millman's Theorems, Tellegen's, Superposition, Reciprocity and Compensation Theorems for D.C And Sinusoidal Excitations.

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | The understand the network, find the equivalent impedance by using network reduction techniques. | PO1,PO2, PO3 , PO4, PO5,PO12 |
| CO2 | The knowledge of circuits and the excitation, determine the real power, reactive power, power factor etc., | PO1,PO2, PO3 , PO4, ,PO12 |
| CO3 | The understand the current through any element and voltage across any element | PO1,PO2, PO3 , PO4, ,PO12 |
| CO4 | The course also helps the students to be series R-L, R-C, R-L-C and parallel combination | PO1,PO2, PO3 , PO4, PO5,PO12 |
| CO5 | Analysis the network theorems suitably | PO1,PO2, PO3 , PO4, PO5,PO12 |

**TEXT BOOKS:**

1. Electrical Circuit Theory and Technology 4th Edition, John Bird, Rovtledge/T&F, 2011.
2. Network Analysis 3rd Edition, M.E Van Valkenberg, PHI.

**REFERENCES:**

1. Circuit Theory (Analysis & Synthesis) 6th Edition, A. Chakrabarti, Dhanpat Rai & Sons, 2008.
2. Electric Circuits by N.Sreenivasulu, REEM Publications
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.
4. Circuits & Networks by A. Sudhakar and Shyammohan S Palli, Tata McGraw- Hill

**CO-PO Mapping**

| PO CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 |
| **CO2** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 |
| **CO3** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 |
| **Average** | **3** | **3** | **3** | **3** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **3** |


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# (18PC0501)DATA STRUCTURES USING 'C'
# (Common to EEE & CSE)

**COURSE OBJECTIVES:**

- To understand the concepts all types of Linked List.
- To understand the concepts of Stacks and Queues.
- To understand the concepts of Trees and Graphs.
- To understand the concept of various Sorting techniques.
- To Understand the concept of various Searching and Collision Resolution techniques.

**UNIT-I**

Introduction and Overview: Asymptotic Notations, One-Dimensional Array, Multi-Dimensional Array, Pointer Array.

**Linked Lists**: Definition, Single Linked List, Circular Linked List, Double Linked List, Circular Double Linked List, Applications of Linked Lists.

**UNIT-II**

**Stacks**: Introduction, Definition, Representation of Stack, Operations on Stacks, Applications of Stacks.

**Queues**: Introduction, Definition, Representation of Queue, Various Queue Structures, Applications of Queues.

**UNIT-III**

**Trees**: Basic Terminologies, Definition and Concepts, Representation of Binary Tree, Operation on a Binary Tree, Types of Binary Trees- Binary search Trees, Heap Trees, Height Balanced Trees.

**Graph**: Introduction, Graph Terminologies, Representation of Graphs, Operations on Graphs, Application of Graph Structures: Shortest Path Problem- Warshall's Algorithm, Dijkstra's Algorithm, Topological Sorting.

**UNIT-IV**

**Sorting**: Sorting by Insertion- Straight Insertion Sort, List Insertion Sort, Binary Insertion Sort, Sorting by Selection- Straight Selection Sort, Heap Sort, Sorting by exchange- Bubble Sort, Shell Sort, Quick Sort, Sorting by Merging- Simple Merging, Binary merge, Merge Sort- Internal Merge Sort.

**UNIT-V**

**Searching**: Sequential search- Variations on Sequential Search, Binary Search, Analyzing Search Algorithms**.**

**Tables**: Hash Tables, Hashed List Searches, Basic Concepts, Hashing Methods, Collision Resolutions- Open Addressing, Closed Hashing**.**

**COURSE OUTCOMES:**

| **On successful completion of the course, students will be able to** | | **POs related to COs** |
|---|---|---|
| CO1 | Able to implement all types of Linked List. | PO1,PO2 |
| CO2 | Able to implement Stack and Queue Operations. | PO1,PO2,PO3 |
| CO3 | Able to implement various Tree and Graph Operations. | PO1,PO2,PO4 |
| CO4 | Able to implement all sort of Sorting techniques. | PO1,PO2,PO4 |
| CO5 | Able to implement various Searching techniques. | PO1,PO2,PO3 |

**Text Books**

1. **"Classic Data Structures ", Second Edition By Debasis Samanta, PHI.**

**Reference Books**

1. **Fundamentals of Data Structures in C- Horowitz, Sahni, Anderson, University Press, Second Edition.**
2. **Schaum' Outlines- Data Structures- Seymour Lipschutz, McGraw Hill, Revised First Edition.**

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 3 | - | 3 | - | - | - | - | - | - | - | - |
| **CO4** | 2 | 3 | - | 3 | - | - | - | - | - | - | - | - |
| **CO5** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - |
| Average | **2.2** | **3** | **3** | **3** | - | - | - | - | - | - | - | - |

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# (18ES0301) ENGINEERING GRAPHICS & DESIGN

**( Common to CE & MECH)**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 4 | 4 |

**Course Objectives:**

- To gain and understanding of the basics of geometrical constructions of various planes and solids, understanding system of graphical representation of various objects and various views to draft and read the products to be designed and eventually for manufacturing applications.
- To learn about various projections, to understand complete dimensions and details of object.
- Ultimately student must get imaginary skill to put an idea of object, circuit, assembly of parts in black & white, to design a product and to understand the composition, which can be understood universally.

**UNIT – I**

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance, Dimensioning, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain & Diagonal.

**UNIT- II**

**Orthographic Projections:** Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of regular Plane.—Auxiliary Planes.

**UNIT – III**

Projections of Regular Solids – Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

**UNIT – IV**

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

**UNIT – V**

**Isometric Projections:** 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. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

**Auto CAD (for Practice only not for External Exam)**

**Introduction to CAD**, Applications, commands, Tool bar, modeling of Simple parts, isometric problems.

**Course Outcomes:**

| **On successful completion of the course, students will be able to** | | POs related to COs |
|---|---|---|
| CO1 | understanding of the basics of geometrical constructions of various planes and solids | PO1,PO2,PO3,PO10 |
| CO2 | The knowledge to about various projections understand complete dimensions and details of object. | PO1,PO2,PO3,PO10 |
| CO3 | The understand the composition, which can be understood universally. | PO1,PO2,PO3,PO10 |
| CO4 | Preparing working drawings to communicate the ideas and information. | PO1,PO2,PO3,PO10 |
| CO5 | Read, understand and interpret engineering drawings. | PO1,PO2,PO3,PO10 |

**TEXTBOOKS:**

1. Engineering Drawing N.D. Bhatt / Charotar

2. Engineering Drawing, K.L. Narayana& P. Kannaih, Scitech Publishers, Chennai

3. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

**REFERENCE BOOKS:**

1. Engineering Drawing / BasantAgrawal and McAgrawal/ McGraw Hill

2. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.

3. A text Book of Engineering Drawing and Graphic, K.Venugopal New Age Publishin New

Delhi, 2008.
4. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

CO-PO Mapping

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | 1 | - | - |
| **CO2** | 3 | 3 | 3 | - | - | - | - | - | - | 1 | - | - |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | - | 1 | - | - |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | 2 | - | - |
| **Average** | **3** | **2.8** | **2.8** | **-** | **-** | **-** | **-** | **-** | **-** | **1.4** | **-** | **-** |

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**(18BSBH13) ENGINEERING CHEMISTRY LAB**
**(CSE)**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Objectives:** The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The student will learn:

- The hygiene aspects of water would be in a position to design methods to produce potable water using modern technology.
- The preparation and properties of synthetic polymers and other material that would provide sufficient impetus to engineer these to suit diverse applications.
- Will able to understand the knowledge to the processes of corrosion and its prevention.

**LIST OF EXPERIMENTS:**

**Choice of 10 experiments from the following**:

1. Estimation of hardness of water by complexometric method using EDTA.
2. Determination of Alkalinity of water.
3. pH Metry- Analysis of acidic and Basic water samples.
4. Estimation of Dissolved oxygen in water.
5. Preparation of standard $KMnO_4$ solution & Estimation of Iron by Potentiometry.
6. Determination of strength of given strong acid and strong base solution by conductometric titration.
7. Determination of Viscosity of oil through Ostwald/Redwood Viscometer – I.
8. Synthesis of Aspirin.
9. Estimation of Manganese in Cement by Colorimetry.
10. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.
11. Determination of surface tension of a give liquid using stalagmometer.

| COURSE OUTCOMES | |
|---|---|
| CO1 | Acquired the practical skill to handle the analytical methods with confidence.(PO1,PO2,PO3) |
| CO2 | The desirable limits of various constituents in water analysis and its importance. (PO1, PO2) |
| CO3 | Understand of practical molecular properties such as viscosity, conductance of solutions, etc (PO1, PO2, PO3) |
| CO4 | Analyze the rate constant of a reaction from concentration – time relationships.(PO1,PO2,PO4) |
| CO5 | Analyze the preparations, properties of Aspirin in modern technology. (PO1, PO2, PO3). |
| CO6 | Follow the ethical principles in implementing the experiments (PO8) |
| CO7 | Do experiments effectively as an individual and as a team member in a group. (PO9) |
| CO8 | Communicate verbally and in written form, the understanding about the experiments. (PO10) |
| CO9 | Continue updating their skill related to analytical methods, viscosity, rate constant in implementing experiments in future. (PO12) |

**REFERENCE BOOKS:**

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et al, Pearson Education, Sixth Edition, 2012.
2. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co.,Delhi).
3. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi).

**CO-PO Mapping**

| PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | | | | | | | | | | | |
| CO2 | 3 | 2 | | | | | | | | | | | | |
| CO3 | 2 | 3 | 2 | | | | | | | | | | | |
| CO4 | 3 | 2 | | 2 | | | | | | | | | | |
| CO5 | 2 | 2 | 3 | | | | | | | | | | | |
| CO6 | | | | | | | | 3 | | | | | | |
| CO7 | | | | | | | | | 2 | | | | | |
| CO8 | | | | | | | | | | 3 | | | | |
| CO9 | | | | | | | | | | | | 3 | | |
| **average** | **2.6** | **2.4** | **2.3** | **2** | **-** | **-** | **-** | **3** | **2** | **3** | **-** | **3** | **2** | **2** |

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# (18ES0202) ELCTRICAL CIRCUITS LAB
## (only for EEE)

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**OBJECTIVE:** To make the student learn about:

- Experimental verification of theorems
- Experimental verification of two port network parameters
- Experimental verification of resonance phenomenon.

Any Ten of the following experiments are to be conducted.

1. Verification of KCL & KVL for any network.
2. Verification of Superposition Theorem with analysis.
3. Verification of Thevenin's Theorem with analysis.
4. Verification of Norton's Theorem with analysis.
5. Verification of Maximum Power Transfer Theorem with analysis.
6. Frequency response of series resonance circuit with analysis and design.
7. Frequency response of parallel resonance circuit with analysis and design.
8. Determination of phase of a sinusoidal signal when passed through RL or RC circuits.
9. Impedance transformation through transformer.
10. Analysis of 3 phase balanced systems
11. Analysis of 3 phase un balanced systems
12. Simulation of DC Circuits

| Course | COURSE OUTCOMES | |
|---|---|---|
| Electrical Circuits Lab | **CO1** | Analysis of KVL & KCL. (PO1, PO2) |
| | **CO2** | Analysis the superposition, thevenin's, norton's, maximum power transfer theorem with analysis. (PO1,PO3) |
| | **CO3** | Analysis of series resonance and parallel resonance circuit with analysis and design. (PO2, P03, PO4) |
| | **CO4** | Determine of phase of a sinusoidal signal when passed through RL or RC circuits and Impedance transformation through transformers.(PO4) . (PO8, PO9, PO10, PO12) |
| | **CO5** | Analysis of 3 phase balanced system and unbalanced system and DC circuits.(PO1, PO4,PO5) |
| | **CO6** | Follow the ethical principles in implementing the experiments. (PO8) |
| | **CO7** | Do discus effectively as an individual and as a team member in a group. (PO9) |

| | | |
|---|---|---|
| | **CO8** | Communicate verbally and in written form, the understanding about the experiments. (PO10) |
| | **CO9** | Continue updating their skill related to parameters, transformer, resonance, circuits implementing skills in future. (PO12) |

**CO-PO Mapping**

| Course | PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electrical Circuits Lab | CO1 | 3 | 2 | | | | | | | | | | | | |
| | CO2 | 2 | | 2 | | | | | | | | | | | |
| | CO3 | | 3 | 3 | 2 | | | | | | | | | | |
| | CO4 | | | | 2 | | | | | | | | | | |
| | CO5 | 2 | | | 2 | 3 | | | | | | | | | |
| | CO6 | | | | | | | | 3 | | | | | | |
| | CO7 | | | | | | | | | 2 | | | | | |
| | CO8 | | | | | | | | | | 3 | | | | |
| | CO9 | | | | | | | | | | | | 3 | | |
| | average | 2.3 | 2.5 | 2.5 | 2 | 3 | - | - | 3 | 2 | 3 | - | 3 | 2 | 2 |

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**(18ES0302) ENGINEERING & IT WORKSHOP PRACTICE**
**( Common to CE, MECH & CSE)**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Part-A Engineering Workshop Lab**

**Course Objectives:**

- To Study of different hand operated tools, uses and their applications
- To Know a basic working knowledge, team work, precision and safety on production of various engineering products.
- To Provide a hands on experience of different engineering materials, tools, equipments and processes those are commonly used in the engineering fields.

**1. TRADES FOR EXERCISES:**

**At least TWO exercises from each trade:**

I. Carpentry : T-Lap Joint, Dovetail Joint, Mortise &Tenon Joint
II. Tin-Smithy : Square Tin, Rectangular Tray & Conical Funnel

**At least ONE exercises from each trade:**

III. Fitting : V-Fit, Dovetail Fit & Semi-circular fit
IV. Foundry :Preparation of Green Sand Mould using Single Piece and Split Pattern
V. Welding practice : Arc Welding & Gas Welding
VI. House-wiring : Parallel & Series, Two-way Switch and Tube Light
VII. Black Smithy : Round to Square, Fan Hook and S-Hook

**2. TRADES FOR DEMONSTRATION & EXPOSURE:**

Plumbing, Machine Shop, Tools in construction work and Wood Working.

**NOTE:** At least the total number of exercises must be SEVEN.

**TEXT BOOKS:**

1. Workshop Practice /B. L. Juneja / Cengage

2. Workshop Manual / K. Venugopal / Anuradha.

**REFERENCE BOOKS:**

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/ SciTech
2. Workshop Manual / Venkat Reddy/ BSP

## Part-B IT Workshop Lab

**Course Objective:**

- To provide Technical training to the students on Productivity tools like Wordprocessors, Spreadsheets, Presentations
- To make the students know about the internal parts of a computer, assembling a Computer from the parts, preparing a computer for use by installing the operating System
- To learn about Networking of computers and use Internet facility for Browsing and Searching.

**Preparing your Computer**

**Task 1: Learn about Computer:** Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

**Task 2: Assembling a Computer:** Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available (eg: beeps). Students should record the process of assembling and trouble shooting a computer.

**Task 3: Install Operating system:** Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

**Networking and Internet** Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimpling activity, logical configuration etc should be done by the student. The entire process has to be documented.

**Browsing Internet:** Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, Skype etc. If Intranet

mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending Messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

**Productivity tools**

**Task 5: Word Processor:** Students should be able to create documents using the word Processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, Changing the font, changing the color, including images and tables in the word file, Making page setup, copy and paste block of text, images, tables, linking the images Which are present in other directory, formatting

paragraphs, spell checking, etc. Students should be able to prepare project covers, table content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered.

**Task 6:** Spreadsheet: Students should be able to create, open, save the application Documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and Deleting cell data, format cells, adjust the cell size, applying formulas and functions, Preparing charts,+ sorting cells. Students should submit a user manual of the Spreadsheet Application considered.

**Task 7:** Presentations: creating, opening, saving and running the presentations, Selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyper linking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.

**Task 8:** Latex introduction, Document Structure, Typesetting Text, table of contents packages, math, adding pictures

**Task 9:** Laboratory Equipment: Students may submit a report on specifications of various equipment that may be used by them for the laboratories in their curriculum starting from I B.Tech to IV. B.Tech. It can vary from department to department. Students can refer to their syllabus books, consult staff members of the concerned department or refer websites. The following is a sample list. Instructors may make modifications to the list to suit the department concerned.

_ Desktop computer
_ Server computer
_ Switch (computer science related)

| COURSE OUTCOMES | |
|---|---|
| CO1 | Understand the mechanical tools and there operations and practice on manufacture of components in different work shop trades. (PO1, PO2, PO4) |
| CO2 | Acquire suitable tools for different trades of engineering processes. (PO1, PO5, PO9) |
| CO3 | Recognize the dissemble and assemble a personal computer and prepare the computer ready to use. ( PO1, PO3, PO12) |
| CO4 | Develop the documents using word processors and slides preparations using presentation tools (PO1, PO10, PO12) |
| CO5 | Access the internet and browse it be obtain the required information and install single or dual operating system and computer. (PO1, PO3, PO12). |
| CO6 | Follow the ethical principles in implementing the engineering materials and presentation tools. (PO8) |
| CO7 | Do practice effectively as an individual and as a team member in a group. (PO9) |
| CO8 | Communicate verbally and in written form, the understanding about the engineering tools. (PO10) |
| CO9 | Continue updating their skill related to trades for exercises, demonstration, productivity tools, networking and internet implementing skills in future. (PO12) |

**CO-PO Mapping**

| Course | PO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENGINEERING AND IT WORK SHOP LAB | CO1 | 2 | 3 | | 2 | | | | | | | | | | |
| | CO2 | 3 | | | | 2 | | | | 2 | | | | | |
| | CO3 | 2 | | 3 | | | | | | | | | 3 | | |
| | CO4 | 2 | | | | | | | | | 2 | | 2 | | |
| | CO5 | 3 | | 2 | | | | | | | | | 3 | | |
| | CO6 | | | | | | | | 3 | | | | | | |
| | CO7 | | | | | | | | | 2 | | | | | |
| | CO8 | | | | | | | | | | 3 | | | | |
| | CO9 | | | | | | | | | | | | 3 | | |
| | **AVEG** | **2.4** | **3** | **2.5** | **2** | 2 | **-** | **-** | 3 | 2 | **2.5** | **-** | **2.7** | **2** | **3** |


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# (18MCBH02) ENVIRONMENTAL SCIENCE

**(common to all)**

**I B.Tech II Sem**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 0 | 0 |

## Course Objectives:

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

**Course Outcomes:**

- Students will get the sufficient information that will clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
- Students will realize the need to change their approach so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning.
- Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
- By studying environmental sciences, students is exposed to the environment that enables one to find out solution of various environmental problems encountered on and often.
- At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and efforts to be taken to protect the environment from getting polluted. This will enable every human being to live in a more sustainable manner.

## UNIT-I ECOSYSTEMS:

Definition, Scope and Importance of ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Food chain, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**UNIT-II 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 BIODIVERSITY AND BIOTIC RESOURCES:**

Introduction Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT-IV ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES:**
Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Noise pollution

**SOLID WASTE MANAGEMENT:** Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.
**E– WASTE MANAGEMENT:** Definition of E-Waste, Effect of E-Waste on Humans and Environment, Treating and management of E-Wastes.

**UNIT – V SOCIAL ISSUES AND THE ENVIRONMENT:**

Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Climate change, global warming, acid rain, ozone layer depletion,– Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act –

Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

**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 PHL 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. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BSPublications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS.Publications.

# (8BSBH03)MATHEMATICS -III

**( Common to CIVIL, EEE, MECH & ECE)**

**III Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

Our emphasis will be more on conceptual understanding and application of Laplace transforms, Fourier transforms, Solution of Algebraic, Transcendental Equations and Numerical solutions of ordinary differential equations.

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

1. Analyze the engineering problems using the concept of laplace transforms.
2. Solve the engineering problems using concept of fourier transforms
3. Gain knowledge to tackle engineering problems using the concepts of Numerical methods

**UNIT– I Laplace Transform-I**

Laplace transform of standard functions – Inverse transform – First shifting Theorem - Second shifting theorem- Transforms of derivatives and integrals – Unit step function –Dirac's delta function .

**UNIT–2 Laplace Transform-II**

Laplace transform of Periodic function–Convolution theorem- Differentiation and integration of transform – Application of Laplace transforms to ordinary differential equations of first and second order.

**UNIT – 3 Fourier Transform**

Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

**UNIT – 4 Numerical Method-I**

Solution of Algebraic and Transcendental Equations: The Bisection Method – The Method of False Position– Newton-Raphson Method

Interpolation: Finite differences-Forward differences- Backward differences- Newton's forward and backward interpolation formulae – Lagrange's formulae.

**UNIT – 5 Numerical Method-II**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method- Modified Euler's Method-Runge-Kutta Methods-Predictor-corrector method-Milne's Method.

**TEXT BOOKS:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI publisher.

**REFERENCES:**

1. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.
2. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.


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## ELECTRICAL MACHINES – I

**III Semester**

| L | T | P | C |
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**Course Objectives:**

Electrical Machines course is one of the important courses of the electrical discipline. In this course the different types of DC Generators, DC Motors and Transformers which are widely used in industry are covered and their performance aspects will be studied.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of dc generators.
2. Understand the operation of dc motors.
3. Understand the testing of dc machine.
4. Analyze single phase transformer.
5. Analyze polyphase transformer.

**UNIT-I DC GENERATORS**

Electromechanical Energy Conversion, Principle operation of DC Generator, Basic construction of a DC machine, Armature winding- Lap windings , Wave windings, Simplex windings, Multiplex windings, EMF equation, Types of DC Generators, Voltage drop equations, Building up of EMF, Critical Resistance and Critical Speed, Characteristics of DC Generator- Internal and External characteristics, Armature Reaction- Reducing methods of armature reaction, Commutation-Methods of improving commutation, Applications of DC Generators

**UNIT-II DC MOTORS**

Principle operation, Effect of Back EMF, Types of DC motors, Torque Equation, Characteristics of DC Motors, Speed control of DC Motors-Armature and Field Control Methods, Ward-Leonard method, Starters – 2 point, 3 point and 4 point starters, Applications of DC Motors.

**UNIT-III TESTING OF DC MACHINES**

Losses – Constant & Variable Losses, Calculation of Efficiency – Condition for maximum efficiency, Methods of Testing – Brake Test, Swinburne‘s Test, Hopkinson ‘s Test, Field Test, Retardation Test

**UNIT-IV SINGLE PHASE TRANSFORMERS**

Principle, Construction and operation of single-phase transformers, EMF equation, equivalent circuit, Phasor diagram, voltage regulation, Losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, parallel operation, Autotransformers - principle, saving of copper, applications.

**UNIT-V POLY PHASE TRANSFORMERS**

Three-phase transformer - types of connection and their comparative features, Parallel operation of three-phase transformers, comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Tertiary winding transformers.

**Text / References:**

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
4. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

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# (18ES0403)ANALOG ELECTRONICS

**III Semester**

| L | T | P | C |
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**Course Objectives:**

1. To give understanding on semiconductor physics of the intrinsic, p and n materials, characteristics of the p-n junction diode.
2. To understand operation of various Electronic devices such as Diodes, BJT, JFET AND MOSFET.
3. To understand various applications of diode and special purpose electronic devices.
4. To understand the design of various biasing circuits of BJT and JFET.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems. Design and analyze basic transistor circuits using BJT and FET
3. Understand the transistor amplifier & the working of timing circuits and oscillators.
4. Design an application using Operational amplifier
5. Learn the basics of Electronic communication system.

**UNIT-I**

P-N junction diode, I-V characteristics of a diode, Avalanche breakdown, Zener diode, Varactor diode, Tunnel Diode ,Schottky diode, LED, photodiode and solar cell, UJT, Rectifiers-types and Filters .

**UNIT-II**

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, Biasing schemes for BJT and FET, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, Bias compensation, Thermal runaway, Thermal stability.

**UNIT- III**

Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier, Feedback topologies: Voltage series, current series, voltage shunt, current shunt.

**UNIT- IV**

**Oscillators**: IC 555 and its applications as astable and mono-stable multi-vibrators Barkhausen's criteria for oscillation,R-C phase shift and Wein bridge oscillator.

**UNIT-V**

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, Instrumentation Amplifier precision rectifier, Schmitt trigger and its applications.

Active filters: Low pass, high pass, band pass and band stop, design guidelines.

**TEXT BOOKS:**


1. J. Millman, C. Halkias, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 4th Edition,2010.
2. R.L. Boylestad and Louis Nashelsky,"Electronic Devices and Circuits",Pearson Publications,,9thEdition,2006.
3. D. Roy Chowdhury, "Linear Integrated Circuits", New Age International (p) Ltd,
4. Simon Haykin, "Communication Systems", Wiley-India edition, 3rd edition, 2010.


**REFERENCES:**


1. Jacob Millman, C. Halkies, C.D.Parikh, "Integrated Electronics", Tata Mc-Graw Hill, 2009.
2. BV Rao, KBR Murty, K Raja Rajeswari, PCR Pantulu, "Electronic Devices and Circuits", Pearson, 2nd edition.
3. Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", Tata Mc-Graw Hill, Second Edition

# (18PC0202)ELECTROMAGNETIC FIELDS

**III Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course objective**:
To make the student learn about:

1. The laws concerning static electric fields: Coulomb's law, Gauss law; the laws concerning static magnetic fields: Biot-savart law, Ampere circuital law
2. The equations concerned with static electric fields
3. The equations concerned with static magnetic fields
4. The difference between the behaviors of conductors and dielectrics in electric fields
5. The energy stored and energy density in (i) static electric field (ii) magnetic field
6. Electric dipole and dipole moment, magnetic dipole and dipole moment

**Course Outcomes:**
At the end of the course, students will demonstrate the ability

1. Understand the basic laws of electromagnetism.
2. Obtain the electric and magnetic fields for simple configurations under static conditions.
3. Analyse time varying electric and magnetic fields.
4. Understand Maxwell's equation in different forms and different media.
5. understand the propagation of EM waves.

**UNIT I**: **Review of Vector Calculus**

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

**UNIT II: Static Electric Field**

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

**UNIT III: Conductors, Dielectrics and Capacitance**

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

**UNIT IV: Static Magnetic Fields**

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Force on a moving charge, Force on a differential current element, Force between differential current

elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances, Energy Stored and Energy Density.

**UNIT V: Time Varying Fields and Maxwell's Equations**

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

**Text / References:**


1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.




## (18ES0208)NETWORK THEORY

**III Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To make the students learn about:

1. The analysis of three phase balanced and unbalanced circuits

2. How to compute two port network parameters
3. How to determine the transient response of R-L, R-C, R-L-C series circuits for d.c and a.c excitations
4. Different types of filters and equalizers

**OUTCOMES:**After completing the course, the students should be able to do the following:

1. Determine the transient response of R-L, R-C, R-L-C circuits for d.c. and a.c. excitation.
2. Design different types of filters,.
3. Determine Z,Y,ABCD and H- Parameters of Different circuits.

## UNIT- I NETWORK TOPOLOGY

Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks with Dependent & Independent Voltage and Current Sources – Duality & Dual Networks. Nodal Analysis, Mesh Analysis, Super Node and Super Mesh for D.C Excitations.

## UNIT- II TWO PORT NETWORKS

Two Port Network Parameters: Impedance, Admittance, Transmission and Hybrid Parameters and their Relations. Concept of Transformed Network, Two Port Network Parameters Using Transformed Variables.

## UNIT- III DC TRANSIENT ANALYSIS

**D.C Transient Analysis:** Transient Response of R-L, R-C, R-L-C Series Circuits for D.C Excitation-Initial Conditions-Solution Method Using Differential Equation and Laplace Transforms, Response of R-L & R-C Networks to Pulse Excitation.

## UNIT- IV AC TRANSIENT ANALYSIS

**A.C Transient Analysis:** Transient Response of R-L, R-C, R-L-C Series Circuits for Sinusoidal Excitations-Initial Conditions-Solution Method Using Differential Equations and Laplace Transforms

## UNIT V: FILTERS

Filters – Low Pass – High Pass and Band Pass – RC, RL filters– derived filters and composite filters design – Attenuators – Principle of Equalizers – Series and Shunt Equalizers – L Type, T type and Bridged – T and Lattice Equalizers.

**TEXT BOOKS:**


1. Electrical Circuit Theory and Technology 4th Edition, John Bird, Rovtled / T&F, 2011.
2. Network Analysis 3rd Edition, M.E Van Valkenberg, PHI, .


**REFERENCES:**


1. Circuit Theory (Analysis & Synthesis) 6th Edition, A. Chakrabarti, Dhanpat Rai & Sons, 2008.
2. Electric Circuits by N.Sreenivasulu, REEM Publications
3. Engineering circuit analysis by William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.

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## (18ES0404)ANALOG ELECTRONIC CIRCUITS LAB

| III Semester | L | T | P | C |
|---|---|---|---|---|
| | 0 | 0 | 3 | 1.5 |

**Objectives:**

1. This Lab provides the students to get an electrical model for various semiconductor devices.
2. Students can find and plot V_I characteristics of all semiconductor devices. Student learns the practical applications of the devices.
3. Students can find and plot Input & Output characteristics of BJT's and FET's
4. students can understand the oscillators and communication systems

**Outcomes:**

1. Students Have Practical knowledge on R, L, C Components (Colour Codes) testing, identification, Specifications, Bread Boards, BJT'S,FET'S,LED'S, etc.....
2. Students Have knowledge on PN diode, zener diode V-I characteristics, different rectifiers.

3. Have practical knowledge on BJT characteristics.
4. Have practical knowledge on oscillators
5. Have practical knowledge on communication\ systems

**PART A: Electronic Workshop Practice**

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Bread Boards.
2. Identification, Specifications and Testing of active devices, Diodes, BJTs, JFETs, LEDs,.
3. Soldering Practice- Simple circuits using active and passive components.
4. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.

**PART B: List of Experiments**

**(For Laboratory Examination-Minimum of Eight Experiments)**

1. P-N Junction Diode Characteristics (Forward bias & Reverse bias)
2. Zener Diode Characteristics (Forward bias & Reverse bias)
3. Half-wave Rectifier & Full-wave Rectifier (without and with filter)
4. BJT Input & Output Characteristics (CE Configuration)
5. FET Transfer & Output Characteristics (CS Configuration)
6. Transistor Biasing
7. Transistor acts as a switch
8. CRO Operation and its Measurements
9. RC Oscillator
10. LC Oscillator



## (18PC0203)ELECTRICAL MACHINES LABORATORY-I

**III Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To analyse the operation of D.C. machines and transformers and give them experimental skill.

**OUTCOMES:**

1. Ability to understand and analyze DC Generator
2. Ability to understand and analyze DC Motor
3. Ability to understand and analyse Transformers**.**

**LIST OF EXPERIMENTS**

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.

2. Load characteristics of DC series generator
3. Load characteristics of DC Shunt generator
4. Load characteristics of DC compound generator with differential and cumulative connections.
5. Brake Test on DC shunt motor.
6. Brake Test on DC compound motor.
7. Brake Test on DC series motor.
8. Swinburne's test and speed control of DC shunt motor.
9. Hopkinson's test on DC motor – generator set.
10. Load test on single-phase transformer and three phase transformers.
11. Predetermination of efficiency on single phase transformer.
12. Sumpner's test on single phase transformers.
13. Separation of no-load losses in single phase transformer.
14. Study of starters and 3-phase transformers connections.

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## (18HSBH03) SOFT SKILLS
## ( II B.Tech I Sem common to all)

| III Semester | L | T | P | C |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

The Language Lab focuses on communication skills, corporate skills and personality development to their personal life and professional life.

**Objectives:**

1. To bring about a consistent accent and intelligibility in student's pronunciation of English by providing an opportunity for practice in speaking.
2. To improve the fluency of students in spoken English and neutralize their mother tongue influence.
3. To train students to use language appropriately for public speaking, interviews and group discussion.

**Outcomes:**

1. Become active participants in the learning process and acquire proficiency in spoken English.
2. Speak with clarity and confidence thereby enhances employability skills.
3. students use language appropriately for public speaking, interviews and group discussion

**UNIT – I**

1. Communication skills
2. Introducing yourself
3. Story telling
4. Telephonic communication
5. Film Review / Book Review

**UNIT – II**

1. Information Transfer
2. Business letters
3. E-mail writing
4. Report writing
5. Resume Writing

**UNIT – III**

1. Body Language
2. Time Management
3. Goal Setting
4. Leadership Skills

**UNIT – IV**

1. Making effective presentations
2. Speaking on various occasions
3. Power Point Presentation
4. Paper Presentation (Research)

**UNIT – V**

1. SWOT (Strength, Weakness, Opportunities and Threats about Companies)
2. Group discussions
3. Interview skills

**Suggested Software:**

1. Walden InfoTech Software
2. Clarity Pronunciation Part I & Part II

**References:**


1. Effective Technical Communication, M. Asraf Rizvi, Tata Mcgraw-Hill, Publishing Company Limited, First Edition, 2006
2. Communication Skills, Sanjay Kumar and Pushpa lata, Oxford University Press, (2018).
3. Technical Communication, Meenakshi Raman and Sangeetha Sharma, Oxford University Press, New Delhi, 2012.
4. Soft Skills By. Dr. K. Alex – S. Chand Publishers.
5. Personality Development, Soft Skills by Barun K. Mitra
6. Communicate To Conquer: A Handbook Of a Effective Public Speaking, Group discussion by Sanjay Kumar and Pushpalata.

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# (18MCBH03) INDIAN CONSTITUTION

**III Semester**

| L | T | P | C |
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**Course Objectives:** Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Course Outcomes:**

1. Students will be able to:
2. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
3. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.

**UNIT-I**

- Meaning of the Constitution Law

**UNIT-II**

- Historical Perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India

**UNIT-III**

- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy – Its importance and implementation
- Federal structure and distribution of legislative and financial powers between the Union and the States

**UNIT-IV**

- Parliamentary Form of Government in India – The constitution powers and status of the President of India.
- Amendment of the Constitutional Powers and Procedure.
- The historical perspectives of the constitutional amendments in India.
- Emergency Provisions : National Emergency, President Rule, Financial Emergency

**UNIT-V**

- Local Self Government – Constitutional Scheme in India.
- Scheme of the Fundamental Right to Equality.
- Scheme of the Fundamental Right to certain Freedom under Article 19
- Scope of the Right to Life and Personal Liberty under Article 21

**Text Books:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.

2. Framing of Indian Constitution, Dr. S. N. Busi, Dr. B. R. Ambedkar 1st Edition, 2015

**Reference Books:**

1. Indian Constitution Law, M. P. Jain 7th Edn., Lexis Nexis, 2014.

2. Introduction to the Constitution of India, D.D. Basu, Lexis Nexis, 2015.

**IV Semester** **L T P C**

**2 1 0 3**

**OBJECTIVES:**

The aim of this course is to introduce complex functions and their applications. Students learn about analytical functions, complex integration, classification of singularities etc. They would also learn conformal mappings. Some special functions and their applications will also be introduced.

**OUTCOMES:**

1. This course will help the student in analysis of real to complex numbers and apply them whenever the problem arises in real analysis and calculus.
2. The students will understand path and contour integrals and able to apply different theorems of integral formulae
3. The student will be able to evaluate some standard integrals using contour integrals
4. The student will be able evaluate the real integrals using beta and gamma functions
5. The student will be able evaluate the real integrals using bessel's and legendre's functions

**UNIT – I (Complex variable –Differentiation)**

Functions of a complex variable – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne–Thomson method. Conformal mapping: Bilinear transformation - Fixed point – Cross ratio – Determination of bilinear transformation.

**UNIT – II (Complex variable –Integration)**

Line integral – Evaluation along a path and by indefinite integration – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula- Liouville's theorem.

Complex power series: Radius of convergence – Expansion in Taylor's series- Maclaurin's series and Laurent series. Singular point – Isolated singular point – Pole of order m – Essential singularity.

**UNIT – III (Residues)**

Evaluation of residue by formula and by Laurent's series – Cauchy's Residue theorem. Evaluation of integrals of the type

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)\,dx$ (b) $\int_{0}^{2\pi} f(\sin\theta, \cos\theta)\,d\theta$ (c) $\int_{-\infty}^{\infty} e^{imx} f(x)\,dx$

**UNIT – IV: Special functions-I**

Special Functions: Gamma and Beta Functions – their properties – Evaluation of improper integrals. Series Solutions of ordinary differential equations (Power series and Frobenius Method).

**UNIT – V: Special functions-II**

Bessel functions – Properties – Recurrence relations – Orthogonality. Legendre polynomials – Properties – Rodrigue's formula – Recurrence relations – Orthogonality.

**TEXT BOOKS:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.

2. Engineering Mathematics, Volume - III, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.

**REFERENCES:**

1. Mathematics III by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications.
2. Advanced Engineering Mathematics, Peter V.O'Neil, CENGAGE publisher.
3. Advanced Engineering Mathematics by M.C. Potter, J.L. Goldberg, Edward F.Aboufadel.

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## (18PC0204) ELECTRICAL MACHINES – II

**IV Semester**

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**Course Objectives:**

As a extension of Electrical Machines – I course, this subject facilitates to study of the performance of Alternators, Induction Motors, Special Machines which are the major part of industrial drives and agricultural pump sets.

**Course Outcomes:**At the end of this course, students will demonstrate the ability to

1. Understand the concepts of synchronous machines.
2. Understand the operation and performance characteristics of induction machines.
3. Understand the operation of special machines.

**UNIT – I ALTERNATORS**

Principle, Constructional features - cylindrical and salient pole rotor – AC winding, EMF equation, Effect of harmonics, Armature reaction – synchronous reactance and impedence , Load characteristics, Regulation of Alternator, EMF Method, MMF Method, ASA Method, Slip Test, Phasor diagram

**UNIT – II SYNCHRONOUS MOTORS**

Theory of operation – not self starting – starting methods, Phasor diagrams, Power flow equation, V and Inverted V Curves, Synchronous condensers, Hunting and its elimination methods, BLDC motor- Principle, Characteristics and applications.

**UNIT – III THREE PHASE INDUCTION MOTORS**

Construction, Types (squirrel cage and slip-ring), Principle of operation, Rotating magnetic field, production of torque, Slip, Slip Speed and its relation between rotor current frequency, Starting and Running Torque, Maximum Torque, Torque slip Characteristics, Equivalent circuit, Phasor Diagram, Losses and Efficiency, , Circle Diagram, No-Load and Blocked Rotor Test, Methods of starting, Speed control for induction motors, Crawling and Cogging Induction Generators, Applications

**UNIT – IV SINGLE PHASE INDUCTION MOTORS**

Constructional features, Double revolving field theory, Split phase motor, Capacitor Start, Capacitor Run, Capacitor Start and Capacitor Run Motors, Shaded Pole Motor, equivalent circuit, determination of parameters.

**UNIT – V SPECIAL MACHINES**

AC Series Motor, Repulsion Motors – Repulsion start, Repulsion start and Induction Run motors, Universal Motors, Reluctance Motors, Switched Reluctance Motor, Stepper Motors, Hysteresis Motor, Split-phase starting methods and applications.

**Text/References:**

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons,2007.

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# (18PC0205) POWER ELECTRONICS

**IV Semester**

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**Course Objectives:**

With the advent of semiconductor devices, revolution is taking place in the power transmission, distribution and utilization. This course introduces the basic concepts of power semiconductor devices, Converters, Inverters, Choppers and their analysis.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand the different types of power semiconductor devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers and regulators
4. Analyse the operation of voltage source and current inverters.
5. Analyse the operation of ac voltage controllers & Cycloconverter

.

## UNIT-I POWER SEMICONDUCTOR DEVICES

Study of switching devices, Diode, , Power BJT, Power MOSFET, IGBT-Static and Dynamic characteristics –Construction and Characteristics of Thyristor Family, TRIAC, GTO, MCT, Different ratings of SCR, Triggering and commutation circuit for SCR- Protection of Thyristors-Overvoltage and Overcurrent Protection, di/dt and dv/dt protection - Design of Snubber circuit, Series and Parallel Connection of SCRs.

## UNIT-II PHASE CONTROLLED RECTIFIERS

Types of Converter, Single-phase half-wave controlled, half controlled and fully-controlled rectifier with R-load, RL load and RLE load; Three-phase fully-controlled rectifier with R-load and highly inductive load, freewheeling diode;. Effect of source inductance, Dual Converter

**UNIT III CHOPPERS AND REGULATORS**

Time Ratio Control and Current Limit Control Strategies – Step Down and Step up Choppers – Four quadrant Choppers with different modes of operation –Buck, Boost and Buck-Boost regulators.

**UNIT IV INVERTERS**

Inverters – Single Phase voltage source Inverter — Waveforms –Forced Commutated Thyristor Inverters – Single Phase Half and Full Bridge Inverters-Pulse Width Modulation Control-Harmonic Reduction Techniques-Voltage Control Techniques for Inverters – Pulse width modulated inverters, Current source inverters- Basic Series Inverter – Basic Parallel Capacitor, Three Phase VSI in $120^0$ And $180^0$ Modes of Conduction.

**UNIT V AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS**

AC Voltage Controllers –Principles of phase control, Principle of integral cycle, single phase voltage controllers with R and RL loads, Cycloconverters – Single Phase Mid Point Cycloconverters with Resistive and Inductive Load– Bridge Configuration of Single Phase Cycloconverter, Three phase Cycloconverter

**Text/References:**

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
5. Dr.P.S.Bimbhra, "Power Electronics"Khanna publishers,Fifth edition, 2012

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# (18ES0405)DIGITAL ELECTRONICS

**IV Semester**

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**Course Objectives:**

To provide fundamental concepts used in the design of digital systems and learn the methods for the design of digital circuits

**Course Outcomes:**

1. At the end of this course, students will demonstrate the ability to
2. Understand working of logic families and logic gates.Design and implement Combinational and Sequential logiccircuits.
3. Understand the process of Analog to Digital conversion and Digital to Analogconversion.
4. Be able to use PLDs to implement the given logical problem.

**UNIT I NUMBER SYSTEM & BOOLEAN ALGEBRA**

Digital systems, Binary Numbers, Number base conversions, Complements of numbers, Signed binary numbers, Binary codes. Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, Other logic operations & Logic gates.

**UNIT II GATE LEVEL MINIMIZATION**

The map method, four variable, K-map, Five variable map, POS & SOP Simplification, Don't care Conditions, Tabular Method- Simplification of Boolean function using tabulation Method.

**UNIT III ANALYSIS AND SYNTHESIS OF COMBINATIONAL CIRCUITS:**

Combinational circuits, Analysis & Design procedure, Binary Adder-subtractor, Decoder, Encoders, Multiplexers.

**UNIT IV ANALYSIS AND SYNTHESIS OF SEQUNTIAL CIRCUITS:**

Sequential Circuits, Latches Flips-Flops, Analysis of Clocked sequential circuits, Design procedure, Registers & Counters – Registers, Shift Registers, Ripple Counters,Synchronous counters, other counters.

**UNIT V ASYNCHRONOUS SEQUENTIAL LOGIC & PROGRAMMABLE MEMORIES**

Introduction, Analysis Procedure, Circuits with Latches, Design Procedure, Reduction of State flow tables,.Random Access Memory, Memory Decoding, ROM,PLA, PAL.

***Text Books:***

*1. M.Morris Mano & Michel D. Ciletti, "Digital Design" ,Pearson ,5th Edition.*

*2. Zvi KOhavi and Nirah K.Jha, "Switching theory and Finite Automata Theory" ,Cambridge,3rd Edition*

***Reference Books:***

*1. Subratha Goshal, "Digital Electronics", Cambridge.*

*2. Comer, "Digital & State Machine Design", Third Indian edition, OXFORD.*


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## (18PC0402)SIGNALS & SYSTEMS

**IV Semester** **L** **T** **P** **C**

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**Course objectives**:

1. To study about signals and systems.
2. To do analysis of signals & systems (continuous and discrete) using time domain & frequency domain methods.
3. To understand the stability of systems through the concept of ROC.
4. To know various transform techniques in the analysis of signals and systems.

**Course outcomes:**At the end of this course students will demonstrate the ability to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

**UNIT 1: Introduction to Signals and Systems**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Continuous time signals (CT signals)- Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and aperiodic signals, random signals, deterministic signals, Energy ,Power signals - CT systems and DT systems.
Fourier series: Trigonometric and Exponential and concept of discrete spectrum

**UNIT 2: Behavior of continuous and Discrete-time LTI systems**

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis. Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems.

**UNIT 3: Continuous & Discrete Fourier Transforms:**

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, Properties & Signal representation.The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

**UNIT 4: Laplace and z- Transforms**

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals.
Review of the z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

**UNIT 5: Sampling and Reconstruction**

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.

**Text/References:**

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India,1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.

4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

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## (18PC0205) POWER ELECTRONICS LAB

**IV Semester**

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**OBJECTIVES:**

To analyze the operation of Rectifiers, Inverters, Voltage Controllers and Choppers and give them experimental skill.

**LIST OF EXPERIMENTS:**

1. Gate Firing Circuits For SCR’ s
2. Single Phase A.C Voltage Controller With R & RL Loads
3. Single Phase Fully Controlled Bridge Converter
4. Forced Commutation Circuits (Class A, B & C)
5. D.C Jones Chopper With R & RL Loads

6. Single Phase Cycloconverters With R & RL Loads
7. Single Phase Series Inverter With R & RL Loads
8. Single Phase Dual Converter With R & RL Loads
9. Study Of Characteristics of SCR, MOSFET & IGBT
10. Three Phase inverter in $180^0$ & $120^0$ conduction mode in MATLAB/Simulink
11. Resonant pulse commutation circuit in MATLAB/Simulink.
12. Single phase Half Bridge Rectifiers in MATLAB/Simulink.


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## (18PC0207)ELECTRICAL MACHINES LABORATORY-II

**IV Semester**

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**OBJECTIVES:**

To analyze the operation of synchronous machines and induction motors and give them experimental skill.

**LIST OF EXPERIMENTS:**

1. Regulation of three phase alternator by emf and mmf methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. Determination of equivalent circuit parameters of three-phase induction motor by conducting No load and blocked rotor.
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.

11. Study of Induction motor Starters

**OUTCOMES:**

1. Ability to model and analyze electrical apparatus and their application to power system


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## (18MCBH04)ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

| IV Semester | L | T | P | C |
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## Course objective

1. The course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature.
2. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
3. The course focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

**Unit-1**

- Basic structure of Indian Knowledge System: Astadash Vidya- 4 ved
- 4 Upaved (Ayurved, Dhanurved, Gandharva Ved & Sthapthya Adi.,)

**Unit-2**

- 6 Vedanga (Shisha, Kalppa, Nirukha, VYkaran, Jyothish & Chand)
- 4 Upanga (Dharma Shastra, Meemamsa, Purana & Tharka Shastra)

**Unit-3**

- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

**Unit-4**

- Philosophical Tradition (Sarvadarshan) Nyaya, Vyshepec,Sankhya, Yog, Meemamsa, Vedantha, Chavanka, Jain & Boudh
- Indian Linguistic Tradition –(Phonology, morphology, syntax and semantics)

**Unit-5**

- Indian Artistic Tradition - Chitra kala, Moorthi kala, Vasthu kala , Sthapthya, Sangeetha, Nruthya Yevam Sahithya
- Case studies

**Text Books:**

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
4. Fritzof Capra, *Tao of Physics*
5. Fritzof Capra, *The Wave of life*

**References:**


1. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
2. *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
3. RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
4. P B Sharma (English translation), *Shodashang Hridayan*
5. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
6. S.C. Chaterjee & D.M. Datta, *An Introduction to Indian Philosophy*, University of Calcutta, 1984
7. K.S. Subrahmanialyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan College Pune 1965
8. *Panini Shiksha,* MotilalBanarasidas
9. V.N. Jha, *Language, Thought and Reality,* Vasudevasharan AGRAWAL Kala yevam Samskruthi, Shithya Bhavan Elahabad, 1952
10. Pramod Chandra, *India Arts,* Howard Univ. Press, 1983
11. Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
12. R. Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002


**Pedagogy:** Problem based learning, group discussions, collaborative mini projects.
**Outcome:** Ability to understand, connect up and explain basics of Indian traditional Knowledge in modern scientific perspective.

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# (18M00112) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

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**PRE-REQUISITES: NIL**

**Course Objective:**

The objective of this course is to equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to enrich analytical skills in helping them take sound financial decisions for achieving higher productivity.

**Course Outcome**:

The thorough understanding of Managerial Economics and Analysis of Financial Statements facilitates the Technocrats – cum – Entrepreneurs to take-up decisions effectively and efficiently in the challenging Business Environment.

**UNIT I**

**INTRODUCTION TO MANAGERIAL ECONOMICS**

Managerial Economics - Definition, nature and scope –Role of Managerial Economics in Business Decisions- Demand Analysis: Determinants- Law of Demand - Elasticity of Demand. Significance – types – measurement of elasticity of demand - Demand forecasting- factors governing

Demand forecasting- methods of demand forecasting

**UNIT II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

Production Function – Short-run and long- run production - Isoquants and Isocosts, MRTS, least cost Combination of inputs - - laws of returns - Internal and External Economies of scale - **Cost Analysis**: Cost concepts- Time Value of Money - Break-Even Analysis (BEA) – Managerial Significance and limitations of BEA - Determination of Break Even Point (Simple Problems)

**UNIT III**

**INTRODUCTION TO MARKETS AND FORMS OF BUSINESS ORGANIZATIONS**

Market structures: Types of Markets - Perfect and Imperfect Competition - Features, Oligopoly - Monopolistic competition. Price-Output determination - Pricing Methods and Strategies. Forms of Business Organization – Sole Proprietorship- Partnership – Joint Stock Companies –National Income: Concepts- Inflation: Types – Business Cycle: Phases of business cycle

**UNIT IV**

**INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Financial Accounting – Concept - emerging need and importance - Double-Entry Book Keeping-Journal - Ledger – Trial Balance - Financial Statements - - Trading Account – Profit & Loss Account – Balance Sheet (with simple adjustments). Financial Analysis – Ratios – Techniques –Liquidity, Leverage, Profitability, and Activity Ratios (simple problems).

**UNIT V**

**CAPITAL AND CAPITAL BUDGETING**

Concept of Capital - Sources of Short term and Long term capital - Estimating Working Capital requirement – Capital budgeting – Features of Capital budgeting proposals – Methods and Evaluation of Capital budgeting – Pay Back Method –Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

**Text Books:**

1. Aryasri: Managerial Economics and Financial Analysis, 4/e, TMH, 2009.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.

**Reference Books:**

1. Premchand Babu, Madan Mohan:Financial Accounting and Analysis,Himalaya, 2009
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International,. 2009.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2009.
5. H.L.Ahuja: Managerial Economics, S.Chand, 3/e, 2009
6. Gupta G.S., Managerial Economics, TaTa Mc Gra Hill
7. Joel Dean, Managerial Economics, Prentice Hall

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**PRE-REQUISITES: NIL**

**Course Outcomes**: At the end of this course, students will demonstrate the ability to

- Understand the concepts of power generating systems.
- Understand the various economic aspects of power generation.
- Computation of the parameters of a Transmission line
- Understand the concept of performance of Transmission lines
- Understand concepts of travelling wave phenomenon on transmission lines

**UNIT I**

**POWER GENERATING SYSTEMS**

Structure of a power system. Block Diagram of Thermal Power Station (TPS) showing paths of Coal, Steam, Water, Air, Ash and Flue Gasses - Brief Description of TPS Components: Economizers, Boilers, Super Heaters, Turbines, Condensers, Chimney and Cooling Towers.

**Hydro Power**: Selection of Site, Classification, Layout, Description of Main Components.

**Nuclear Power:** Nuclear Fission and Chain Reaction.- Nuclear Fuels.- Principle of Operation of Nuclear Reactor.-Reactor Components: Moderators, Control Rods, Reflectors and Coolants.- Radiation Hazards: Shielding and Safety Precautions.- Types of Nuclear Reactors and Brief Description of PWR, BWR and FBR.

**UNIT II**

**ECONOMIC ASPECTS OF POWER GENERATION**

Load Curve, Load Duration and Integrated Load Duration Curves-Load Demand, Diversity, Capacity, Utilization and Plant Use Factors- Numerical Problems. Costs Of Generation and their Division Into Fixed, Semi-Fixed and Running Costs. Tariff Methods: Desirable Characteristics of a Tariff Method.- Flat Rate, Block-Rate, Two-Part, Three –Part, and Power Factor Tariff Methods and Numerical Problems.

**UNIT III**

**TRANSMISSION LINE PARAMETERS**

Overhead Transmission Lines and Cables: Types of Conductors – ACSR, Bundled and Stranded Conductors- Resistance For Solid Conductors – Skin Effect- Calculation of Inductance for Single Phase and Three Phase, Single and Double Circuit Lines, Concept of GMR & GMD, Symmetrical and Asymmetrical Conductor Configuration with and without Transposition, Numerical Problems, Capacitance Calculations for Symmetrical and Asymmetrical Single and Three Phase, Single and Double Circuit Lines, Effect of Ground on Capacitance, Numerical Problems

**UNIT IV**

**MECHANICAL DESIGN OF TRANSMISSION LINES**

Overhead Line Insulators: Types of Insulators, String Efficiency and Methods for Improvement, Capacitance Grading and Static Shielding. Corona: Corona Phenomenon, Factors Affecting Corona,

Critical Voltages and Power Loss, Radio Interference. Sag and Tension Calculations: Sag and Tension Calculations with Equal and Unequal Heights of Towers, Effect of Wind and Ice on Weight of Conductor, Stringing Chart and Sag Template and Its Applications, Numerical Problems.

**UNIT V**

**POWER SYSTEM TRANSIENTS & TRAVELLING WAVES**

Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of Lines with Different Types of Conditions - Open Circuited Line, Short Circuited Line, T-Junction, Lumped Reactive Junctions (Numerical Problems). Bewley‟s Lattice Diagrams (for all the cases mentioned with numerical examples).

**Text/References:**


1. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014
2. Electric Power Generation Distribution and Utilization by C.L Wadhwa, New Age International (P) Ltd., 2005.
3. Power System Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
4. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, " Electric Power Systems" , Wiley, 2012



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## (18PC0209) CONTROL SYSTEMS

| B.Tech | V SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES:**

To make the students learn about:

- Merits and demerits of open loop and closed loop systems; the effect of feedback
- The use of block diagram algebra and Mason's gain formula to find the effective transfer function
- Transient and steady state response , time domain specifications
- The concept of Root loci
- Frequency domain specifications, Bode diagrams and Nyquist plots
- The fundamental aspects of modern control

**COURSE OUTCOMES**:

After completing the course, the student should be able to do the following:

- Evaluate the effective transfer function of a system from input to output using (i) block diagram reduction techniques (ii) Mason's gain formula
- Compute the steady state errors and transient response characteristics for a given system and excitation
- Determine the absolute stability and relative stability of a system
- Draw root loci
- Derive state space model of a given physical system and solve the state equation

**UNIT – I**

**INTRODUCTION**

Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback Characteristics, Effects of positive and negative feedback. Mathematical models – Differential equations of Translational and Rotational mechanical systems, and Electrical Systems, Block diagram reduction methods – Signal flow graph - Reduction using Mason's gain formula. Transfer Function of DC Servo motor - AC Servo motor - Synchro transmitter and Receiver

**UNIT-II**

**TIME RESPONSE ANALYSIS**

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

**UNIT – III**

**STABILITY**

The concept of stability – Routh's stability criterion – Stability and conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

**UNIT – IV**

**FREQUENCY RESPONSE ANALYSIS**

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain margin-Stability Analysis.

**UNIT – V**

**STATE SPACE ANALYSIS**

Concepts of state, state variables and state model, derivation of state models from differential equations. Transfer function models. Block diagrams. Diagonalization. Solving the Time invariant state Equations-State Transition Matrix and it's Properties. System response through State Space models.

**TEXT BOOKS:**


1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007.


**REFERENCE BOOKS:**


1. Control Systems Principles & Design 4th Edition, M.Gopal, Mc Graw Hill Education, 2012.
2. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son's, 8th edition, 2003.
3. Control Systems 3rd Edition, Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, Schaum's Mc Graw Hill Education.
4. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.

# (18PC0210) MEASUREMENTS AND INSTRUMENTATION

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**Course Objectives**: The objectives of the course are to make the student learn about

- The basic principles of different types of electrical instruments for the Measurement of voltage, current, power factor, power and energy.
- The measurement of R, L, and C parameters using bridge circuits.
- The principle of working of CRO and its applications.
- Characteristics of signals, their representation, and signal modulation techniques
- Several types of transducers and their use for measurement of non-electrical quantities

**COURSE OUTCOMES:**

- The student should have learnt how to

  Use wattcmeters, pf meters, and energy meters in a given circuit.
- Extend the range of ammeters and voltmeters
- Measure active power, reactive power, power factor, and energy in both 1-phase and 3-phase circuits
- Determine the resistance values of various ranges, L and C values using appropriate bridges.
- Analyze the different characteristic features of periodic, and a periodic signals using CRO.
- Analyze different types of data transmission and acquisition and measure strain value

**UNIT- I**

**MEASURING INSTRUMENTS**

Classification – Ammeters and Voltmeters – PMMC, Dynamometer, Moving Iron Type Instruments – Expression for the Deflecting Torque and Control Torque – Errors and Compensations, Range Extension. Cathode Ray Oscilloscope- Cathode Ray tube-Time base generator-Horizontal and Vertical Amplifiers – Applications of CRO – Measurement of Phase , Frequency, Current & Voltage- Lissajous Patterns

**UNIT – II**

**D.C & A.C BRIDGES**

Methods of Measuring Low, Medium and High Resistances – Sensitivity of Wheatstone‟s Bridge – Kelvin‟s Double Bridge for Measuring Low Resistance, Measurement of High Resistance – Loss of Charge Method. Measurement of Inductance - Maxwell‟s Bridge, Anderson‟s Bridge. Measurement of Capacitance and Loss Angle - Desauty Bridge. Wien‟s Bridge – Schering Bridge.

**UNIT – III**

**MEASUREMENT OF POWER AND ENERGY & POTENTIOMETER**

Single Phase Dynamometer Wattmeter, LPF and UPF, Double Element and Three Element Dynamometer Wattmeter, Expression for Deflecting and Control Torques. Types of P.F. Meters – Dynamometer and Moving Iron Type – 1-ph and 3-ph Meters. Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and Compensations. Three Phase Energy Meter Potentiometers: Principle and Operation of D.C. Crompton‟s Potentiometer –Standardization – Measurement of unknown Resistance, Current, Voltage. Standardization – Applications.

**UNIT-IV**

**CHARACTERISTICS OF SIGNALS & DATA TRANSMISSION , TELEMETRY AND DAS**

. Signals and Their Representation: Standard Test, Periodic, Aperiodic, Modulated Signal, Sampled Data, Pulse Modulation and Pulse Code Modulation. Methods of Data Transmission – General Telemetry System. Frequency Modulation (FM), Pulse Modulation (PM), Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM) Telemetry. Comparison of FM, PM, PAM and PCM. Analog and Digital Data Acquisition Systems – Components of Analog DAS – Types of Multiplexing Systems: Time Division and Frequency Division Multiplexing – Digital DAS – Block Diagram — Modern Digital DAS (Block Diagram)

**UNIT-V**

**TRANSDUCERS**

Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle of Operation of Resistive, Inductive, Capacitive Transducers, LVDT, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, Synchros, Piezoelectric Transducers, Photovoltaic, Photo Conductive Cells, Photo Diodes.

**TEXT BOOKS**:

1. Electrical & Electronic Measurement & Instruments, A.K.Sawhney and Dhanpat Rai & Co. Publications, 2011, Reprint 2014.

2.Electrical Measurements and measuring Instruments 5thEdition, E.W. Golding and F.C. Widdis, Reem Publications, 5th Edition, 2011.

**REFERENCE BOOKS:**

1. Electronic Instrumentation, 3rd Edition, H. S. Kalsi, Tata Mcgrawhill, 2011.

2. Electrical Measurements, Buckingham and Price, Prentice Hall, 1970.

3. Electrical Measurements: Fundamentals, Concepts, Applications, Reissland, M.U., New Age International (P) Limit

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# PEC_I

## (18PE0201) Electrical Drives

| B.Tech | V SEMESTER | L | T | P | C |
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**Course Objectives:**

At the end of this course, students will demonstrate the ability to

Understand the characteristics of dc motors and induction motors.

- Understand the principles of speed-control of dc motors and induction motors.

- Understand the power electronic converters used for dc motor and induction motor speed control.

**Course Outcomes:** The student should be able to:

- Identify the choice of the electric drive system based on their applications
- Explain the operation of single and multi quadrant electric drives
- Analyze single phase and three phase rectifiers fed DC motors as well as chopper fed DC motors
- Explain the speed control methods for AC-AC & DC-AC converters fed to Induction motors and Synchronous motors with closed loop, and open loop operations

**UNIT – I**

**CONVERTER FED DC MOTORS**

Classification of Electric Drives, Basic elements of Electric Drive, Dynamic Control of a Drive system, Stability analysis, Introduction to Thyristor Controlled Drives, Single Phase, Three Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited and D.C Series Motors – Continuous Current Operation – Output Voltage and Current Waveforms – Speed and Torque Expressions – Speed – Torque Characteristics- Problems.

**UNIT – II**

**FOUR QUADRANT OPERATION OF DC DRIVES**

Introduction to Four Quadrant Operation – Motoring Operations, Electric Braking – Plugging, Dynamic and Regenerative Braking Operations. Four Quadrant Operation of D.C Motors by Dual Converters – Closed Loop Operation of DC Motor (Block Diagram Only)

**UNIT – III**

**CHOPPER FED DC MOTORS** Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited and Series Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics – Problems on Chopper Fed D.C Motors

**UNIT – IV CONTROL OF INDUCTION MOTOR**

Induction Motor Stator Voltage Control and Characteristics. AC Voltage Controllers – Waveforms – Speed Torque Characteristics - Stator Frequency Control and Characteristics. Voltage Source and Current Source Inverter - PWM Control – Comparison of VSI and CSI Operations – Speed Torque Characteristics – Numerical Problems on Induction Motor Drives – Closed Loop Operation of Induction Motor Drives (Block Diagram Only) – Principles of Vector Control Static Rotor Resistance Control – Slip Power Recovery – V/f control of Induction Motor – Their Performance and Speed Torque Characteristics – Advantages- Applications – Problems

**UNIT – V**

**CONTROL OF SYNCHRONOUS MOTORS** Separate Control & Self Control of Synchronous Motors – Operation of Self Controlled Synchronous Motors by VSI and CSI Cycloconverters. Load Commutated

CSI Fed Synchronous Motor – Operation – Waveforms – Speed Torque Characteristics – Applications – Advantages and Numerical Problems – Closed Loop Control Operation of Synchronous Motor Drives (Block Diagram Only), Introduction to variable frequency control.

**TEXT BOOKS:**

1. Power semiconductor controlled drives, G K Dubey, Prentice Hall, 1995.
2. Modern Power Electronics and AC Drives, B.K.Bose, PHI, 2002.

**REFERENCE BOOKS:**

1. Power Electronics, MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company, 2008.
2. Power Electronic Circuits, Devices and applications, M.H.Rashid, PHI, 2005.
3. Electric drives Concepts and Applications, Vedam Subramanyam, Tata McGraw Hill Publications, 2nd Edition, 2011.

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**PEC_I**

## (18PE0202) ENERGY AUDITING AND CONSERVATION

| B.Tech | V SEMESTER | L | T | P | C |
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**Course objective:** To know the necessity of conservation of energy

- To generalize the methods of energy management
- To illustrate the factors to increase the efficiency of electrical equipment
- To detect the benefits of carrying out energy audits.

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- Tell energy audit of industries
- Predict management of energy systems
- Sequence the methods of improving efficiency of electric motor

- Analyze the power factor and to design a good illumination system
- Determine pay back periods for energy saving equipment

**UNIT- I:**

**Basic Principles of Energy Audit:**

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT- II:**

**Energy Management:**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

**UNIT- III:**

**Energy Efficient Motors:**

Energy efficient motors, factors affecting efficiency, loss distribution , constructional details , characteristics – variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

**UNIT- IV:**

**Power Factor Improvement, Lighting and Energy Instruments:**

Power factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

**UNIT- V:**

**Economic Aspects and Analysis:**

Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .

**TEXT BOOKS:**

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.

2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998

**REFERENCES:**

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-

2. Energy management hand book by W.C.Turner, John wiley and sons

3. Energy management and good lighting practice : fuel efficiency- booklet 12-EEO

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**PEC_I**

# (18PE0203) SENSORS AND SIGNAL CONDITIONING

| B.Tech | V SEMESTER | L | T | P | C |
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**Course Objectives:**

- To introduce the basics of measurements.
- To elucidate sensors and signal conditioning circuits.
- To introduce different error analysis methods.
- To familiarize with different sensors and transducers.
- To explain signal conditioning circuits.

**Course Outcomes (CO):** After the completion of the course student will be able to:

- Apply different methods for the measurement of length and angle
- Elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
- Explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
- Ability to analyze, formulate and select suitable sensor for the given industrial applications
- Describe signal conditioning circuits

**UNIT-I**

**Introduction**: Definition, Application and types of measurements, Instrument classification, Functional elements of an instrument, Input-output configuration of measuring instruments, Methods of correction for interfering and modifying inputs, Standards, Calibration, Introduction to Static characteristics and Dynamic characteristics, Selection of instruments, Loading effects.

**UNIT-II**

**Error Analysis:** Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, General consideration in data analysis, Design of Experiment planning.

**UNIT-III**

**Sensors/Transducers:** Definition, Types, Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance. Fiber optic sensors, Bio-chemical sensors, Hall-Effect, Photo emissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge Digital transducers: Principle, Construction, Encoders, Absolute and incremental encoders, Silicon micro transducers.

**UNIT-IV**

**Signal Conditioning**: Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.

**UNIT-V:** Measurement of Linear Displacement, Angular displacement, Temperature, Light intensity, Capacitance, Resistance, Inductance.

**Text Books:**

1. Doebelin, E.O. and Manic, D.N., Measurement Systems: Applications and Design, McGrawHill (2004).

2. Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai (2008).

**Reference Books:**

1. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).

2. Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, TMH (2003)

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## (18PE0204) POWER SYSTEM PROTECTION

**PEC_II**

| **V –SEMESTER** | **L** | **T** | **P** | **C** |
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**Course Objectives:** The objectives of the course are to make the students learn about:

- The technical aspects involved in the operation of circuit breakers
- The different types of electromagnetic relays and microprocessor based relays
- The protection of Generators & Transformers
- The protection of feeders and lines
- Generation of over voltages and protection from over voltages

**Course Outcomes:** At the end of the course the student should be able to:

- Solve numerical problems concerning the arc interruption and recovery in circuit breakers
- Explain the principles of operation of various types of electromagnetic relays, Static relays as well as Microprocessor based relays
- Understanding the protection of generators and determination of what %generator winding is Un protected under fault occurrence
- Understanding the protection of transformers and make design calculations to determine the required CT ratio for transformer protection
- Explain the use of relays in protecting Feeders, lines and bus bars
- Understand why over voltages occur in power system and how to protect the system

**UNIT-1**

**CIRCUIT BREAKERS**

Circuit Breakers: Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB Ratings and Specifications: Types and Numerical Problems. – Auto Re closures. Description and Operation of Following Types of Circuit Breakers: Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers.

**UNIT-2**

**RELAYS**

Electromagnetic Relays - Basic Requirements of Relays – Primary and Backup Protection - Construction Details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays – Universal Torque Equation – Characteristics of Over Current, Direction and Distance Relays. Static Relays – Advantages and Disadvantages – Definite Time, Inverse and IDMT. Static Relays – Comparators – Amplitude and Phase Comparators. Microprocessor Based Relays – Advantages and Disadvantages – Block Diagram for Over Current (Definite, Inverse and IDMT) and Distance Relays and Their Flow Charts.

**UNIT – 3**

**PROTECTION OF GENERATORS & TRANSFORMERS**

Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection. Numerical Problems on percentage winding unprotected. Protection of Transformers: Percentage Differential Protection, Numerical Problems on Design of CT Ratio, Buchholtz Relay Protection, Numerical Problems.

**UNIT –4**

**PROTECTION OF FEEDERS & LINES**

Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of Transmission Line – 3 Zone Protection Using Distance Relays. Carrier Current Protection. Protection of Bus Bars.

**UNIT – V**

**OVER VOLTAGES IN POWER SYSTEMS**

Generation of Over Voltages in Power Systems.-Protection against Lightning over Voltages - Valve Type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL.

**TEXT BOOKS:**

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.

2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

**REFERENCE BOOKS:**

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited,Publishers, 2012.

2. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009.

3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010.

# PEC_II
# (18PE0205) POWER QUALITY

| V –SEMESTER | L | T | P | C |
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**Course Objectives**: The objectives of the course are to make the students learn about:

- Power quality issues and standards.
- The sources of power quality disturbances and power transients that occur in power systems.
- The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
- The principle of operation of DVR and UPQC.

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

- Address power quality issues to ensure meeting of standards
- Apply the concepts of compensation for sags and swells using voltage regulating devices
- Assess harmonic distortion and its mitigation.
- Explain the power measurement data according to standards

**UNIT I**

**INTRODUCTION**

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude versus Duration Plot - Power Quality Standards -Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

**UNIT II**

**TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS**

Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption-Under Voltage – Over Voltage–Outage. Source of Different Power Quality Disturbances-Principles of Regulating the Voltage-Conventional Devices for Voltage Regulation.

**UNIT III**

**FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS**

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics: Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

**UNIT-IV POWER QUALITY MONITORING**

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments-Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

**UNITV POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

**TEXT BOOKS:**

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition,2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

**REFERENCE BOOKS**:

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H.J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

# PEC_II
# (18PE0206) Power System Dynamics and Control

| V –SEMESTER | L | T | P | C |
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**Course Objectives:** The objectives of the course are to make the students learn about:

- The kinds of power stability problems
- The basic concepts of modeling and analysis of dynamical systems.
- Modeling of power system components - generators, transmission lines, excitation and prime move Controllers.
- Stability of single machine and multi-machine systems is analyzed using digital Simulation and Small- Signal analysis techniques.
- The impact of stability problems on power system planning and operation.

**Course Outcomes**: After completion of Course, the student should be able to

- Understand the power stability problems
- Understand the basic concepts of modeling of synchronous machine and power system components
- Analyze the stability issues in interconnected systems
- Understand the power system stability analysis tools and enhancement of power system stability

**Unit – I Introduction to Power System Stability**

Power System Operation and Control - Stability Problems faced by Power Systems -Impact on Power System Operation and Control - Analysis of Dynamical Systems -Concept of Equilibria, Small and Large Disturbance Stability - Example: Single Machine Infinite Bus System - Modal Analysis of Linear Systems - Analysis using Numerical Integration Techniques - Issues in Modeling: Slow and Fast Transients, Stiff Systems

**Unit – II Modeling of a Synchronous Machine**

Physical Characteristics - Rotor Position Dependent model - D-Q Transformation -Model with Standard Parameters - Steady State Analysis of Synchronous Machine -Short Circuit Transient Analysis of a Synchronous Machine - Synchronous Machine Connected to Infinite Bus.

**Unit – III Modeling of power system components**

Physical Characteristics and Models - Control system components - Excitation System Controllers - Prime Mover Control Systems - Transmission Line Physical Characteristics -

Transmission Line Modeling - Load Models - induction machine model - Other Subsystems - HVDC, protection systems.

**Unit – IV Stability Issues in Interconnected Power Systems**

Single Machine Infinite Bus System - Multi-machine Systems - Stability of Relative Motion - Frequency Stability: Centre of Inertia Motion - Concept of Load Sharing: Governors - Single Machine Load Bus System: Voltage Stability - Torsional Oscillations

**Unit – V Enhancing System Stability**

Planning Measures - Stabilizing Controllers (Power System Stabilizers) – Operational Measures-Preventive Control - Emergency Control - Power System Stability Analysis Tools: Small Signal Analysis Program - Transient Stability Program - Real-Time Simulators.

**Reference Books:**

1. K.R.Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.
2. P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York, 1995.
3. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.
4. Jan Machowski, Janusz Bialek, James Richard Bumby, Power system dynamics and control , John Wiley & Sons, 1997.



## (18PC0211) CONTROL SYSTEMS & SIMULATION LABORATORY

| B.Tech | V semester | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1.5 |

**COURSE OBJECTIVES:-**

The objectives of this lab course are to make the student practically learn about

- The effects of feedback on system performance
- Determination of transfer functions of DC Machine.
- The design of controllers to achieve desired specifications.
- The characteristics of servo mechanisms used in automatic control applications.

**Any Eight of the following experiments are to be conducted:**

1. Time Response of Second Order System
2. Characteristics of Synchros
3. Programmable Logic Controller – Study and Verification of Truth Tables of Logic Gates, Simple Boolean Expressions and Application of Speed Control of Motor.
4. Effect of P, PD, PI, PID Controller on a Second Order System.
5. Characteristics of Magnetic Amplifier
6. Temperature Controller Using PID
7. State Space Model for Classical Transfer Function Using MATLAB – Verification.
8. Stability Analysis Bode Plot of Linear Time Invariant System Using MATLAB

**In addition to the above six experiments, at least any two of the experiments from the following list are required to be conducted**:

1. Stability Analysis Root Locus of Linear Time Invariant System Using MATLAB
2. Effect of feedback on DC servo motor
3. Transfer function of DC motor
4. Lag and Lead compensation - Magnitude and phase plot Using MATLAB



**(18PC0212) MEASUREMENTS &INSTRUMENTATION LABORATORY**

| **B.Tech** | **V semester** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **1.5** |

**COURSE OBJECTIVES:**

The objectives of the course are to make the students learn about:

- Calibration of various electrical measuring/recording instruments.
- Accurate determination of resistance, inductance and capacitance using D.C and A.C Bridges.

- Measurement of parameters of choke coil

**The following experiments are required to be conducted as compulsory experiments**:

1. Calibration of Single Phase Energy Meter using Phantom loading method with RSS meter as standard
2. Calibration of Dynamometer Power Factor Meter
3. Kelvin's Double Bridge – Measurement of very low Resistance values –Determination of Tolerance.
4. Schering Bridge & Anderson Bridge for measurement of Capacitance and Inductance values
5. Measurement of 3 Phase Reactive Power with Single-Phase Wattmeter
6. Measurement of Parameters of a Choke Coil Using 3 Voltmeter and 3 Ammeter Methods
7. Calibration of LPF Wattmeter – by Phantom Testing
8. Measurement of 3 Phase Power with Two Watt Meter Method (Balanced & Un balanced).

**In addition to the above six experiments, at least any two of the experiments from the following list are required to be conducted**:

1. Optical Bench – Determination of Polar Curve, Measurement of MHCP of Filament Lamps
2. Dielectric Oil Testing Using H.T. Testing Kit
3. LVDT and Capacitance Pickup – Characteristics and Calibration
4. Resistance Strain Gauge – Strain Measurement and Calibration
5. Transformer Turns Ratio Measurement Using A.C. Bridge.

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**B.Tech (18M00413) MANAGEMENT SCICENCE**

| **VI –SEMESTER** | **L** | **T** | **P** | **C** |
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**Course Objective:**

The Objective of the course is to give a basic perspective of Management and behavioral concepts. This will form foundation to study other functional areas of management. Also this course provides insight into behavioral issues.

**UNIT-I**

**Meaning and nature of organizational behavior**

Introduction to concept and importance of OB in Modern management Individual Behavior – Personality – values – Attitudes - Perception, Learning, Emotions-emotional intelligence& emotional Labor.

**UNIT-II**

**Designing and Developing HR systems:** Human Resource Planning, Job Analysis, Job Evaluation, Job Design, Job Enlargement, Job Rotation, Job Enrichment, Recruitment & Selection, Placement, Induction, Transfer and Promotion, Separation

**UNIT-III**

**Human Resource Development:-**Concepts, Development Function, Training and Development, Performance Appraisal & Career Planning and Development

**UNIT-IV**

**Understanding Marketing Management:** Concepts of marketing, Role of Marketing, Marketing Process, Marketing Environment, Consumer Behavior-decision process

**UNIT-V**

**strategic management:** Concepts in Strategic Management - Strategic Management Process - Environmental Scanning - Industry and Competitive analysis - Core competencies - Competitive Advantage.

**Textbooks:**

- Personal and Human Resource Management – Text and cases, P. Subbarao, Himalaya.

- Human Resource Management, Noe A.Raymond, John Hollenbeck, Barry Gerhart and Patrick Wright, Tata McGraw Hill.

**References**


- Human Resource Management, Aswathappa, 4th Edition, TMH 2006
- Human Resource Mangement, Ian Beardwell & Len Holden-Macmillan India Ltd.
- Managing Human Resources: Productivity, quality of work life, profits- Wayne F.

## (18PC0425) BASIC MICROPROCESSOR AND MICROCONTROLLER

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives**

- To study the architecture and assembly language programming of 8086 microprocessor.
- To learn about interrupt and bus structure of 8086 microprocessor.
- To interface 8086 microprocessor with supporting peripheral chips.
- To study the architecture and instruction set of 8051 microcontroller.
- To design microcontroller-based systems.

**UNIT I:** 8086 Microprocessor The 8086 Microprocessor: Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

**UNIT II:** 8086 Interrupts and System Bus Architecture Interrupts and interrupt service routines – 8086 signals – Minimum and Maximum modes of operation – Multiprogramming – Multiprocessor configurations – closed coupled and tightly coupled configurations - Introduction to advanced processors.

**UNIT III:** I/O Interfacing with 8086 I/O Interfacing: Parallel communication interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: LED display, Keyboard display interface.

**UNIT IV:** 8051 Microcontroller: Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

**UNIT V:** Interfacing with 8051 microcontroller Interfacing Microcontroller: Programming 8051 Timers – Serial Port Programming – Interrupts Programming - Stepper Motor and Waveform generation – LCD and Keyboard interfacing.

Text Books

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Douglas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”, TMH,2012.
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education, 2011

**Reference Books**

1. Kenneth J. Ayala, "The 8086 Microprocessor- Programming and Interfacing The PC", India Edition, Cengage Learning.

2. Kenneth J. Ayala, "The 8051 Microcontroller – Architecture, Programming and Applications" Second Edition, Delmar Cengage Learning, ", Second Edition, Cengage Learning, 2004.

# (18PC0213) Power Systems – II

| VI –SEMESTER | L | T | P | C |
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**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Classification of transmission lines and representation by suitable equivalent circuits.
- Understand Short circuit analysis of power systems.
- Understand Swing equation solutions, Equal area criterion and its applications.
- Understand the Power flow studies by various methods.
- Understand Load frequency control in single area and two area systems.

**UNIT – I POWER SYSTEM NETWORK MATRICES**

Representation of Power System Elements, Graph Theory: Definitions, Bus Incidence Matrix, Ybus Formation by Direct and Singular Transformation Methods, Numerical Problems. Formation of ZBus: Partial Network, Algorithm for the Modification of ZBusMatrix for Addition Element for the Following Cases: Addition of Element from a New Bus to Reference, Addition of Element from a New Bus to an Old Bus, Addition of Element Between an Old Bus to Reference and Addition of Element Between Two Old Busses (Derivations and Numerical Problems).- Modification of ZBus for the Changes in Network ( Problems )

**UNIT 2: SHORT CIRCUIT ANALYSIS**

Per-Unit System of Representation. Per-Unit Equivalent Reactance Network of a Three Phase Power System, Numerical Problems. Symmetrical Fault Analysis: Short Circuit Current and MVA Calculations, Fault Levels, Application of Series Reactors, Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero Sequence Components: Voltages, Currents and Impedances. Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without Fault Impedance, Numerical Problems.

**UNIT 3: POWER FLOW STUDIES**

Necessity of Power Flow Studies – Data for Power Flow Studies – Derivation of Static Load Flow Equations – Load Flow Solutions using Gauss Seidel Method: Acceleration Factor, Load Flow Solution with and without P-V Buses, Algorithm and Flow chart. Numerical Load flow Solution for Simple Power Systems (Max. 3-Buses) Load Flow Solution with or without PV Buses using Newton Raphson Method.

**UNIT4: PERFORMANCE OF TRANSMISSION LINES:**

Classification of Transmission Lines - Short, Medium and Long Lines and Their Exact Equivalent Circuits- Nominal-T, Nominal-π. Mathematical Solutions to Estimate Regulation and Efficiency of All Types of Lines. Long Transmission Line-Rigorous Solution, Evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations –Surge Impedance and Surge Impedance Loading - Wavelengths and Velocity of Propagation – Ferranti Effect , Charging Current-Numerical Problems.

**UNIT 5: POWER SYSTEM STABILITY ANALYSIS**

Elementary Concepts of Steady State, Dynamic and Transient Stabilities –Description of: Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability and Methods to Improve Steady State Stability - Derivation of Swing Equation -Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Solution of Swing Equation by 4th Order Runga Kutta Method (up to 2 iterations) - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

**TEXT BOOKS:**

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

## PEC_III

## (18PE0207) Electrical and Hybrid Vehicles

| VI –SEMESTER | L | T | P | C |
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**Course Objectives:-**Students will be able to:

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

**Course Outcomes:-**Students will be able to:

- Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To learn electric drive in vehicles / traction.

**UNIT-I:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, mathematical models to describe vehicle performance

**UNIT-II:** Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis. Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.

**UNIT-III:** Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives , configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

**UNIT-IV:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology communications, supporting subsystems

**UNIT-V:** Introduction to energy management and their strategies used in hybrid and electric vehicle , Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

**References:-**


1. Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

# PEC_III

## (18PE0208) Electrical Machine Design

| VI –SEMESTER | L | T | P | C |
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**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

**UNIT I Introduction**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT II Transformers**

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT III Induction Motors**

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT IV Synchronous Machines**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

**UNIT V Computer aided Design (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

**Text / References:**

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.

2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.

3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.


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**PEC_III**

**(18PE0416) DISCRETE SIGNAL PROCESSING**

**(EEE)**

| VI –SEMESTER | L | T | P | C |
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| | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Program a DSP chip to filter signals using either assembly language or a C compiler for the chip.
- Use discrete time Fourier transforms to analyze a digital system.

**Course Outcomes:**

At the end of the course, the student should be able to:

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications
- Formulate engineering problems in terms of DSP tasks.
- Apply engineering problems solving strategies to DSP problems.
- Design and test DSP algorithms.
- Analyze digital and analog signals and systems.
- Analyze and compare different signal processing strategies

**UNIT-I**

**Discrete time signals and systems**: Review of discrete-time signals and systems – Time domain analysis of discrete-time signals & systems, Frequency domain analysis of discrete-time signals and systems.

**Discrete Fourier Transform (DFT)**-The DFT as a linear transformation, Relationship of the DFT to other transforms, Properties of DFT, Frequency analysis of signals using the DFT.

**UNIT-II**

**Fast Fourier Transform Algorithm-** Divide and conquer approach to computation of DFT, Radix-2, Radix-4, and Split radix FFT algorithms. A linear filtering approach to computation of the DFT- the Goertzel, and the Chirp-z transform algorithms, Quantization errors in the computation of DFT.

**UNIT-III**

**Design of IIR Digital filters:** Design of Impulse Invariance Response (IIR) filters from analog filters– IIR filter design by approximation of derivatives, by Impulse invariance, and by bilinear transformation methods,

**Design of Finite Impulse Response (FIR) filters –**

Symmetric and asymmetric FIR filters, Design of linear phase FIR filters using windows, Design of linear phase FIR filters by the frequency sampling method, Design of optimum equi-ripple linear phase FIR filters, Comparison of design methods for linear phase FIR filters

**UNIT-IV**

**Structures for the realization of discrete-time systems**

**Structures for IIR systems** – Direct form, Signal flow graphs & Transposed, Cascade form, Parallel form and Lattice structures, Conversion from Lattice structure to direct form, lattice – Ladder structure.

**Structures for FIR systems** -

Direct form, Cascade form, Frequency sampling, and Lattice structures.

**UNIT-V**

**Introduction to multi rate signal processing**.

Decimation, and interpolation, sampling rate conversion by a rational factor, Implementation of sampling rate conversion, multistage implementation of sampling rate conversion, Application of DSP.

**Text/Reference Books:**


1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
5. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988



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## OEC_I

## (18OE0201) ARTIFICIAL INTELLIGENCE APPLICATIONS FOR ELECTRICAL SYSTEMS

| VI –SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES**

- To provide insight into fundamentals of Artificial Intelligence Techniques to the students.
- To convey application of Artificial Intelligence techniques in power system.

**UNIT I:**

**ARTIFICIAL INTELLIGENCE:**

History and Applications Introduction, Intelligence, Communication, Learning, Artificial Intelligence, History, Early Works, Importance, Definitions, Programming Methods, Techniques, Progress of Artificial Intelligence, Growth of AI, AI and Industry, AI and the world, Current Trends in Applied AI, Modeling, Simulation and AI, Intelligent Systems, Role of IS, Comparisons with conventional programs, Fundamentals of various IS

**UNIT II:**

**ARTIFICIAL NEURAL NETWORK**:

Difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Power System

**UNIT III**

**FUZZY LOGIC:**

Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, The alpha cut method, The extension method, Linguistic Descriptions and their Analytical Forms, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences Fuzzy Implication and Algorithms, Defuzzification Methods, Centre of Area Defuzzification, Centre of Sums Defuzzification

**UNIT IV:**

**GENETIC ALGORITHMS AND EVOLUTIONARY PROGRAMMING:**

Introduction, Genetic Algorithms, Procedure of Genetic Algorithms, Genetic Representations, Initialization and Selection, Genetic Operators, Mutation, The Working of Genetic Algorithms, Evolutionary Programming, The Working of Evolutionary Programming

**UNIT V:**

**APPLICATION OF AI IN POWER SYSTEMS:**

Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting

**TEXT & REFERENCE BOOKS:**

1. Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005- N. P. Paddy

2. Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002- Estimations V. Kiriakopoulos

3. Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series, UK, 1997- Kevin Warwick, Arthur Ekwueme and Raj Aggarwal

4. Intelligent Systems and Signal Processing in Power Engineering, Springer Berlin Heidelberg, New York- Abhishek Utkal

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# (18OE0501) OPERATING SYSTEM WITH LINUX

## OEC_I

| VI –SEMESTER | L | T | P | C |
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**Course Outcomes:**

- Able to understand the system calls and design structureof an operating systems
- Able to understand the Linux operating system and implementation of commands
- Able to implement different Linux commands
- Able to learn shell programming
- Able to implement Linux system administration

**UNIT_ I**

**Operating systems Overview:** Operating systems functions, Operating systems structure, operating

systems operations, protection and security, computing environments, open-source operating systems. System Structures: Operating systems Services, User and Operating systems Interface, System calls, Types of system calls, system programs, Operating systems design structure, debugging, system boot.

**UNIT_ II**

**Overview of Linux,** What is Linux,Linux's root in Unix,Common Linux Features,advantage of Linux,Overview of Unix and Linux architectures,Linux files system,hardware requirements for Linux,Linux standard directories,Commands for files and directories cd, ls, cp, rm, mkdir,rmdir, pwd, file, more, lessCreating and viewing files using cat,file comparisons

**UNIT_ III**

**Essential Linux commands**

Processes in Linux,Process fundamentals,Connecting processes with pipes,Redirecting input,Redirecting output,Background processing,Managing multiple processes,Process scheduling – (at,batch),nohup command,kill, ps, who,find, sort, touch, file,file processing commands – wc, cut, paste etc,Mathematical commands – expr, factor etc,

**UNIT_ IV**

**SHELL**

Creating files with vi editor,Editing files with vi editor,Basics of shell programming,various types of shell available in Linux,Comparisons between various shells,Shell programming in bash,Conditional statements,Looping statements.Case statement,Parameter passing and arguments

**UNIT_ V**

**Basic Administration**: Basic System Administration (Run levels, User accounts), Kernel Administration: (Linux kernel sources, rebuilding kernel, installing kernel), Managing Users, Managing File Systems, Linux File Permissions, Devices and Modules (device drivers)

**Text Books for Reference**


1. Operating Systems Concepts, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Wiley, 8th Edition, 2014
2. Cristopher Negus – Red Hat Linux Bible, Wiley Dreamtech India 2005 edition.
3. YeswantKanethkar – UNIX Shell Programming, First edition, BPB.

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**(18OE0202) Programmable Logic Controllers**

**VI –SEMESTER**

| L | T | P | C |
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**Course Objectives:** The objectives of the course are to make the students learn about:

- PLC and its basics, architecture, connecting devices and programming
- Implementation of Ladder logic for various Industrial applications
- Designing of control circuits for various applications
- PLC logic and arithmetic operations

**UNIT-I**

PLC Basics: PLC System, I/O Modules and Interfacing, CPU Processor, Programming Equipment, Programming Formats, Construction of PLC Ladder Diagrams, Devices Connected To I/O Modules. PLC Programming: Input Instructions, Outputs, Operational Procedures, Programming Examples Using Contacts and Coils. Drill Press Operation.

**UNIT-II**

Digital Logic Gates, Programming in the Boolean algebra System, Conversion Examples. Ladder Diagrams for Process Control: Ladder Diagrams & Sequence Listings, Ladder Diagram Construction and Flowchart for Spray Process System.

**UNIT-III**

PLC Registers: Characteristics of Registers, Module Addressing, Holding Registers, Input Registers, Output Registers. PLC Functions: Timer Functions & Industrial Applications, Counter Function & Industrial Applications, Arithmetic Functions, Number Comparison Functions, Number Conversion Functions

**UNIT-IV**

Data Handling Functions: SKIP, Master Control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep Functions and Their Applications. Bit Pattern and Changing a Bit Shift Register, Sequence Functions and Applications, Controlling of Two-Axis & Three Axis Robots With PLC, Matrix Functions.

**UNIT-V**

Analog PLC Operation, Types of PLC Analog Modules and Systems, PLC Analog Signal Processing, BCD or Multibit data Processing, Analog output application examples, PID Modules, PID Tuning, Typical PID Functions, PLC Installation, Troubleshooting and Maintenance.

**Course Outcomes:** The student should be able to:

- Program a PLC for a given application
- Implement Ladder logic for various Industrial applications
- Design control circuits for various applications

**TEXT BOOKS:**

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition,
ELSEVIER Ltd., 2009.

2. Programmable Logic Controllers 5th Edition, William Bolton, Newnes, ELSEVIER Ltd., 2009.

**REFERENCES:**

1. Programmable Logic Controllers: An Emphasis on design & application, Kelvin T.Erickson, Dogwood Valley Press,
2011.

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**OEC_II**
**(18OE0203) ELECTRICAL MATERIALS**

| **VI –SEMESTER** | **L** | **T** | **P** | **C** |
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**COURSE OBJECTIVE:**

- To clarify the students on insulating, conducting & magnetic materials.
- To impart knowledge on the Physical, Electrical & Mechanical properties
- To impart knowledge on practical uses of various materials in different areas.

**UNIT_I**

**Introduction**

Introduction-Resistivity, factors affecting resistivity-Classification of conducting materials into low-resistivity and high resistivity materials-Low Resistivity Materials and their Applications-Copper, Silver, Gold, Aluminum, Steel, Stranded conductors, Bundled conductors, Low resistivity copper alloys, High Resistivity Materials a -Tungsten, Carbon, Platinum, Mercury, Superconducting materials, Application of superconductor materials

**UNIT-II**

**Semiconducting Materials:**

Introduction_, Semiconductors, Electron Energy and Energy Band Theory , Excitation of Atoms , Insulators, Semiconductors and Conductors , Semiconductor Materials, Covalent Bonds, Intrinsic Semiconductors, Extrinsic Semiconductors, N-Type Materials , P-Type Materials ,Minority and Majority Carriers, Semi-Conductor Material. Applications of Semiconductor materials-Rectifiers , Temperature-sensitive resisters or thermostats, Photoconductive cells , Photovoltaic cells, Varistors , Transistors, Hall effect generators ,Solar power

**UNIT-III**

**Insulating Materials:**

Introduction, General properties of Insulating Materials_ Electrical properties , Visual properties , Mechanical properties ,Thermal properties, Chemical properties, Ageing, Insulating Materials –

Classification, properties, applications, Introduction, Classification of insulating materials on the basis physical and chemical structure, Insulating Gases_ Introduction, Commonly used insulating gases

**UNIT-IV**

**Dielectric Materials:**

Introduction, Dielectric Constant of Permittivity, Polarization, Dielectric Loss, Electric Conductivity of Dielectrics and their Break Down, Properties of Dielectrics, Applications of Dielectrics

**UNIT-V**

**Magnetic Materials:**

Introduction , Classification - Diamagnetism , Para magnetism , Ferromagnetism , Magnetization Curve, Hysteresis, Eddy Currents , Curie Point , Magneto-striction, Soft and Hard magnetic Materials ,Soft magnetic materials , Hard magnetic materials

**Text Books:**


1. Title of the Book Name of Publisher 1 K.B.Raina, S.K. Bhattacharya, T. Joneja Electrical Engg. Material & Electronic components S. K. Kataria & Sons
2. R.K.Shukla, Archana Singh Electrical Engineering Materials Mc Graw Hill

# OEC_II
# (18OE0204) ENERGY CONVERSION SYSTEMS

| VI –SEMESTER | L | T | P | C |
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## UNIT _I

Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for pv systems, applications of super conducting materials in electrical equipment systems.

## UNIT_II

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.

## UNIT_III

Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

## UNIT_IV

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation. Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples,

## UNIT_V

Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells

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**OEC_II**

**VI –SEMESTER**

| L | T | P | C |
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# (18OE0316) MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

**(Open Elective to EEE)**

**Course Objectives:**

- To learn basics of Micro Electro Mechanical Systems (MEMS).
- To learn about various sensors and actuators used in MEMS
- To learn the principle and various devices of MOEMS, Fluidic, bio and chemical systems

**Course Out comes**:

Students undergoing this course are able to

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering

**UNIT – I**

**INTRODUCTION:** Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

**MECHANICAL SENSORS AND ACTUATORS:** Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

**UNIT – II**

**THERMAL SENSORS AND ACTUATORS:** Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

**UNIT – III**

**MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS:** Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

**MAGNETIC SENSORS AND ACTUATORS:** Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators

**UNIT – IV**

**MICRO FLUIDIC SYSTEMS:** Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps.

**RADIO FREQUENCY (RF) MEMS:** RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

**UNIT - V**

**CHEMICAL AND BIO MEDICAL MICRO SYSTEMS:** Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

**TEXT BOOKS:**

1. MEMS/Nitaigour Premchand Mahalik/TMH Publishing co.
2. MEMS and NEMS/Sergey Edwrd Lyshevski/CRC Press, Indian Edition, 2013

**REFERENCE BOOKS:**

1. Foundation of MEMS/Chang Liu/Prentice Hall Ltd.
2. RF MEMS Theory, Design and Technology Gabriel M. Rebeiz, Wiley- India,2010
3. MEMS and Micro Systems: Design and Manufacture/Tai-Ran Hsu/TMH Publishers.
4. Introductory MEMS/ Thomas M Adams, Richard A Layton/Springer International Publishers.

| VI –SEMESTER | L | T | P | C |
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## (18PC0418) MICRO PROCESSORS & MICRO CONTROLLER LAB

**Course Objective:**

- To become skilled in 8086 Assembly Language programming.
- To understand programmable peripheral devices and their Interfacing.
- To understand and learn 8051 microcontroller.
- To learn 8051 assembly Language programming

**Learning Outcome:**

- Able to write8086 Assembly Language programs.
- Able to understand programmable peripheral devices and their Interfacing.
- Able to write 8051 assembly Language programs.

**Minimum Ten Experiments to be conducted (Five from each section)**

**PART A: 8086 Microprocessor Programs using TASM**

1. Introduction to TASM Programming
2. Programs using arithmetic and logical operations
3. Programs using string operations and Instruction prefix: Move Block, Reverse string, Sorting, String comparison
4. Programs for code conversion
5. Multiplication and Division programs
6. Sorting and multi byte arithmetic

**PART B: Embedded C Experiments using MSP430 Microcontroller**

1. Interfacing and programming GPIO ports in C using MSP430 (blinking LEDs, push buttons)
2. Usage of Low Power Modes
3. Interrupt programming examples through GPIOs
4. PWM generation using Timer on MSP430 GPIO

5. Interfacing potentiometer with MSP430

6. PWM based Speed Control of Motor controlled by potentiometer connected to MSP430 GPIO
7. Using ULP advisor in Code Composer Studio on MSP430
8. Low Power modes and Energy trace++

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## (18PC0214) POWER SYSTEM LAB

| VI –SEMESTER | L | T | P | C |
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**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**Minimum Ten Experiments to be conducted (Five from each section)**

**List of experiments:-**

1. Determination of sequence impedances of cylindrical Rotor synchronous machine.
2. Fault Analysis-I (LG FAULT, LL FAULT).
3. Fault Analysis-II (LLG FAULT, LLLG FAULT).
4. Determination of Sub transient reactance's of a salient pole synchronous machine.
5. Equivalent circuit of a 3-Φ three winding transformer.
6. under voltage relay.
7. over voltage relay.
8. Negative sequence Relay.
9. Z-bus building algorithm.
10. Program for swing curve when the fault is cleared.

**ADDITIONAL EXPERIMENTS:**

11. Swing curve for sustained fault and critical clearing angle & time.
12. Mat lab Program to Simulate Ferranti Effect.

# PEC_IV
## (18PE0209) FACTS CONTROLLERS

**VII –SEMESTER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

To make the student learn about:

- To know the basic definitions and different types of Facts controllers and their uses.
- To know about the voltage source converter operation and different modulation techniques with comparison.2
- To improve the stability of power system by Shunt Compensation and Series Compensation with facts controllers.
- To enhance the transient stability and power oscillation damping by SVC and STATCOM.

**COURSE OUTCOMES:**

After the end of this course student will:

- Know the basic definitions and different types of Facts controllers and their uses.
- Know about the voltage source converter operation and different modulation techniques with comparison.
- Improve the stability of power system by Shunt Compensation and Series Compensation with facts controllers.
- Enhancement of the transient stability and power oscillation damping by SVC and STATCOM.

**UNIT-I:**

**FACTS CONCEPTS**

Introduction to FACTS, Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

**UNIT-II:**

**VOLTAGE SOURCE CONVERTERS**

Single & three phase full wave bridge converters, transformer connections for 12, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation, basic concept of current source converters, and comparison of current source converters with voltage source converters.

**UNIT-III:**

**STATIC SHUNT COMPENSATION**

Objectives of shunt compensation, mid-point voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators, hybrid VAR generators.

**UNIT-IV:**

**SVC AND STATCOM**

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

**UNIT-V:**

**STATIC SERIES COMPENSATORS**

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor-controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor-controlled series capacitor (TCSC) Control schemes for GSC, TSSC and TCSC.

**TEXT BOOKS:**


1. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007


**REFERENCES:**


1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

# PEC_IV

## (18PE0210) INDUSTRIAL ELCTRICAL SYSTEMS

| VII –SEMESTER | L | T | P | C |
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| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- At the end of this course, students will demonstrate the ability to
- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and selected proper size of various electrical system components.

**UNIT I: ELECTRICAL SYSTEM COMPONENTS**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

**UNIT II: RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

**UNIT III: ILLUMINATION SYSTEMS**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

**UNIT IV: INDUSTRIAL ELECTRICAL SYSTEMS I**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

**UNIT V: INDUSTRIAL ELECTRICAL SYSTEMS II**

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Industrial Electrical System Automation Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

**TEXT BOOKS/REFERENCE BOOKS**


1. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
3. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4. Web site for IS Standards.
5. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.




**PEC_IV**

**(18PE0211) POWER SYSTEMS AUTOMATION**

| VII –SEMESTER | L | T | P | C |
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| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**

- Understand various components of industrial electrical systems.
- Analyze and selected proper size of various electrical system components.

**UNIT I: INTRODUCTION**

Purpose of automatic power control systems, elements of automatic power control systems, automatic power control and controllers' relays and relaying devices

**UNIT II: OPERATION AND CONTROL**

Operations environment of distribution networks, evolution of distribution management systems, basic dis tribution management system functions, basis of a real-time control system (SCADA), data acquisition, m onitoring and event processing, control functions, data storage, archiving,and analysis, hardware system c onfigurations, SCADA system principles

**UNIT III: DISTRIBUTION AUTOMATION**

Problems with existing distribution system, need for distribution automation, characteristics of distribution system, distribution automation, feeder automation

**UNIT IV: SUBSTATION AUTOMATION**

Definition, functions of substation automation state and trends of substation automation, intelligent afford able substation monitoring and control

**UNIT V: FEEDER AUTOMATION**

Losses in distribution systems, system losses and loss reduction, network reconfiguration, improvement in voltage profile, capacitor placement for reactive power compensation, algorithm for location of capacitor

**TEXT BOOKS:**

1. Automation in Electrical power systems by, P.I. Zabolotny, MIR Publishers, Moscow
2.Control and Automation of Electrical Power Distribution Systems (Power Engineering) James Northcot green James Northcote-Green, Taylor & Francis, 2007
3.A Textbook of Electric Power Distribution Automation By Dr. M.K. Khedkar, Dr. G.M. Dhole, universi ty science press, new delhi2010

**REFERENCE BOOKS:**

1. Sunil S. Rao, Switchgear and Protections, Khanna Publication
2. Stuart A Boyer: SCADA supervisory control and data acquisition
3. Gordan Clark, Deem Reynders, Practical Modem SCADA Protocols

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# PEC_V
# (18PE0212) HVDC Transmission Systems

| VII –SEMESTER | L | T | P | C |
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**Course Objectives:** The objectives of the course are to make the students learn about:

- Technical and economic aspects of HVAC and HVDC transmission and their comparison.

- Static power converters
- Control of HVDC converter systems
- Origin, effects, classification and elimination of harmonics
- The occurrence of faults, and transients in HVDC system and their protection.

**Course Outcomes:** After Completion of Course, the student should be able to:

- Compare HVDC and HVAC transmission systems
- Understand the operation of various converters used in HVDC transmission systems
- Devise means to suppress / eliminate harmonics.
- Design HVDC and AC Filters

**UNIT-I**

**INTRODUCTION TO HVDC TRANSMISSION**

HVDC Transmission: Technical And Economical Comparison of HVAC and HVDC Transmission, Types of DC Links, Power Handling Capabilities of HVDC Lines, static Conversion Principles, Static Converter Configuration.

**UNIT-II**

**STATIC POWER CONVERTER ANALYSIS**

Static Power Converters: 3-Pulse, 6-Pulse & 12-Pulse Converters, Converter Station and Terminal Equipment, Commutation Process, Rectifier and Inverter Operation, Equivalent Circuit for Rectifier, Inverter and HVDC Link- Special Features of Converters.

**UNIT-III**

**CONTROL OF HVDC CONVERTER SYSTEMS**

Control of HVDC Converter Systems: Principle of DC Link Control – Constant Current, Constant Extinction Angle and Constant Ignition Angle Control and Voltage Dependent Current Control. Individual Phase Control and Equidistant Firing Angle Control

**UNIT-IV**

**HARMONICS AND FILTERS**

Origin of Harmonics in HVDC Systems, Classification of Harmonics, Elimination of Harmonics, Suppression Methods, Harmonic Instability Problems, Design of HVDC AC & DC Filters.

**UNIT-V**

**TRANSIENTS, FAULTS AND PROTECTION OF HVDC SYSTEMS**

Origin of over Voltages in HVDC Systems, Over Voltages due to DC and AC Side Line Faults - Converter Faults, Over Current Protection- Valve Group and DC Line Protection. Over Voltage Protection of Converters, Surge Arresters etc.

**TEXT BOOKS:**

1. HVDC Power Transmission Systems, K.R.Padiyar, 3rd Edition, New Age International publishers, 2015.

2. HVDC Transmission, S.Kamakshaiah, V.Kamaraju, Mc Graw Hill Education (India) Pvt. Ltd., 2011.

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## PEC_V

## (18PE0213) WIND AND SOLAR ENERGY SYSTEM

| VII –SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES:**

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

**UNIT 1:**

**PHYSICS OF WIND POWER**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

**UNIT II:**

**WIND GENERATOR**

topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

**UNIT III:**

**THE SOLAR RESOURCE**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

**UNIT IV:**

**SOLAR PHOTOVOLTAIC**

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

**UNIT V: NETWORK INTEGRATION ISSUES**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

**TEXT BOOKS / REFERENCES:**


1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

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**PEC_V**

# (18PE0214) SPECIAL ELECTRICAL MACHINES

| **VII –SEMESTER** | **L** | **T** | **P** | **C** |
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**COURSE OBJECTIVES:**

- To learn about the stepper motor characteristics, operation and speed control.
- To learn about the Variable Reluctance (VR) Stepping Motors characteristics, operation and position control.
- To learn about the Switched mode reluctance motor characteristics, operation and design.
- To learn about the Brushless DC motor and Permanent magnet motor performance prediction and rotor position sensing and learn about double sided linear induction motor.

**COURSE OUTCOMES**:

- Understand the stepper motor characteristics, operation and able to do speed control.
- Understand the Variable Reluctance (VR) Stepping Motors characteristics, operation and able to do Position control.
- Understand the Switched mode reluctance motor characteristics and able to design.

- Get knowledge on Brushless DC motor and Permanent magnet motor performance prediction and rotor Position sensing and learn about double sided linear induction motor.

**UNIT I:**

**STEPPER MOTORS**

Introduction –Synchronous Inductor, Hybrid Stepping Motor, Construction, Principle of Operation, Energization with two phase at a time –Essential conditions for the satisfactory Operation of a 2 –Phase Hybrid Step Motor –Very Slow-Speed Synchronous Motor for Servo Control –Different Configurations for Switching the Phase Windings –Control Circuits for Stepping Motors –An Open –Loop Controller for a 2-Phase Stepping Motor.

**UNIT II:**

**VARIABLE RELUCTANCE (VR) STEPPING MOTORS**

Single –Stack VR step motors, Multiple stack VR motors –Open –Loop Control of 3-Phase VR Step Motor –Closed –Loop Control of Step Motor, Discriminator, Translator, Major loop –Characteristics of Step Motor in Open –Loop Drive –Comparison between Open-Loop Position Control with Step Motor and a Position Control Servo using a Conventional Servo Motor –Suitability and Areas of Application of Stepping Motors,5–Phase Hybrid Stepping Motor, Single –Phase Stepping Motor-The Construction, Operating Principle, Torque developed in the Motor.

**UNIT III:**

**SWITCHED RELUCTANCE MOTOR (SRM)**

Introduction –Improvements in the Design of Conventional reluctance Motors –Some Distinctive Differences between SR and Conventional Reluctance Motors –principle of Operation of SRM –Some Design Aspects of Stator and Rotor Pole Arcs, Design of stator and Rotor and pole Arcs in SR Motor, Determination of $L(\theta)$ –$\theta$ Profile –Power Converter for SR Motor –A Numerical Example -Rotor Sensing Mechanism and Logic Control, Drive and Power Circuits, Position Sensing of rotor with Hall Problems –Derivation of Torque Expression, General, Linear Case.

**UNIT IV: BRUSHLESS DC MOTOR AND PERMANENT MAGNET MATERIALS AND MOTORS**

Types of Construction –Principle of Operation of BLDM –Sensing and Switching Logic Scheme, Sensing, Logic Controller, Lockout Pulses –Drive and Power Circuits, Base Drive Circuit, Power Converter Circuit –Theoretical Analysis and Performance Prediction, Modeling and magnet circuit, d-q analysis of BLDM –Transient Analysis –Formulation in terms of Flux Linkages as State Variables –Approximate Solutions for Current and Torque under Steady State –Theory of BLDM as Variable Speed Synchronous Motor, Rotor position Sensing and Switching Logic for a BLDM for forward and reverse position.

**UNIT V: LINEAR INDUCTION MOTOR**

Development of a Double-sided LIM from Rotary type IM –A Schematic of LIM Drive for Electric Traction –Development of one-sided LIM with back Iron –Field Analysis of a DSLIM: Fundamental Assumptions.

**TEXT BOOKS:**

1. K . Venkata Ratnam, Special Electrical Machines, University Press.

2. R. K. Rajput, Electrical machines, 5thEdition [For Chapters I and II refer Chapter VIII of this book]

3. V. V. Athena, Stepper Motors: Fundamentals, Applications and Design, New Age International Pub.

4. N. Mohan, Undemand & Robbins, Power Electronics Converters, Applications & Design.

5. Johan E. Gibson and F. B. Tauter, Control System Components.6. M. G. Say & E. O. Taylor, D. C. Machines

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## PEC_VI
## (18PE0215) HIGH VOLTAGE ENGINEERING

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objective:**

To understand the various types of over voltages in power system and protection methods.

- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

**Course Outcome**:

- Ability to understand and analyze power system operation, stability, control and protection

**UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltage, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

**UNIT II DIELECTRIC BREAKDOWN**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

**UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

**UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

**UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

**Text Books:**

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013..

2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.

3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

**Reference Books:**

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.

2. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

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# OEC _III
# (18OE0402)VLSI DESIGN

| VII –SEMESTER | L | T | P | C |
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**Course Objectives:**

- To understand VLSI circuit design processes.
- To understand basic circuit concepts and designing Arithmetic Building Blocks.
- To have an overview of Low power VLSI.

**Course Outcomes:**

- Complete Knowledge about Fabrication process of ICs
- Able to design VLSI circuits as per specifications given.
- Capable of optimizing the design of Arithmetic / logic building Blocks at all levels of Design/Fabrication.
- Can implement circuit through various design styles (semi- Custom, Full Custom)

**UNIT-I**

**Introduction:** Basic steps of IC fabrication, PMOS, NMOS, CMOS & BiCMOS, and SOI process technologies, MOS transistors - MOS transistor switches – Basic gate using switches, working polar transistor Resistors and Capacitors.

**Basic Electrical Properties of MOS and BiCMOS Circuits:** Working of MOS transistors – threshold voltage; MOS design equations: **Ids–Vds** relationships, Threshold Voltage, Body effect, Channel length modulation , **gm**, **gds**, figure of merit **ω0**; Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Various pull ups loads, Bi-CMOS Inverters.

**UNIT-II**

**Basic Circuit Concepts:** Capacitance, resistance estimations- Sheet Resistance Rs, MOSDivice Capacitances, routing Capacitance, Analytic Inverter Delays, Driving large Capacitive Loads, Fan-in and fan-out.

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

**UNIT-III**

**Gate level Design:** Logic gates and other complex gates, Switch logic, Alternate gate circuits.

**Physical Design:** Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing

**UNIT-IV**

**Subsystem Design**: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters, High Density Memory Elements.

**VLSI Design styles**: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.

**UNIT-V**

**VHDL Synthesis:** VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools.

**Test and Testability:** Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

**TEXT BOOKS**:

1. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, “Essentials of VLSI circuits and systems”, PHI, 2013 Edition.
2. K.Lal Kishore and V.S.V. Prabhakar, “VLSI Design”, IK Publishers

**REFERENCES:**

1. Weste and Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education,1999.
2. Wayne Wolf, “Modern VLSI Design”, Pearson Education, 3rd Edition, 1997.
3. John P. Uyemura, “Chip Design for Submicron VLSI: CMOS layout and Simulation”, Thomson Learning.
4. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John wiley, 2003.
5. John M. Rabaey, “Digital Integrated Circuits”, PHI, EEE, 1997.

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**OEC_III**

**(18OE0511) DATABASE MANAGEMENT SYSTEMS**

| B.Tech | VII SEMESTER | L | T | P | C |
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| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- To understand and use data manipulation language to query, update, and manage a database
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

**Course Outcomes:**

- For a given query write relational algebra expressions for that query and optimize the developed expressions
- For a given specification of the requirement design the databases using E_R method and normalization.
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
- Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

**UNIT- I**

**Introduction**: Database System Applications, Purpose of Database Systems, View of Data - Data Abstraction, Data Independence , Data Models, Database Languages - DDL, DML, Database Architecture, Database Users and Administrators.

**Introduction to Data base design**: ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Conceptual Design with the ER Model.

**Relational Model: Integrity** Constraints over Relations, Logical data base Design, Introduction to Views destroying/ altering Tables and Views.

**UNIT- II**

**Relational Algebra and Calculus:** Relational Algebra - Selection and Projection, Set operations, Renaming, Joins, Division, Examples of Algebra Queries, Relational calculus - Tuple relational Calculus - Domain relational calculus.

**Form of Basic SQL Query-** Examples of Basic SQL Queries, Introduction to Nested Queries, Correlated Nested Queries, Set - Comparison Operators, Aggregate Operators, NULL values - Comparison using Null values - Logical connectives - AND, OR and NOT - Outer Joins, Triggers.

**UNIT -III**

**Introduction to Schema Refinement-** Problems Caused by redundancy, Functional Dependencies, Armstrong's axioms, Normal Forms - FIRST, SECOND, THIRD Normal forms - BCNF - Properties of Decompositions- Loss less join Decomposition, Dependency preserving Decomposition - FOURTH Normal Form, FIFTH Normal form.

**UNIT- IV**

**Transaction Management:** Transaction Concept, Transaction State, ACID Property, Serializability, Recoverability.

**Concurrency Control:** Lock - Based Protocols, Timestamp Based Protocols, Validation - Based Protocols, Multiple Granularities.

**Recovery System:** Log - Based Recovery, Buffer Management, Remote Backup systems.

**UNIT- V**

**Storage strategies and Indexing:** RAID Levels, Indices.

**Tree Structured Indexing:** Indexed Sequential Access Methods (ISAM) B+ Trees: Search, Insert, Delete.

**Hash Based Indexing:** Static Hashing, Extendable hashing, Linear Hashing, Extendible vs. Linear Hashing.

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models

**TEXT BOOKS:**

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, McGrawHill Education, 3rd Edition, 2003.
2. Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition, 2006.

**REFERENCE BOOKS:**

1. Database Systems, 6th edition, RamezElmasri, Shamkat B. Navathe, Pearson Education, 2013.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. Database Systems Concepts, Peter Rob & Carlos Coronel, Cengage Learning, 2008.
4. Introduction to Database Systems, C.J. Date, Pearson Education.
5. Database Management Systems, G.K. Gupta, McGraw Hill Education.

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# OEC_III

## (18OE0205) DESIGN AND ESTIMATION OF ELECTRICAL SYSTEMS

| VII –SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES:**

At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

**UNIT 1:**

**INTRODUCTION:**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT 2:**

**TRANSFORMERS**:

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT 3:**

**INDUCTION MOTORS**:

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT 4:**

**SYNCHRONOUS MACHINES:**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

**UNIT 5:**

**COMPUTER AIDED DESIGN (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

**TEXT / REFERENCES:**


1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.

2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

# OEC_IV
## (18OE0401) IMAGE PROCESSING

| VII –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

• To know the fundamentals of Image Processing

• To know about various techniques of image enhancement, reconstruction and image compression.

**Course Outcomes:**

• Able to apply the Image processing concept for various fields of engineering and real life to process as per needs &specifications.

• Get the skills to heuristically develop new techniques to process images of any context

• Can experiment, analyze & interpret image data /processing data.

**UNIT–I**

Introduction to Digital Image processing – Example fields of its usage- Image sensing and Acquisition – image Modeling - Sampling, Quantization and Digital Image representation - Basic relationships between pixels, - Mathematical tools/ operations applied on images - imaging geometry.

**UNIT–II**

2D Orthogonal and Unitary Transforms and their properties - Fast Algorithms - Discrete Fourier Transform - Discrete Cosine Transforms- Walsh- Hadamard Transforms- Hoteling Transforms , Comparison of properties of the above.

**UNIT–III**

Background enhancement by point processing Histogram processing, Spatial filtering, Enhancement in frequency Domain, Image smoothing, Image sharpening, Color image Enhancement

**UNIT–IV** Degradation model, Algebraic approach to restoration – Inverse filtering – Least Mean Square filters, Constrained Least square restoration and Blind De convolution. Image

segmentation: Edge detection - Edge linking, Threshold based segmentation methods – Region based Approaches - Template matching –use of motion in segmentation

**UNIT–V**

Redundancies in Images - Compression models, Information theoretic perspective- Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, run length coding, Transform coding, Image Formats and compression standards.

**Text Books:**

1. R.C .Gonzalez & R.E. Woods, “Digital Image Processing”, Addison Wesley/Pearson education, 3rd Edition, 2010.

2. A .K. Jain, “Fundamentals of Digital Image processing”, PHI.

**References:**

1. Rafael C. Gonzalez, Richard E woods and Steven L.Eddins, “Digital Image processing using MATLAB”, Tata McGraw Hill, 2010.

2. S jayaraman, S Esakkirajan, T Veerakumar, “Digital Image processing”,Tata McGraw Hill

3. William K. Pratt, “Digital  Image Processing”, John Wilely, 3rd Edition, 2004.

# OEC_IV
# (18OE0206) SMART GRID TECHNOLOGIES

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech** | **3** | **0** | **0** | **3** |

**VII –SEMESTER**

**Course Objectives:**

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

**Course Outcomes:**

Upon the completion of the subject, the student will be able to

- Understand technologies for smart grid
- Appreciate the smart transmission as well distribution systems
- Realize the distribution generation and smart consumption
- Know the regulations and market models for smart grid

**UNIT – I: INTRODUCTION TO SMART GRIDS**

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

**UNIT – II: SMART TRANSMISSION TECHNOLOGIES**

Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

**UNIT – III: SMART DISTRIBUTION TECHNOLOGIES**

Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

**UNIT – IV: DISTRIBUTED GENERATION AND SMART CONSUMPTION**

Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes /

buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid

**UNIT – V: Regulations And Market Models For Smart Grid**

Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.

**TEXT BOOKS:**

**1.**Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009. **2.**Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

**REFERENCES:**

- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.
- India Smart Grid Knowledge Portal

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# OEC_IV
## (18OE0509)-COMPUTER NETWORKS

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| **B.Tech** | **3** | **0** | **0** | **3** |

**VII –SEMESTER**

**Course Objectives:**

- To understand the concepts of computer networks fundamentals.
- Study the concepts of computer networks from layered perspective.
- Illustrate the issues open for research in computer Networks.

**Course Outcomes:**

- Ability to select transmission media for effective communication.
- Develop applications using computer networks.
- Able to configure a computer network logically.
- Ability to design new protocols for computer network.

**UNIT I**

**Introduction:** Networks, Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP Protocol Suite, OSI Model

**Transmission Media**: Guided and Unguided Media, Switching: Circuit Switching, Packet Switching, Structure of a Switch.

**UNIT II**

**Data link layer:** Introduction, Link-Layer Addressing, Error detection and Correction: Cyclic codes, Checksum, Forward Error Correction.

**Data Link Control:** DLC Services, Data Link Layer Protocols, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access, and Channelization.

**UNIT-III**

**Network layer:** Network Layer Design Issues, Network Layer Services, Routing Algorithms, Congestion Control, IPV4 Addressing, IPV6 Addressing, IPV6 Protocol,Routing Information Protocol, OSPF,BGP, IGMP.

**UNIT IV**

**Transport layer:** Introduction, Transport-Layer Protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Cryptography and Network Security: Introduction, Confidentiality, Aspects of Security.

**UNIT V**

**Application layer:** Introduction, Client-server Programming, WWW and HTTP, FTP, E-Mail, TELNET, Secure Shell, Domain name system, SNMP.

**Text Books:**

1. Data communications and networking‖, Behrouz A. Forouzan, McGraw Hill Education, 5th edition, 2012.

2. “Computer Networks” Andrew S.Tanenbaum, Wetherill, Pearson,5th edition,2010.

**References:**

1. Data Communication and Network, Bhusan Trivedi, Oxford

2. “Internetworking with TCP/IP-Principles, Protocols and architecture – volume 1, Douglas E. Comer, 5th edition, PHI

3. “Computer Networks”, 5E , Peterson ,Davie, Elsevier.

4. “Introduction to Computer Networks and Cyber Security”, Chawan –Hwa Wu, Irwin, CRC Publications.

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## DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

## (18PC0215) SIMULATION-I LABORATORY

**VII –SEMESTER**

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**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**LIST OF EXPERIMENTS:**

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

**ADDITIONAL EXPERIMENTS:**

11. Load flow analysis of a given power system with STATCOM
12. Transient analysis of single machine infinite bus system with STATCOM

| VII –SEMESTER | L | T | P | C |
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# (18PC0216)SIMULATION-II LABORATORY

**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**LIST OF EXPERIMENTS:**

1. a). ABCD parameters for t network
   b). ABCD parameters for long transmission network
2. a). Formation of y- bus using singular transformation method with and without mutual coupling
   b).Formation of 'Y- BUS' by inspection method
3. Z-bus building algorithm
4. Determination of power angle curve for non- salient pole synchronous machines
5. Determination of power angle curve salient pole synchronous machines
6. Program for swing curve when the fault is cleared
7. Swing curve for sustained fault and critical clearing angle & time
8. Formation of jacobian for the system not exceeding 4 buses (no pv buses) in polar coordinates
9. Gauss-seidel method
10. Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile.

**ADDITIONAL EXPERIMENTS:**

11. Formation for symmetric π /T configuration for Verification of $AD-BC=1$, Determination of Efficiency and Regulation.
12. Formation of Jacobian for a System not Exceeding 4 Buses (No PV Buses) in Polar Coordinates

# (18M00112) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

| B.Tech | V SEMESTER | L | T | P | C |
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**PRE-REQUISITES: NIL**

**Course Objective:**

The objective of this course is to equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to enrich analytical skills in helping them take sound financial decisions for achieving higher productivity.

**Course Outcome**:

The thorough understanding of Managerial Economics and Analysis of Financial Statements facilitates the Technocrats – cum – Entrepreneurs to take-up decisions effectively and efficiently in the challenging Business Environment.

**UNIT I**

**INTRODUCTION TO MANAGERIAL ECONOMICS**

Managerial Economics - Definition, nature and scope –Role of Managerial Economics in Business Decisions- Demand Analysis: Determinants- Law of Demand - Elasticity of Demand. Significance – types – measurement of elasticity of demand - Demand forecasting- factors governing

Demand forecasting- methods of demand forecasting

**UNIT II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

Production Function – Short-run and long- run production - Isoquants and Isocosts, MRTS, least cost Combination of inputs - - laws of returns - Internal and External Economies of scale - **Cost Analysis**: Cost concepts- Time Value of Money - Break-Even Analysis (BEA) – Managerial Significance and limitations of BEA - Determination of Break Even Point (Simple Problems)

**UNIT III**

**INTRODUCTION TO MARKETS AND FORMS OF BUSINESS ORGANIZATIONS**

Market structures: Types of Markets - Perfect and Imperfect Competition - Features, Oligopoly - Monopolistic competition. Price-Output determination - Pricing Methods and Strategies. Forms of Business Organization – Sole Proprietorship- Partnership – Joint Stock Companies –National Income: Concepts- Inflation: Types – Business Cycle: Phases of business cycle

**UNIT IV**

**INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Financial Accounting – Concept - emerging need and importance - Double-Entry Book Keeping-Journal - Ledger – Trial Balance - Financial Statements - - Trading Account – Profit & Loss Account – Balance Sheet (with simple adjustments). Financial Analysis – Ratios – Techniques –Liquidity, Leverage, Profitability, and Activity Ratios (simple problems).

**UNIT V**

**CAPITAL AND CAPITAL BUDGETING**

Concept of Capital - Sources of Short term and Long term capital - Estimating Working Capital requirement – Capital budgeting – Features of Capital budgeting proposals – Methods and Evaluation of Capital budgeting – Pay Back Method –Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

**Text Books:**

1. Aryasri: Managerial Economics and Financial Analysis, 4/e, TMH, 2009.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.

**Reference Books:**

1. Premchand Babu, Madan Mohan:Financial Accounting and Analysis,Himalaya, 2009
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International,. 2009.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2009.
5. H.L.Ahuja: Managerial Economics, S.Chand, 3/e, 2009
6. Gupta G.S., Managerial Economics, TaTa Mc Gra Hill
7. Joel Dean, Managerial Economics, Prentice Hall

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**PRE-REQUISITES: NIL**

**Course Outcomes**: At the end of this course, students will demonstrate the ability to

- Understand the concepts of power generating systems.
- Understand the various economic aspects of power generation.
- Computation of the parameters of a Transmission line
- Understand the concept of performance of Transmission lines
- Understand concepts of travelling wave phenomenon on transmission lines

**UNIT I**

**POWER GENERATING SYSTEMS**

Structure of a power system. Block Diagram of Thermal Power Station (TPS) showing paths of Coal, Steam, Water, Air, Ash and Flue Gasses - Brief Description of TPS Components: Economizers, Boilers, Super Heaters, Turbines, Condensers, Chimney and Cooling Towers.

**Hydro Power**: Selection of Site, Classification, Layout, Description of Main Components.

**Nuclear Power:** Nuclear Fission and Chain Reaction.- Nuclear Fuels.- Principle of Operation of Nuclear Reactor.-Reactor Components: Moderators, Control Rods, Reflectors and Coolants.- Radiation Hazards: Shielding and Safety Precautions.- Types of Nuclear Reactors and Brief Description of PWR, BWR and FBR.

**UNIT II**

**ECONOMIC ASPECTS OF POWER GENERATION**

Load Curve, Load Duration and Integrated Load Duration Curves-Load Demand, Diversity, Capacity, Utilization and Plant Use Factors- Numerical Problems. Costs Of Generation and their Division Into Fixed, Semi-Fixed and Running Costs. Tariff Methods: Desirable Characteristics of a Tariff Method.- Flat Rate, Block-Rate, Two-Part, Three –Part, and Power Factor Tariff Methods and Numerical Problems.

**UNIT III**

**TRANSMISSION LINE PARAMETERS**

Overhead Transmission Lines and Cables: Types of Conductors – ACSR, Bundled and Stranded Conductors- Resistance For Solid Conductors – Skin Effect- Calculation of Inductance for Single Phase and Three Phase, Single and Double Circuit Lines, Concept of GMR & GMD, Symmetrical and Asymmetrical Conductor Configuration with and without Transposition, Numerical Problems, Capacitance Calculations for Symmetrical and Asymmetrical Single and Three Phase, Single and Double Circuit Lines, Effect of Ground on Capacitance, Numerical Problems

**UNIT IV**

**MECHANICAL DESIGN OF TRANSMISSION LINES**

Overhead Line Insulators: Types of Insulators, String Efficiency and Methods for Improvement, Capacitance Grading and Static Shielding. Corona: Corona Phenomenon, Factors Affecting Corona, Critical Voltages and Power Loss, Radio Interference. Sag and Tension Calculations: Sag and Tension

Calculations with Equal and Unequal Heights of Towers, Effect of Wind and Ice on Weight of Conductor, Stringing Chart and Sag Template and Its Applications, Numerical Problems.

**UNIT V**

**POWER SYSTEM TRANSIENTS & TRAVELLING WAVES**

Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of Lines with Different Types of Conditions - Open Circuited Line, Short Circuited Line, T-Junction, Lumped Reactive Junctions (Numerical Problems). Bewley"s Lattice Diagrams (for all the cases mentioned with numerical examples).

**Text/References:**


1. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014
2. Electric Power Generation Distribution and Utilization by C.L Wadhwa, New Age International (P) Ltd., 2005.
3. Power System Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
4. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, " Electric Power Systems" , Wiley, 2012

| B.Tech | V SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES:**

To make the students learn about:

- Merits and demerits of open loop and closed loop systems; the effect of feedback
- The use of block diagram algebra and Mason's gain formula to find the effective transfer function
- Transient and steady state response , time domain specifications
- The concept of Root loci
- Frequency domain specifications, Bode diagrams and Nyquist plots
- The fundamental aspects of modern control

**COURSE OUTCOMES**:

After completing the course, the student should be able to do the following:

- Evaluate the effective transfer function of a system from input to output using (i) block diagram reduction techniques (ii) Mason's gain formula
- Compute the steady state errors and transient response characteristics for a given system and excitation
- Determine the absolute stability and relative stability of a system
- Draw root loci
- Derive state space model of a given physical system and solve the state equation

**UNIT – I**

**INTRODUCTION**

Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback Characteristics, Effects of positive and negative feedback. Mathematical models – Differential equations of Translational and Rotational mechanical systems, and Electrical Systems, Block diagram reduction methods – Signal flow graph - Reduction using Mason's gain formula. Transfer Function of DC Servo motor - AC Servo motor - Synchro transmitter and Receiver

**UNIT-II**

**TIME RESPONSE ANALYSIS**

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

**UNIT – III**

**STABILITY**

The concept of stability – Routh's stability criterion – Stability and conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

**UNIT – IV**

**FREQUENCY RESPONSE ANALYSIS**

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain margin-Stability Analysis.

**UNIT – V**

**STATE SPACE ANALYSIS**

Concepts of state, state variables and state model, derivation of state models from differential equations. Transfer function models. Block diagrams. Diagonalization. Solving the Time invariant state Equations-State Transition Matrix and it's Properties. System response through State Space models.

**TEXT BOOKS:**


1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007.


**REFERENCE BOOKS:**


1. Control Systems Principles & Design 4th Edition, M.Gopal, Mc Graw Hill Education, 2012.
2. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son's, 8th edition, 2003.
3. Control Systems 3rd Edition, Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, Schaum's Mc Graw Hill Education.
4. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.

# (18PC0210) MEASUREMENTS AND INSTRUMENTATION

| B.Tech | V SEMESTER | L | T | P | C |
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**Course Objectives**: The objectives of the course are to make the student learn about

- The basic principles of different types of electrical instruments for the Measurement of voltage, current, power factor, power and energy.
- The measurement of R, L, and C parameters using bridge circuits.
- The principle of working of CRO and its applications.
- Characteristics of signals, their representation, and signal modulation techniques
- Several types of transducers and their use for measurement of non-electrical quantities

**COURSE OUTCOMES:**

- The student should have learnt how to

  Use wattcmeters, pf meters, and energy meters in a given circuit.
- Extend the range of ammeters and voltmeters
- Measure active power, reactive power, power factor, and energy in both 1-phase and 3-phase circuits
- Determine the resistance values of various ranges, L and C values using appropriate bridges.
- Analyze the different characteristic features of periodic, and a periodic signals using CRO.
- Analyze different types of data transmission and acquisition and measure strain value

**UNIT- I**

**MEASURING INSTRUMENTS**

Classification – Ammeters and Voltmeters – PMMC, Dynamometer, Moving Iron Type Instruments – Expression for the Deflecting Torque and Control Torque – Errors and Compensations, Range Extension. Cathode Ray Oscilloscope- Cathode Ray tube-Time base generator-Horizontal and Vertical Amplifiers – Applications of CRO – Measurement of Phase , Frequency, Current & Voltage- Lissajous Patterns

**UNIT – II**

**D.C & A.C BRIDGES**

Methods of Measuring Low, Medium and High Resistances – Sensitivity of Wheatstone‟s Bridge – Kelvin‟s Double Bridge for Measuring Low Resistance, Measurement of High Resistance – Loss of Charge Method. Measurement of Inductance - Maxwell‟s Bridge, Anderson‟s Bridge. Measurement of Capacitance and Loss Angle - Desauty Bridge. Wien‟s Bridge – Schering Bridge.

**UNIT – III**

**MEASUREMENT OF POWER AND ENERGY & POTENTIOMETER**

Single Phase Dynamometer Wattmeter, LPF and UPF, Double Element and Three Element Dynamometer Wattmeter, Expression for Deflecting and Control Torques. Types of P.F. Meters – Dynamometer and Moving Iron Type – 1-ph and 3-ph Meters. Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and Compensations. Three Phase Energy Meter Potentiometers: Principle and Operation of D.C. Crompton‟s Potentiometer –Standardization – Measurement of unknown Resistance, Current, Voltage. Standardization – Applications.

**UNIT-IV**

**CHARACTERISTICS OF SIGNALS & DATA TRANSMISSION , TELEMETRY AND DAS**

. Signals and Their Representation: Standard Test, Periodic, Aperiodic, Modulated Signal, Sampled Data, Pulse Modulation and Pulse Code Modulation. Methods of Data Transmission – General Telemetry System. Frequency Modulation (FM), Pulse Modulation (PM), Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM) Telemetry. Comparison of FM, PM, PAM and PCM. Analog and Digital Data Acquisition Systems – Components of Analog DAS – Types of Multiplexing Systems: Time Division and Frequency Division Multiplexing – Digital DAS – Block Diagram — Modern Digital DAS (Block Diagram)

**UNIT-V**

**TRANSDUCERS**

Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle of Operation of Resistive, Inductive, Capacitive Transducers, LVDT, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, Synchros, Piezoelectric Transducers, Photovoltaic, Photo Conductive Cells, Photo Diodes.

**TEXT BOOKS**:

1. Electrical & Electronic Measurement & Instruments, A.K.Sawhney and Dhanpat Rai & Co. Publications, 2011, Reprint 2014.

2.Electrical Measurements and measuring Instruments 5thEdition, E.W. Golding and F.C. Widdis, Reem Publications, 5th Edition, 2011.

**REFERENCE BOOKS:**

1. Electronic Instrumentation, 3rd Edition, H. S. Kalsi, Tata Mcgrawhill, 2011.

2. Electrical Measurements, Buckingham and Price, Prentice Hall, 1970.

3. Electrical Measurements: Fundamentals, Concepts, Applications, Reissland, M.U., New Age International (P) Limit

# PEC_I

## (18PE0201) Electrical Drives

| B.Tech | V SEMESTER | L | T | P | C |
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**Course Objectives:**

At the end of this course, students will demonstrate the ability to

Understand the characteristics of dc motors and induction motors.

- Understand the principles of speed-control of dc motors and induction motors.
- Understand the power electronic converters used for dc motor and induction motor speed control.

**Course Outcomes:** The student should be able to:

- Identify the choice of the electric drive system based on their applications
- Explain the operation of single and multi quadrant electric drives
- Analyze single phase and three phase rectifiers fed DC motors as well as chopper fed DC motors
- Explain the speed control methods for AC-AC & DC-AC converters fed to Induction motors and Synchronous motors with closed loop, and open loop operations

**UNIT – I**

**CONVERTER FED DC MOTORS**

Classification of Electric Drives, Basic elements of Electric Drive, Dynamic Control of a Drive system, Stability analysis, Introduction to Thyristor Controlled Drives, Single Phase, Three Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited and D.C Series Motors – Continuous Current Operation – Output Voltage and Current Waveforms – Speed and Torque Expressions – Speed – Torque Characteristics- Problems.

**UNIT – II**

**FOUR QUADRANT OPERATION OF DC DRIVES**

Introduction to Four Quadrant Operation – Motoring Operations, Electric Braking – Plugging, Dynamic and Regenerative Braking Operations. Four Quadrant Operation of D.C Motors by Dual Converters – Closed Loop Operation of DC Motor (Block Diagram Only)

**UNIT – III**

**CHOPPER FED DC MOTORS** Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited and Series Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics – Problems on Chopper Fed D.C Motors

**UNIT – IV CONTROL OF INDUCTION MOTOR**

Induction Motor Stator Voltage Control and Characteristics. AC Voltage Controllers – Waveforms – Speed Torque Characteristics - Stator Frequency Control and Characteristics. Voltage Source and Current Source Inverter - PWM Control – Comparison of VSI and CSI Operations – Speed Torque Characteristics – Numerical Problems on Induction Motor Drives – Closed Loop Operation of Induction Motor Drives (Block Diagram Only) – Principles of Vector Control Static Rotor Resistance Control – Slip Power Recovery – V/f control of Induction Motor – Their Performance and Speed Torque Characteristics – Advantages- Applications – Problems

**UNIT – V**

**CONTROL OF SYNCHRONOUS MOTORS** Separate Control & Self Control of Synchronous Motors – Operation of Self Controlled Synchronous Motors by VSI and CSI Cycloconverters. Load Commutated CSI Fed Synchronous Motor – Operation – Waveforms – Speed Torque Characteristics – Applications – Advantages and Numerical Problems – Closed Loop Control Operation of Synchronous Motor Drives (Block Diagram Only), Introduction to variable frequency control.

**TEXT BOOKS:**

1. Power semiconductor controlled drives, G K Dubey, Prentice Hall, 1995.
2. Modern Power Electronics and AC Drives, B.K.Bose, PHI, 2002.

**REFERENCE BOOKS:**

1. Power Electronics, MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company, 2008.
2. Power Electronic Circuits, Devices and applications, M.H.Rashid, PHI, 2005.
3. Electric drives Concepts and Applications, Vedam Subramanyam, Tata McGraw Hill Publications, 2nd Edition, 2011.

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**PEC_I**

# (18PE0202) ENERGY AUDITING AND CONSERVATION

| B.Tech | V SEMESTER | L | T | P | C |
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**Course objective:** To know the necessity of conservation of energy

- To generalize the methods of energy management
- To illustrate the factors to increase the efficiency of electrical equipment
- To detect the benefits of carrying out energy audits.

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- Tell energy audit of industries
- Predict management of energy systems
- Sequence the methods of improving efficiency of electric motor
- Analyze the power factor and to design a good illumination system
- Determine pay back periods for energy saving equipment

**UNIT- I:**

**Basic Principles of Energy Audit:**

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT- II:**

**Energy Management:**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

**UNIT- III:**

**Energy Efficient Motors:**

Energy efficient motors, factors affecting efficiency, loss distribution , constructional details , characteristics – variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

**UNIT- IV:**

**Power Factor Improvement, Lighting and Energy Instruments:**

Power factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice,

lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

**UNIT- V:**

**Economic Aspects and Analysis:**

Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .

**TEXT BOOKS:**

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.

2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998

**REFERENCES:**

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-

2. Energy management hand book by W.C.Turner, John wiley and sons

3. Energy management and good lighting practice : fuel efficiency- booklet 12-EEO

**PEC_I**

# (18PE0203) SENSORS AND SIGNAL CONDITIONING

| B.Tech | V SEMESTER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the basics of measurements.
- To elucidate sensors and signal conditioning circuits.
- To introduce different error analysis methods.
- To familiarize with different sensors and transducers.
- To explain signal conditioning circuits.

**Course Outcomes (CO):** After the completion of the course student will be able to:

- Apply different methods for the measurement of length and angle
- Elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
- Explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
- Ability to analyze, formulate and select suitable sensor for the given industrial applications
- Describe signal conditioning circuits

**UNIT-I**

**Introduction**: Definition, Application and types of measurements, Instrument classification, Functional elements of an instrument, Input-output configuration of measuring instruments, Methods of correction for interfering and modifying inputs, Standards, Calibration, Introduction to Static characteristics and Dynamic characteristics, Selection of instruments, Loading effects.

**UNIT-II**

**Error Analysis:** Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, General consideration in data analysis, Design of Experiment planning.

**UNIT-III**

**Sensors/Transducers:** Definition, Types, Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance. Fiber optic sensors, Bio-chemical sensors, Hall-Effect, Photo emissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge Digital transducers: Principle, Construction, Encoders, Absolute and incremental encoders, Silicon micro transducers.

**UNIT-IV**

**Signal Conditioning**: Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.

**UNIT-V:** Measurement of Linear Displacement, Angular displacement, Temperature, Light intensity, Capacitance, Resistance, Inductance.

**Text Books:**

1. Doebelin, E.O. and Manic, D.N., Measurement Systems: Applications and Design, McGrawHill (2004).

2. Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai (2008).

**Reference Books:**

1. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).

2. Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, TMH (2003)

**OEC_I**

# (18OE0201) ELECTRICAL MATERIALS

| B.Tech | V SEMESTER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To clarify the students on insulating, conducting & magnetic materials.
- To impart knowledge on the Physical, Electrical & Mechanical properties
- To impart knowledge on practical uses of various materials in different areas.

**UNIT_I**

**Introduction**

Introduction-Resistivity, factors affecting resistivity-Classification of conducting materials into low-resistivity and high resistivity materials-Low Resistivity Materials and their Applications-Copper, Silver, Gold, Aluminum, Steel, Stranded conductors, Bundled conductors, Low resistivity copper alloys, High Resistivity Materials a -Tungsten, Carbon, Platinum, Mercury, Superconducting materials, Application of superconductor materials

**UNIT-II**

**Semiconducting Materials:**

Introduction_, Semiconductors, Electron Energy and Energy Band Theory , Excitation of Atoms , Insulators, Semiconductors and Conductors , Semiconductor Materials, Covalent Bonds, Intrinsic Semiconductors, Extrinsic Semiconductors, N-Type Materials , P-Type Materials ,Minority and Majority Carriers, Semi-Conductor Material. Applications of Semiconductor materials-Rectifiers , Temperature-sensitive resisters or thermostats, Photoconductive cells , Photovoltaic cells, Varistors , Transistors, Hall effect generators ,Solar power

**UNIT-III**

**Insulating Materials:**

Introduction, General properties of Insulating Materials_ Electrical properties , Visual properties , Mechanical properties ,Thermal properties, Chemical properties, Ageing, Insulating Materials – Classification, properties, applications, Introduction, Classification of insulating materials on the basis physical and chemical structure, Insulating Gases_ Introduction, Commonly used insulating gases

**UNIT-IV**

**Dielectric Materials:**

Introduction, Dielectric Constant of Permittivity, Polarization, Dielectric Loss, Electric Conductivity of Dielectrics and their Break Down, Properties of Dielectrics, Applications of Dielectrics

**UNIT-V**

**Magnetic Materials:**

Introduction , Classification - Diamagnetism , Para magnetism , Ferromagnetism , Magnetization Curve, Hysteresis, Eddy Currents , Curie Point , Magneto-striction, Soft and Hard magnetic Materials ,Soft magnetic materials , Hard magnetic materials

**Text Books:**


1. Title of the Book Name of Publisher 1 K.B.Raina, S.K. Bhattacharya, T. Joneja Electrical Engg. Material & Electronic components S. K. Kataria & Sons
2. R.K.Shukla, Archana Singh Electrical Engineering Materials Mc Graw Hill

# OEC_I

## (18PC0411) ANALOG & DIGITAL COMMUNICATIONS

| B.Tech | V SEMESTER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

- Analyze and compare different analog modulation schemes for their efficiency and bandwidth
- Analyze the behavior of a communication system in presence of noise
- Investigate pulsed modulation system and analyze their system performance
- Analyze different digital modulation schemes and can compute the bit error performance

**UNIT-I**

Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

**UNIT-II**

Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

**UNIT-III**

**Pulse modulation**. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. Delta modulation, Differential PCM (DPCM), Processing gain, Adaptive DPCM (ADPCM), Comparison of the above systems.

**UNIT-IV**

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with Waveforms- Probability of Error evaluations. Base band Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

**UNIT-V**

**INFORMATION THEORY**

Measure of information, Source Encoding - Huffman coding, Shanon-Fano Coding; Error Free Communication over Noisy Channel.

**ERROR CORRECTION CODES** Introduction, Linear Block codes, Cyclic Codes, Convolution Codes, Comparison of Coded and Un coded Systems.

**TEXT BOOKS:**

1. H. Taub and D. Schilling, Principles of Communication Systems, TMH, 2nd Edition, 2003.

2. B.P.Lathi, Modern Digital and Analog Communication Systems, Oxford reprint, 3rd Edition, 2004.

**REFERENCE BOOKS:**

1. Simon Haykin, Digital communications, John Wiley, 2005.

2. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley, 2005. 3. R.P Singh and S.D Sapre, Communication Systems Analog and Digital, TMH, 2nd Edition, 2007

**OEC -1**

# (18OE0202) POWER ELECTRONIC CONVERTERS

| B.Tech | V semester | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:-**Students will be able to:

- Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.
- Understand the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality.

**Course Outcomes:-** Students will be able to:

- To give a systematic approach for transient and steady state analysis of all power electronic converters with passive and active loads.
- To know and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.

**Unit-I:**

Analysis of power semiconductor switched circuits with R, L, RL, RC loads-D.C. motor load. Battery charging circuit.

**Unit-II:**

Single-Phase and Three-Phase AC to DC converters.-Half controlled configurations-operating domains of three phase full converters and semi-converters. Reactive power considerations.

**Unit-III:**

Analysis and design of DC to DC converters.-Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converters, Cuk converters.

**Unit-IV:**

Single phase and three phase inverters.-Voltage source and Current source inverters.-Voltage control and harmonic minimization in inverters.

**Unit-V:**

AC to AC power conversion using voltage regulators.-Choppers and cyclo-converters. -Consideration of harmonics, introduction to Matrix converters. Design aspects of converters, Few practical applications. .

**Refernces**

1. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design”, John’s Wiley and sons. Inc, Newyork.
2. M.H.Rashid, “Power Electronics”, Prentice Hall of India 1994

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# (18PC0211) CONTROL SYSTEMS & SIMULATION LABORATORY

| B.Tech | V semester | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1.5 |

**COURSE OBJECTIVES:-**

The objectives of this lab course are to make the student practically learn about

- The effects of feedback on system performance
- Determination of transfer functions of DC Machine.
- The design of controllers to achieve desired specifications.
- The characteristics of servo mechanisms used in automatic control applications.

**Any Eight of the following experiments are to be conducted:**

1. Time Response of Second Order System
2. Characteristics of Synchros
3. Programmable Logic Controller – Study and Verification of Truth Tables of Logic Gates, Simple Boolean Expressions and Application of Speed Control of Motor.
4. Effect of P, PD, PI, PID Controller on a Second Order System.
5. Characteristics of Magnetic Amplifier
6. Temperature Controller Using PID
7. State Space Model for Classical Transfer Function Using MATLAB – Verification.
8. Stability Analysis Bode Plot of Linear Time Invariant System Using MATLAB

**In addition to the above six experiments, at least any two of the experiments from the following list are required to be conducted**:

1. Stability Analysis Root Locus of Linear Time Invariant System Using MATLAB
2. Effect of feedback on DC servo motor
3. Transfer function of DC motor
4. Lag and Lead compensation - Magnitude and phase plot Using MATLAB

**(18PC0212) MEASUREMENTS &INSTRUMENTATION LABORATORY**

| **B.Tech** | **V semester** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **1.5** |

**COURSE OBJECTIVES:**

The objectives of the course are to make the students learn about:

- Calibration of various electrical measuring/recording instruments.
- Accurate determination of resistance, inductance and capacitance using D.C and A.C Bridges.
- Measurement of parameters of choke coil

**The following experiments are required to be conducted as compulsory experiments**:

1. Calibration of Single Phase Energy Meter using Phantom loading method with RSS meter as standard
2. Calibration of Dynamometer Power Factor Meter
3. Kelvin's Double Bridge – Measurement of very low Resistance values –Determination of Tolerance.
4. Schering Bridge & Anderson Bridge for measurement of Capacitance and Inductance values
5. Measurement of 3 Phase Reactive Power with Single-Phase Wattmeter
6. Measurement of Parameters of a Choke Coil Using 3 Voltmeter and 3 Ammeter Methods
7. Calibration of LPF Wattmeter – by Phantom Testing
8. Measurement of 3 Phase Power with Two Watt Meter Method (Balanced & Un balanced).

**In addition to the above six experiments, at least any two of the experiments from the following list are required to be conducted**:

1. Optical Bench – Determination of Polar Curve, Measurement of MHCP of Filament Lamps
2. Dielectric Oil Testing Using H.T. Testing Kit
3. LVDT and Capacitance Pickup – Characteristics and Calibration
4. Resistance Strain Gauge – Strain Measurement and Calibration
5. Transformer Turns Ratio Measurement Using A.C. Bridge.

**B.Tech (18M00413) MANAGEMENT SCICENCE**

**VI –SEMESTER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objective:**

The Objective of the course is to give a basic perspective of Management and behavioral concepts. This will form foundation to study other functional areas of management. Also this course provides insight into behavioral issues.

**UNIT-I**

**Meaning and nature of organizational behavior**

Introduction to concept and importance of OB in Modern management Individual Behavior – Personality – values – Attitudes - Perception, Learning, Emotions-emotional intelligence& emotional Labor.

**UNIT-II**

**Designing and Developing HR systems:** Human Resource Planning, Job Analysis, Job Evaluation, Job Design, Job Enlargement, Job Rotation, Job Enrichment, Recruitment & Selection, Placement, Induction, Transfer and Promotion, Separation

**UNIT-III**

**Human Resource Development:-**Concepts, Development Function, Training and Development, Performance Appraisal & Career Planning and Development

**UNIT-IV**

**Understanding Marketing Management:** Concepts of marketing, Role of Marketing, Marketing Process, Marketing Environment, Consumer Behavior-decision process

**UNIT-V**

**strategic management:** Concepts in Strategic Management - Strategic Management Process - Environmental Scanning - Industry and Competitive analysis - Core competencies - Competitive Advantage.

**Textbooks:**

- Personal and Human Resource Management – Text and cases, P. Subbarao, Himalaya.
- Human Resource Management, Noe A.Raymond, John Hollenbeck, Barry Gerhart and Patrick Wright, Tata McGraw Hill.

**References**

- Human Resource Management, Aswathappa, 4th Edition, TMH 2006
- Human Resource Mangement, Ian Beardwell & Len Holden-Macmillan India Ltd.
- Managing Human Resources: Productivity, quality of work life, profits- Wayne F.

# (18PC0416) MICROPROCESSOR AND MICROCONTROLLER

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives**

- To study the architecture and assembly language programming of 8086 microprocessor.
- To learn about interrupt and bus structure of 8086 microprocessor.
- To interface 8086 microprocessor with supporting peripheral chips.
- To study the architecture and instruction set of 8051 microcontroller.
- To design microcontroller-based systems.

**UNIT I:** 8086 Microprocessor The 8086 Microprocessor: Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

**UNIT II:** 8086 Interrupts and System Bus Architecture Interrupts and interrupt service routines – 8086 signals – Minimum and Maximum modes of operation – Multiprogramming – Multiprocessor configurations – closed coupled and tightly coupled configurations - Introduction to advanced processors.

**UNIT III:** I/O Interfacing with 8086 I/O Interfacing: Parallel communication interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: LED display, Keyboard display interface.

**UNIT IV:** 8051 Microcontroller: Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

**UNIT V:** Interfacing with 8051 microcontroller Interfacing Microcontroller: Programming 8051 Timers – Serial Port Programming – Interrupts Programming - Stepper Motor and Waveform generation – LCD and Keyboard interfacing.

Text Books

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Douglas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”, TMH,2012.
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education, 2011

**Reference Books**

1. Kenneth J. Ayala, "The 8086 Microprocessor- Programming and Interfacing The PC", India Edition, Cengage Learning.
2. Kenneth J. Ayala, "The 8051 Microcontroller – Architecture, Programming and Applications” Second Edition, Delmar Cengage Learning, ", Second Edition, Cengage Learning, 2004.

# (18PC0213) Power Systems – II

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Classification of transmission lines and representation by suitable equivalent circuits.
- Understand Short circuit analysis of power systems.
- Understand Swing equation solutions, Equal area criterion and its applications.
- Understand the Power flow studies by various methods.
- Understand Load frequency control in single area and two area systems.

## UNIT – I POWER SYSTEM NETWORK MATRICES

Representation of Power System Elements,Graph Theory:Definitions, Bus Incidence Matrix, $Y_{bus}$ Formation by Direct and Singular Transformation Methods, Numerical Problems. Formation of $Z_{Bus}$: Partial Network, Algorithm for the Modification of $Z_{Bus}$ Matrix for Addition Element for the Following Cases: Addition of Element from a New Bus to Reference, Addition of Element from a New Bus to an Old Bus, Addition of Element Between an Old Bus to Reference and Addition of Element Between Two Old Busses (Derivations & Numerical Problems) Modification of $Z_{Bus}$ for the Changes in Network (Problems )

## UNIT 2: SHORT CIRCUIT ANALYSIS

Per-Unit System of Representation. Per-Unit Equivalent Reactance Network of a Three Phase Power System, Numerical Problems. Symmetrical Fault Analysis: Short Circuit Current and MVA Calculations, Fault Levels, Application of Series Reactors, Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero Sequence Components: Voltages, Currents and Impedances. Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without Fault Impedance, Numerical Problems.

## UNIT 3: POWER FLOW STUDIES

Necessity of Power Flow Studies – Data for Power Flow Studies – Derivation of Static Load Flow Equations – Load Flow Solutions using Gauss Seidel Method: Acceleration Factor, Load Flow Solution with and without P-V Buses, Algorithm and Flow chart. Numerical Load flow Solution for Simple Power Systems (Max. 3-Buses) Load Flow Solution with or without PV Buses using Newton Raphson Method.

**UNIT4: PERFORMANCE OF TRANSMISSION LINES:**

Classification of Transmission Lines - Short, Medium and Long Lines and Their Exact Equivalent Circuits- Nominal-T, Nominal-π. Mathematical Solutions to Estimate Regulation and Efficiency of All Types of Lines. Long Transmission Line-Rigorous Solution, Evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations –Surge Impedance and Surge Impedance Loading - Wavelengths and Velocity of Propagation – Ferranti Effect , Charging Current-Numerical Problems.

**UNIT 5: POWER SYSTEM STABILITY ANALYSIS**

Elementary Concepts of Steady State, Dynamic and Transient Stabilities –Description of: Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability and Methods to Improve Steady State Stability - Derivation of Swing Equation -Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Solution of Swing Equation by 4th Order Runga Kutta Method (up to 2 iterations) - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

**TEXT BOOKS:**


1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

## (18PE0204) POWER SYSTEM PROTECTION

**PEC_II**

| **VI –SEMESTER** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **3** | **0** | **0** | **3** |

**Course Objectives:** The objectives of the course are to make the students learn about:

- The technical aspects involved in the operation of circuit breakers
- The different types of electromagnetic relays and microprocessor based relays
- The protection of Generators & Transformers
- The protection of feeders and lines
- Generation of over voltages and protection from over voltages

**Course Outcomes:** At the end of the course the student should be able to:

- Solve numerical problems concerning the arc interruption and recovery in circuit breakers
- Explain the principles of operation of various types of electromagnetic relays, Static relays as well as Microprocessor based relays
- Understanding the protection of generators and determination of what %generator winding is Un protected under fault occurrence
- Understanding the protection of transformers and make design calculations to determine the required CT ratio for transformer protection
- Explain the use of relays in protecting Feeders, lines and bus bars
- Understand why over voltages occur in power system and how to protect the system

**UNIT-1**

**CIRCUIT BREAKERS**

Circuit Breakers: Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB Ratings and Specifications: Types and Numerical Problems. – Auto Re closures. Description and Operation of Following Types of Circuit Breakers: Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers.

**UNIT-2**

**RELAYS**

Electromagnetic Relays - Basic Requirements of Relays – Primary and Backup Protection - Construction Details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays – Universal Torque Equation – Characteristics of Over Current, Direction and Distance Relays. Static Relays – Advantages and Disadvantages – Definite Time, Inverse and IDMT. Static Relays – Comparators –

Amplitude and Phase Comparators. Microprocessor Based Relays – Advantages and Disadvantages – Block Diagram for Over Current (Definite, Inverse and IDMT) and Distance Relays and Their Flow Charts.

**UNIT – 3**

**PROTECTION OF GENERATORS & TRANSFORMERS**

Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection. Numerical Problems on percentage winding unprotected. Protection of Transformers: Percentage Differential Protection, Numerical Problems on Design of CT Ratio, Buchholtz Relay Protection, Numerical Problems.

**UNIT –4**

**PROTECTION OF FEEDERS & LINES**

Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of Transmission Line – 3 Zone Protection Using Distance Relays. Carrier Current Protection. Protection of Bus Bars.

**UNIT – 5**

**OVER VOLTAGES IN POWER SYSTEMS**

Generation of Over Voltages in Power Systems.-Protection against Lightning over Voltages - Valve Type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL.

**TEXT BOOKS:**

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.

2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

**REFERENCE BOOKS:**

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited,Publishers, 2012.

2. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009.

3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010.

# PEC_II
# (18PE0205) POWER QUALITY

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives**: The objectives of the course are to make the students learn about:

- Power quality issues and standards.
- The sources of power quality disturbances and power transients that occur in power systems.
- The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
- The principle of operation of DVR and UPQC.

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

- Address power quality issues to ensure meeting of standards
- Apply the concepts of compensation for sags and swells using voltage regulating devices
- Assess harmonic distortion and its mitigation.
- Explain the power measurement data according to standards

**UNIT I**

**INTRODUCTION**

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude versus Duration Plot - Power Quality Standards -Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

**UNIT II**

**TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS**

Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption-Under Voltage – Over Voltage–Outage. Source of Different Power Quality Disturbances-Principles of Regulating the Voltage-Conventional Devices for Voltage Regulation.

**UNIT III**

**FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS**

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics: Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

**UNIT-IV POWER QUALITY MONITORING**

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments-

Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

**UNITV POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

**TEXT BOOKS:**

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition,2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

**REFERENCE BOOKS**:

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H.J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

# PEC_II
# (18PE0206) Power System Dynamics and Control

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives:** The objectives of the course are to make the students learn about:

- The kinds of power stability problems
- The basic concepts of modeling and analysis of dynamical systems.
- Modeling of power system components - generators, transmission lines, excitation and prime move Controllers.
- Stability of single machine and multi-machine systems is analyzed using digital Simulation and Small- Signal analysis techniques.
- The impact of stability problems on power system planning and operation.

**Course Outcomes**: After completion of Course, the student should be able to

- Understand the power stability problems
- Understand the basic concepts of modeling of synchronous machine and power system components
- Analyze the stability issues in interconnected systems
- Understand the power system stability analysis tools and enhancement of power system stability

**Unit – I Introduction to Power System Stability**

Power System Operation and Control - Stability Problems faced by Power Systems -Impact on Power System Operation and Control - Analysis of Dynamical Systems -Concept of Equilibria, Small and Large Disturbance Stability - Example: Single Machine Infinite Bus System - Modal Analysis of Linear Systems - Analysis using Numerical Integration Techniques - Issues in Modeling: Slow and Fast Transients, Stiff Systems

**Unit – II Modeling of a Synchronous Machine**

Physical Characteristics - Rotor Position Dependent model - D-Q Transformation -Model with Standard Parameters - Steady State Analysis of Synchronous Machine -Short Circuit Transient Analysis of a Synchronous Machine - Synchronous Machine Connected to Infinite Bus.

**Unit – III Modeling of power system components**

Physical Characteristics and Models - Control system components - Excitation System Controllers - Prime Mover Control Systems - Transmission Line Physical Characteristics - Transmission Line Modeling - Load Models - induction machine model - Other Subsystems - HVDC, protection systems.

**Unit – IV Stability Issues in Interconnected Power Systems**

Single Machine Infinite Bus System - Multi-machine Systems - Stability of Relative Motion - Frequency Stability: Centre of Inertia Motion - Concept of Load Sharing: Governors - Single Machine Load Bus System: Voltage Stability - Torsional Oscillations

**Unit – V Enhancing System Stability**

Planning Measures - Stabilizing Controllers (Power System Stabilizers) – Operational Measures- Preventive Control - Emergency Control - Power System Stability Analysis Tools: Small Signal Analysis Program - Transient Stability Program - Real-Time Simulators.

**Reference Books:**

1. K.R.Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.
2. P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York, 1995.
3. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.
4. Jan Machowski, Janusz Bialek, James Richard Bumby, Power system dynamics and control , John Wiley & Sons, 1997.

# PEC_III
# (18PE0207) HVDC Transmission Systems

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives:** The objectives of the course are to make the students learn about:

- Technical and economic aspects of HVAC and HVDC transmission and their comparison.
- Static power converters
- Control of HVDC converter systems
- Origin, effects, classification and elimination of harmonics
- The occurrence of faults, and transients in HVDC system and their protection.

**Course Outcomes:** After Completion of Course, the student should be able to:

- Compare HVDC and HVAC transmission systems
- Understand the operation of various converters used in HVDC transmission systems
- Devise means to suppress / eliminate harmonics.
- Design HVDC and AC Filters

**UNIT-I**

**INTRODUCTION TO HVDC TRANSMISSION**

HVDC Transmission: Technical And Economical Comparison of HVAC and HVDC Transmission, Types of DC Links, Power Handling Capabilities of HVDC Lines, static Conversion Principles, Static Converter Configuration.

**UNIT-II**

**STATIC POWER CONVERTER ANALYSIS**

Static Power Converters: 3-Pulse, 6-Pulse & 12-Pulse Converters, Converter Station and Terminal Equipment, Commutation Process, Rectifier and Inverter Operation, Equivalent Circuit for Rectifier, Inverter and HVDC Link- Special Features of Converters.

**UNIT-III**

**CONTROL OF HVDC CONVERTER SYSTEMS**

Control of HVDC Converter Systems: Principle of DC Link Control – Constant Current, Constant Extinction Angle and Constant Ignition Angle Control and Voltage Dependent Current Control. Individual Phase Control and Equidistant Firing Angle Control

**UNIT-IV**

**HARMONICS AND FILTERS**

Origin of Harmonics in HVDC Systems, Classification of Harmonics, Elimination of Harmonics, Suppression Methods, Harmonic Instability Problems, Design of HVDC AC & DC Filters.

**UNIT-V**

**TRANSIENTS, FAULTS AND PROTECTION OF HVDC SYSTEMS**

Origin of over Voltages in HVDC Systems, Over Voltages due to DC and AC Side Line Faults - Converter Faults, Over Current Protection- Valve Group and DC Line Protection. Over Voltage Protection of Converters, Surge Arresters etc.

**TEXT BOOKS:**

1. HVDC Power Transmission Systems, K.R.Padiyar, 3rd Edition, New Age International publishers, 2015.

2. HVDC Transmission, S.Kamakshaiah, V.Kamaraju, Mc Graw Hill Education (India) Pvt. Ltd., 2011.

**PEC_III**

**(18PE0208) Electrical and Hybrid Vehicles**

**VI –SEMESTER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:-**Students will be able to:

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

**Course Outcomes:-**Students will be able to:

- Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To learn electric drive in vehicles / traction.

**UNIT-I:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, mathematical models to describe vehicle performance

**UNIT-II:** Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis. Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.

**UNIT-III:** Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives , configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

**UNIT-IV:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology communications, supporting subsystems

**UNIT-V:** Introduction to energy management and their strategies used in hybrid and electric vehicle , Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

**References:-**

1. Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

## PEC_III

## (18PE0209) Electrical Machine Design

**VI –SEMESTER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

**UNIT I Introduction**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT II Transformers**

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT III Induction Motors**

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT IV Synchronous Machines**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

**UNIT V Computer aided Design (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation.

Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

**Text / References:**

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.

2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

# OEC_II
## (18OE0203) Programmable Logic Controllers

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives:** The objectives of the course are to make the students learn about:

- PLC and its basics, architecture, connecting devices and programming
- Implementation of Ladder logic for various Industrial applications
- Designing of control circuits for various applications
- PLC logic and arithmetic operations

**Course Outcomes:** The student should be able to:

- Program a PLC for a given application
- Implement Ladder logic for various Industrial applications
- Design control circuits for various applications

**UNIT-I**

PLC Basics: PLC System, I/O Modules and Interfacing, CPU Processor, Programming Equipment, Programming Formats, Construction of PLC Ladder Diagrams, Devices Connected To I/O Modules. PLC Programming: Input Instructions, Outputs, Operational Procedures, Programming Examples Using Contacts and Coils. Drill Press Operation.

**UNIT-II**

Digital Logic Gates, Programming in the Boolean algebra System, Conversion Examples. Ladder Diagrams for Process Control: Ladder Diagrams & Sequence Listings, Ladder Diagram Construction and Flowchart for Spray Process System.

**UNIT-III**

PLC Registers: Characteristics of Registers, Module Addressing, Holding Registers, Input Registers, Output Registers. PLC Functions: Timer Functions & Industrial Applications, Counter Function & Industrial Applications, Arithmetic Functions, Number Comparison Functions, Number Conversion Functions

**UNIT-IV**

Data Handling Functions: SKIP, Master Control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep Functions and Their Applications. Bit Pattern and Changing a Bit Shift Register, Sequence Functions and Applications, Controlling of Two-Axis & Three Axis Robots With PLC, Matrix Functions.

**UNIT-V**

Analog PLC Operation, Types of PLC Analog Modules and Systems, PLC Analog Signal Processing, BCD or Multibit data Processing, Analog output application examples, PID Modules, PID Tuning, Typical PID Functions, PLC Installation, Troubleshooting and Maintenance.

**TEXT BOOKS:**

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition,
ELSEVIER Ltd., 2009.

2. Programmable Logic Controllers 5th Edition, William Bolton, Newnes, ELSEVIER Ltd., 2009.

**REFERENCES:**

1. Programmable Logic Controllers: An Emphasis on design & application, Kelvin T.Erickson, Dogwood Valley Press,
2011.

# OEC_II
## (18OE0509)-COMPUTER NETWORKS

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech** | **3** | **0** | **0** | **3** |

**VI –SEMESTER**

**Course Objectives:**

- To understand the concepts of computer networks fundamentals.
- Study the concepts of computer networks from layered perspective.
- Illustrate the issues open for research in computer Networks.

**Course Outcomes:**

- Ability to select transmission media for effective communication.
- Develop applications using computer networks.
- Able to configure a computer network logically.
- Ability to design new protocols for computer network.

**UNIT I**

**Introduction:** Networks, Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP Protocol Suite, OSI Model

**Transmission Media**: Guided and Unguided Media, Switching: Circuit Switching, Packet Switching, Structure of a Switch.

**UNIT II**

**Data link layer:** Introduction, Link-Layer Addressing, Error detection and Correction: Cyclic codes, Checksum, Forward Error Correction.

**Data Link Control:** DLC Services, Data Link Layer Protocols, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access, and Channelization.

**UNIT-III**

**Network layer:** Network Layer Design Issues, Network Layer Services, Routing Algorithms, Congestion Control, IPV4 Addressing, IPV6 Addressing, IPV6 Protocol,Routing Information Protocol, OSPF,BGP, IGMP.

**UNIT IV**

**Transport layer:** Introduction, Transport-Layer Protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Cryptography and Network Security: Introduction, Confidentiality, Aspects of Security.

**UNIT V**

**Application layer:** Introduction, Client-server Programming, WWW and HTTP, FTP, E-Mail, TELNET, Secure Shell, Domain name system, SNMP.

**Text Books:**

1. Data communications and networking‖, Behrouz A. Forouzan, McGraw Hill Education, 5th edition, 2012.

2. “Computer Networks” Andrew S.Tanenbaum, Wetherill, Pearson,5th edition,2010.

**References:**

1. Data Communication and Network, Bhusan Trivedi, Oxford

2. “Internetworking with TCP/IP-Principles, Protocols and architecture – volume 1, Douglas E. Comer, 5th edition, PHI

3. “Computer Networks”, 5E , Peterson ,Davie, Elsevier.

4. “Introduction to Computer Networks and Cyber Security”, Chawan –Hwa Wu, Irwin, CRC Publications.

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# OEC_II
## (18OE0401) IMAGE PROCESSING

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

• To know the fundamentals of Image Processing

• To know about various techniques of image enhancement, reconstruction and image compression.

**Course Outcomes:**

• Able to apply the Image processing concept for various fields of engineering and real life to process as per needs &specifications.

• Get the skills to heuristically develop new techniques to process images of any context

• Can experiment, analyze & interpret image data /processing data.

**UNIT–I**

Introduction to Digital Image processing – Example fields of its usage- Image sensing and Acquisition – image Modeling - Sampling, Quantization and Digital Image representation - Basic relationships between pixels, - Mathematical tools/ operations applied on images - imaging geometry.

**UNIT–II**

2D Orthogonal and Unitary Transforms and their properties - Fast Algorithms - Discrete Fourier Transform - Discrete Cosine Transforms- Walsh- Hadamard Transforms- Hoteling Transforms , Comparison of properties of the above.

**UNIT–III**

Background enhancement by point processing Histogram processing, Spatial filtering, Enhancement in frequency Domain, Image smoothing, Image sharpening, Color image Enhancement

**UNIT–IV** Degradation model, Algebraic approach to restoration – Inverse filtering – Least Mean Square filters, Constrained Least square restoration and Blind De convolution. Image segmentation: Edge detection - Edge linking, Threshold based segmentation methods – Region based Approaches - Template matching –use of motion in segmentation

**UNIT–V**

Redundancies in Images - Compression models, Information theoretic perspective- Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, run length coding, Transform coding, Image Formats and compression standards.

**Text Books:**

1. R.C .Gonzalez & R.E. Woods, “Digital Image Processing”, Addison Wesley/Pearson education, 3rd Edition, 2010.

2. A .K. Jain, “Fundamentals of Digital Image processing”, PHI.

**References:**

1. Rafael C. Gonzalez, Richard E woods and Steven L.Eddins, “Digital Image processing using MATLAB”, Tata McGraw Hill, 2010.

2. S jayaraman, S Esakkirajan, T Veerakumar, “Digital Image processing”,Tata McGraw Hill

3. William K. Pratt, “Digital  Image Processing”, John Wilely, 3rd Edition, 2004.

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 0 | 0 | 3 | 1.5 |

## (18PC0418) MICRO PROCESSORS & MICRO CONTROLLER LAB

**Course Objective:**

- To become skilled in 8086 Assembly Language programming.
- To understand programmable peripheral devices and their Interfacing.
- To understand and learn 8051 microcontroller.
- To learn 8051 assembly Language programming

**Learning Outcome:**

- Able to write8086 Assembly Language programs.
- Able to understand programmable peripheral devices and their Interfacing.
- Able to write 8051 assembly Language programs.

**Minimum Ten Experiments to be conducted (Five from each section)**

**PART A: 8086 Microprocessor Programs using TASM**

1. Introduction to TASM Programming
2. Programs using arithmetic and logical operations
3. Programs using string operations and Instruction prefix: Move Block, Reverse string, Sorting, String comparison
4. Programs for code conversion
5. Multiplication and Division programs
6. Sorting and multi byte arithmetic

**PART B: Embedded C Experiments using MSP430 Microcontroller**

1. Interfacing and programming GPIO ports in C using MSP430 (blinking LEDs, push buttons)
2. Usage of Low Power Modes
3. Interrupt programming examples through GPIOs
4. PWM generation using Timer on MSP430 GPIO
5. Interfacing potentiometer with MSP430
6. PWM based Speed Control of Motor controlled by potentiometer connected to MSP430 GPIO
7. Using ULP advisor in Code Composer Studio on MSP430
8. Low Power modes and Energy trace++

# (18PC0214) POWER SYSTEM LAB

| VI –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 0 | 0 | 3 | 1.5 |

**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**Minimum Ten Experiments to be conducted (Five from each section)**

**List of experiments:-**

1. Determination of sequence impedances of cylindrical Rotor synchronous machine.
2. Fault Analysis-I (LG FAULT, LL FAULT).
3. Fault Analysis-II (LLG FAULT, LLLG FAULT).
4. Determination of Sub transient reactance's of a salient pole synchronous machine.
5. Equivalent circuit of a 3-Φ three winding transformer.
6. under voltage relay.
7. over voltage relay.
8. Negative sequence Relay.
9. Z-bus building algorithm.
10. Program for swing curve when the fault is cleared.

**ADDITIONAL EXPERIMENTS:**

11. Swing curve for sustained fault and critical clearing angle & time.
12. Mat lab Program to Simulate Ferranti Effect.
13. Gauss-Seidel load flow analysis using MATLAB

# PEC_IV
## (18PE0210) FACTS CONTROLLERS

**VII –SEMESTER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

To make the student learn about:

- To know the basic definitions and different types of Facts controllers and their uses.
- To know about the voltage source converter operation and different modulation techniques with comparison.2
- To improve the stability of power system by Shunt Compensation and Series Compensation with facts controllers.
- To enhance the transient stability and power oscillation damping by SVC and STATCOM.

**COURSE OUTCOMES:**

After the end of this course student will:

- Know the basic definitions and different types of Facts controllers and their uses.
- Know about the voltage source converter operation and different modulation techniques with comparison.
- Improve the stability of power system by Shunt Compensation and Series Compensation with facts controllers.
- Enhancement of the transient stability and power oscillation damping by SVC and STATCOM.

**UNIT-I:**

**FACTS CONCEPTS**

Introduction to FACTS, Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

**UNIT-II:**

**VOLTAGE SOURCE CONVERTERS**

Single & three phase full wave bridge converters, transformer connections for 12, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation, basic concept of current source converters, and comparison of current source converters with voltage source converters.

**UNIT-III:**

**STATIC SHUNT COMPENSATION**

Objectives of shunt compensation, mid-point voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators, hybrid VAR generators.

**UNIT-IV:**

**SVC AND STATCOM**

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

**UNIT-V:**

**STATIC SERIES COMPENSATORS**

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor-controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor-controlled series capacitor (TCSC) Control schemes for GSC, TSSC and TCSC.

**TEXT BOOKS:**


1. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007


**REFERENCES:**


1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

# PEC_IV

## (18PE0211) INDUSTRIAL ELCTRICAL SYSTEMS

| VII –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- At the end of this course, students will demonstrate the ability to
- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and selected proper size of various electrical system components.

**UNIT I: ELECTRICAL SYSTEM COMPONENTS**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

**UNIT II: RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

**UNIT III: ILLUMINATION SYSTEMS**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

**UNIT IV: INDUSTRIAL ELECTRICAL SYSTEMS I**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

**UNIT V: INDUSTRIAL ELECTRICAL SYSTEMS II**

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Industrial Electrical System Automation Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

**TEXT BOOKS/REFERENCE BOOKS**

1. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.

2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.

3. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.

4. Web site for IS Standards.

5. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

# PEC_IV

## (18PE0212) POWER SYSTEMS AUTOMATION

| VII –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**

- Understand various components of industrial electrical systems.
- Analyze and selected proper size of various electrical system components.

**UNIT I:**

**INTRODUCTION:**

Purpose of automatic power control systems, elements of automatic power control systems, automatic power control and controllers' relays and relaying devices

**UNIT II:**

**OPERATION AND CONTROL:**

Operations environment of distribution networks, evolution of distribution management systems, basic distribution management system functions, basis of a real-time control system (SCADA), data acquisition, monitoring and event processing, control functions, data storage, archiving, and analysis, hardware system configurations, SCADA system principles

**UNIT III:**

**DISTRIBUTION AUTOMATION:**

Problems with existing distribution system, need for distribution automation, characteristics of distribution system, distribution automation, feeder automation

**UNIT IV:**

**SUBSTATION AUTOMATION:**

Definition, functions of substation automation state and trends of substation automation, intelligent affordable substation monitoring and control

**UNIT V:**

**FEEDER AUTOMATION:**

Losses in distribution systems, system losses and loss reduction, network reconfiguration, improvement in voltage profile, capacitor placement for reactive power compensation, algorithm for location of capacitor

**TEXT BOOKS:**

1. Automation in Electrical power systems by, P.I. Zabolotny, MIR Publishers, Moscow

2.Control and Automation of Electrical Power Distribution Systems (Power Engineering) James Northcot green James Northcote-Green, Taylor & Francis, 2007

3.A Textbook of Electric Power Distribution Automation By Dr. M.K. Khedkar, Dr. G.M. Dhole, universi ty science press, new delhi2010

**REFERENCE BOOKS:**

1. Sunil S. Rao, Switchgear and Protections, Khanna Publication

2. Stuart A Boyer: SCADA supervisory control and data acquisition

3. Gordan Clark, Deem Reynders, Practical Modem SCADA Protocols

# PEC_V

## (18PC0415) DIGITAL SIGNAL PROCESSING

**(Common to ECE, EEE)**

| VII –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Program a DSP chip to filter signals using either assembly language or a C compiler for the chip.
- Use discrete time Fourier transforms to analyze a digital system.

**Course Outcomes:**

At the end of the course, the student should be able to:

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications
- Formulate engineering problems in terms of DSP tasks.
- Apply engineering problems solving strategies to DSP problems.
- Design and test DSP algorithms.
- Analyze digital and analog signals and systems.
- Analyze and compare different signal processing strategies

**UNIT-I**

**Discrete time signals and systems**: Review of discrete-time signals and systems – Time domain analysis of discrete-time signals & systems, Frequency domain analysis of discrete-time signals and systems.

**Discrete Fourier Transform (DFT)**-The DFT as a linear transformation, Relationship of the DFT to other transforms, Properties of DFT, Frequency analysis of signals using the DFT.

**UNIT-II**

**Fast Fourier Transform Algorithm-** Divide and conquer approach to computation of DFT, Radix-2, Radix-4, and Split radix FFT algorithms. A linear filtering approach to computation of the DFT- the Goertzel, and the Chirp-z transform algorithms, Quantization errors in the computation of DFT.

**UNIT-III**

**Design of IIR Digital filters:** Design of Impulse Invariance Response (IIR) filters from analog filters– IIR filter design by approximation of derivatives, by Impulse invariance, and by bilinear transformation methods,

**Design of Finite Impulse Response (FIR) filters –**

Symmetric and asymmetric FIR filters, Design of linear phase FIR filters using windows, Design of linear phase FIR filters by the frequency sampling method, Design of optimum equi-ripple linear phase FIR filters, Comparison of design methods for linear phase FIR filters

**UNIT-IV**

**Structures for the realization of discrete-time systems**

**Structures for IIR systems** – Direct form, Signal flow graphs & Transposed, Cascade form, Parallel form and Lattice structures, Conversion from Lattice structure to direct form, lattice –
Ladder structure.

**Structures for FIR systems** -

Direct form, Cascade form, Frequency sampling, and Lattice structures.

**UNIT-V**

**Introduction to multi rate signal processing**.

Decimation, and interpolation, sampling rate conversion by a rational factor, Implementation of sampling rate conversion, multistage implementation of sampling rate conversion, Application of DSP.

**Text/Reference Books:**

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
5. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988

# PEC_V

## (18PE0213) WIND AND SOLAR ENERGY SYSTEM

| VII –SEMESTER | L | T | P | C |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

**UNIT 1:**

**PHYSICS OF WIND POWER**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

**UNIT II:**

**WIND GENERATOR**

topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

**UNIT III:**

**THE SOLAR RESOURCE**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

**UNIT IV:**

**SOLAR PHOTOVOLTAIC**

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

**UNIT V: NETWORK INTEGRATION ISSUES**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

**TEXT BOOKS / REFERENCES:**


1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

**PEC_V**

# (18PE0214) SPECIAL ELECTRICAL MACHINES

| **VII –SEMESTER** | **L** | **T** | **P** | **C** |
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**COURSE OBJECTIVES:**

- To learn about the stepper motor characteristics, operation and speed control.
- To learn about the Variable Reluctance (VR) Stepping Motors characteristics, operation and position control.
- To learn about the Switched mode reluctance motor characteristics, operation and design.
- To learn about the Brushless DC motor and Permanent magnet motor performance prediction and rotor position sensing and learn about double sided linear induction motor.

**COURSE OUTCOMES**:

- Understand the stepper motor characteristics, operation and able to do speed control.
- Understand the Variable Reluctance (VR) Stepping Motors characteristics, operation and able to do Position control.
- Understand the Switched mode reluctance motor characteristics and able to design.
- Get knowledge on Brushless DC motor and Permanent magnet motor performance prediction and rotor Position sensing and learn about double sided linear induction motor.

**UNIT I:**

**STEPPER MOTORS**

Introduction –Synchronous Inductor, Hybrid Stepping Motor, Construction, Principle of Operation, Energization with two phase at a time –Essential conditions for the satisfactory Operation of a 2 –Phase Hybrid Step Motor –Very Slow-Speed Synchronous Motor for Servo Control –Different Configurations for Switching the Phase Windings –Control Circuits for Stepping Motors –An Open –Loop Controller for a 2-Phase Stepping Motor.

**UNIT II:**

**VARIABLE RELUCTANCE (VR) STEPPING MOTORS**

Single –Stack VR step motors, Multiple stack VR motors –Open –Loop Control of 3-Phase VR Step Motor –Closed –Loop Control of Step Motor, Discriminator, Translator, Major loop –Characteristics of Step Motor in Open –Loop Drive –Comparison between Open-Loop Position Control with Step Motor and a Position Control Servo using a Conventional Servo Motor –Suitability and Areas of Application of Stepping Motors,5–Phase Hybrid Stepping Motor, Single –Phase Stepping Motor-The Construction, Operating Principle, Torque developed in the Motor.

**UNIT III:**

**SWITCHED RELUCTANCE MOTOR (SRM)**

Introduction –Improvements in the Design of Conventional reluctance Motors –Some Distinctive Differences between SR and Conventional Reluctance Motors –principle of Operation of SRM –Some Design Aspects of Stator and Rotor Pole Arcs, Design of stator and Rotor and pole Arcs in SR Motor, Determination of L(θ) –θ Profile –Power Converter for SR Motor –A Numerical Example -Rotor Sensing Mechanism and Logic Control, Drive and Power Circuits, Position Sensing of rotor with Hall Problems – Derivation of Torque Expression, General, Linear Case.

**UNIT IV: BRUSHLESS DC MOTOR AND PERMANENT MAGNET MATERIALS AND MOTORS**

Types of Construction –Principle of Operation of BLDM –Sensing and Switching Logic Scheme, Sensing, Logic Controller, Lockout Pulses –Drive and Power Circuits, Base Drive Circuit, Power Converter Circuit –Theoretical Analysis and Performance Prediction, Modeling and magnet circuit, d-q analysis of BLDM – Transient Analysis –Formulation in terms of Flux Linkages as State Variables –Approximate Solutions for Current and Torque under Steady State –Theory of BLDM as Variable Speed Synchronous Motor, Rotor position Sensing and Switching Logic for a BLDM for forward and reverse position.

**UNIT V: LINEAR INDUCTION MOTOR**

Development of a Double-sided LIM from Rotary type IM –A Schematic of LIM Drive for Electric Traction –Development of one-sided LIM with back Iron –Field Analysis of a DSLIM: Fundamental Assumptions.

**TEXT BOOKS:**

1. K . Venkata Ratnam, Special Electrical Machines, University Press.
2. R. K. Rajput, Electrical machines, 5thEdition [For Chapters I and II refer Chapter VIII of this book]
3. V. V. Athena, Stepper Motors: Fundamentals, Applications and Design, New Age International Pub.
4. N. Mohan, Undemand & Robbins, Power Electronics Converters, Applications & Design.
5. Johan E. Gibson and F. B. Tauter, Control System Components.6. M. G. Say & E. O. Taylor, D. C. Machines

# OEC_III

## (18OE0204) ARTIFICIAL INTELLIGENCE APPLICATIONS FOR ELECTRICAL SYSTEMS

| VII –SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES**

- To provide insight into fundamentals of Artificial Intelligence Techniques to the students.
- To convey application of Artificial Intelligence techniques in power system.

**UNIT I:**

**ARTIFICIAL INTELLIGENCE:**

History and Applications Introduction, Intelligence, Communication, Learning, Artificial Intelligence, History, Early Works, Importance, Definitions, Programming Methods, Techniques, Progress of Artificial Intelligence, Growth of AI, AI and Industry, AI and the world, Current Trends in Applied AI, Modeling, Simulation and AI, Intelligent Systems, Role of IS, Comparisons with conventional programs, Fundamentals of various IS

**UNIT II:**

**ARTIFICIAL NEURAL NETWORK**:

Difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Power System

**UNIT III**

**FUZZY LOGIC:**

Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, The alpha cut method, The extension method, Linguistic Descriptions and their Analytical Forms, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences Fuzzy Implication and Algorithms, Defuzzification Methods, Centre of Area Defuzzification, Centre of Sums Defuzzification

**UNIT IV:**

**GENETIC ALGORITHMS AND EVOLUTIONARY PROGRAMMING:**

Introduction, Genetic Algorithms, Procedure of Genetic Algorithms, Genetic Representations, Initialization and Selection, Genetic Operators, Mutation, The Working of Genetic Algorithms, Evolutionary Programming, The Working of Evolutionary Programming

**UNIT V:**

**APPLICATION OF AI IN POWER SYSTEMS:**

Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting

**TEXT & REFERENCE BOOKS:**

1. Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005- N. P. Paddy

2. Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002- Estimations V. Kiriakopoulos

3. Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series, UK, 1997- Kevin Warwick, Arthur Ekwueme and Raj Aggarwal

4. Intelligent Systems and Signal Processing in Power Engineering, Springer Berlin Heidelberg, New York- Abhishek Utkal

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# OEC_III

## (18OE0316) MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

| VII –SEMESTER | L | T | P | C |
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**(Open Elective to EEE)**

**Course Objectives:**

- To learn basics of Micro Electro Mechanical Systems (MEMS).
- To learn about various sensors and actuators used in MEMS
- To learn the principle and various devices of MOEMS, Fluidic, bio and chemical systems

**Course Out comes**:

Students undergoing this course are able to

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering

**UNIT – I**

**INTRODUCTION:** Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

**MECHANICAL SENSORS AND ACTUATORS:** Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

**UNIT – II**

**THERMAL SENSORS AND ACTUATORS:** Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

**UNIT – III**

**MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS:** Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

**MAGNETIC SENSORS AND ACTUATORS:** Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators

**UNIT – IV**

**MICRO FLUIDIC SYSTEMS:** Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps.

**RADIO FREQUENCY (RF) MEMS:** RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

**UNIT - V**

**CHEMICAL AND BIO MEDICAL MICRO SYSTEMS:** Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

**TEXT BOOKS:**

1. MEMS/Nitaigour Premchand Mahalik/TMH Publishing co.
2. MEMS and NEMS/Sergey Edwrd Lyshevski/CRC Press, Indian Edition, 2013

**REFERENCE BOOKS:**

1. Foundation of MEMS/Chang Liu/Prentice Hall Ltd.
2. RF MEMS Theory, Design and Technology Gabriel M. Rebeiz, Wiley- India,2010
3. MEMS and Micro Systems: Design and Manufacture/Tai-Ran Hsu/TMH Publishers.
4. Introductory MEMS/ Thomas M Adams, Richard A Layton/Springer International Publishers.

# OEC_III

## (18OE0205) DESIGN AND ESTIMATION OF ELECTRICAL SYSTEMS

| VII –SEMESTER | L | T | P | C |
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**COURSE OBJECTIVES:**

At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

**UNIT 1:**

**INTRODUCTION:**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT 2:**

**TRANSFORMERS**:

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT 3:**

**INDUCTION MOTORS**:

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT 4:**

**SYNCHRONOUS MACHINES:**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

**UNIT 5:**

**COMPUTER AIDED DESIGN (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

**TEXT / REFERENCES:**

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.

2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.

3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.

**OEC_IV**

**(18PC0421) EMBEDDED SYSTEMS**

| **VII –SEMESTER** | **L** | **T** | **P** | **C** |
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**Course Objectives**

The course will provide the student:

- To know the fundamental concepts of embedded systems.
- To study state machine models and concurrent process models.
- To study processor peripherals and communication interfaces.
- To learn the kernel, RTOS.

**Outcomes On completion of the course the student will**

- Understand the fundamental concepts of Embedded systems.
- Know the state machine models and concurrent process models.
- Know the watch dog timer, real time clock and communication interfaces.
- Understand the RTOS and Kernel.
- Understand the hardware and software design.

**UNIT I INTRODUCTION TO ASIP & DSP PROCESSORS:**

Embedded systems overview, design challenge, processor technology, embedded hardware units, embedded software in a system, embedded system on chip (SOC), design process, classification of embedded systems General Purpose Processors - Basic architecture, operation- Pipelining, Programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors.

**UNIT II STATE MACHINE AND CONCURRENT PROCESS MODELS:** Introduction, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM), concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real-time systems

**UNIT III STANDARD SINGLE PURPOSE PROCESSORS: PERIPHERALS:** Timers, counters and watch dog timers, real time clock. Communication Interface - Need for communication interfaces, RS232 / UART, RS422/ RS485, USB, Infrared, IEEE 1394 Firewire, Ethernet, IEEE 802.11, Blue tooth.

**UNIT IV SURVEY OF SOFTWARE ARCHITECTURE:** Round robin, round robin with interrupts, function queue scheduling architecture, selecting an architecture saving memory space

EMBEDDED SOFTWARE DEVELOPMENT TOOLS: Host and target machines, linkers, locations for embedded software, getting embedded software into target system, debugging technique

**UNIT V EMBEDDED / RTOS CONCEPTS:** Architecture of the Kernel, Tasks and Task scheduler, Interrupt service routines, Semaphores, Mutex. Mailboxes, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority inversion problem, Embedded operating systems- Embedded Linux, Real-time operating systems- RT Linux, Handheld operating systems- Windows CE.

**Text Books:**

1. Frank Vahid, Tony D. Givargis, "Embedded System Design – A Unified Hardware/Software Introduction", John Wiley, 2002.

2. KVKK Prasad, "Embedded / Real Time Systems", Dreamtech Press, 2005.

**Reference Books:**

1. Jonathan W. Valvano, Brooks / Cole, "Embedded Microcomputer Systems", Thompson Learning.

2. David E. Simon, "An Embedded Software Primer", Pearson Ed., 2005.

3. Raj Kamal, "Introduction to Embedded Systems", TMS, 2002

4.Embedded real time systems programming-sri ram V Iyer, pankajgupta, TMH, 2004

5.Embedded system design- A unified hardware/software introduction- frank vahid, tony D.Givargis, John Willey, 2002

**OEC _IV**
**(18OE0402)VLSI DESIGN**

| **VII –SEMESTER** | **L** | **T** | **P** | **C** |
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**Course Objectives:**

- To understand VLSI circuit design processes.
- To understand basic circuit concepts and designing Arithmetic Building Blocks.
- To have an overview of Low power VLSI.

**Course Outcomes:**

- Complete Knowledge about Fabrication process of ICs
- Able to design VLSI circuits as per specifications given.
- Capable of optimizing the design of Arithmetic / logic building Blocks at all levels of Design/Fabrication.
- Can implement circuit through various design styles (semi- Custom, Full Custom)

**UNIT-I**

**Introduction:** Basic steps of IC fabrication, PMOS, NMOS, CMOS & BiCMOS, and SOI process technologies, MOS transistors - MOS transistor switches – Basic gate using switches, working polar transistor Resistors and Capacitors.

**Basic Electrical Properties of MOS and BiCMOS Circuits:** Working of MOS transistors – threshold voltage; MOS design equations: **Ids–Vds** relationships, Threshold Voltage, Body effect, Channel length modulation , **gm**, **gds**, figure of merit **ω0**; Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Various pull ups loads, Bi-CMOS Inverters.

**UNIT-II**

**Basic Circuit Concepts:** Capacitance, resistance estimations- Sheet Resistance Rs, MOSDivice Capacitances, routing Capacitance, Analytic Inverter Delays, Driving large Capacitive Loads, Fan-in and fan-out.

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

**UNIT-III**

**Gate level Design:** Logic gates and other complex gates, Switch logic, Alternate gate circuits.

**Physical Design:** Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing

**UNIT-IV**

**Subsystem Design**: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters, High Density Memory Elements.

**VLSI Design styles**: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.

**UNIT-V**

**VHDL Synthesis:** VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools.

**Test and Testability:** Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

**TEXT BOOKS**:

1. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, “Essentials of VLSI circuits and systems”, PHI, 2013 Edition.

2. K.Lal Kishore and V.S.V. Prabhakar, “VLSI Design”, IK Publishers

**REFERENCES:**

1. Weste and Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education,1999.

2. Wayne Wolf, “Modern VLSI Design”, Pearson Education, 3rd Edition, 1997.

3. John P. Uyemura, “Chip Design for Submicron VLSI: CMOS layout and Simulation”, Thomson Learning.

4. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John wiley, 2003.

5. John M. Rabaey, “Digital Integrated Circuits”, PHI, EEE, 1997.

**VII –SEMESTER**

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**Course Objectives:**

- To understand the basic operating system functions and services.
- To understand the process and synchronization concepts.
- To understand the memory management concepts.
- To understand the file system and directory implementation.
- To understand the protection and security concepts.

**Course Outcomes:**

- Able to use different operating systems effectively.
- Able to implement process synchronization concepts.
- Able to implement different memory management techniques.
- Able to implement files and directories.
- Able to provide different protection and security measures.

**UNIT I**

**Operating systems Overview:** Operating systems functions, Operating systems structure, operating systems operations, protection and security, computing environments, open-source operating systems.

System Structures: Operating systems Services, User and Operating systems Interface, System calls, Types of system calls, system programs, Operating systems design structure, debugging, system boot.

**UNIT II**

**Processes:** Process concept, process scheduling, operations on processes, IPC, Examples of IPC systems.

**Process Synchronization:** The critical-section problem, Peterson's Solution, Synchronization Hardware, Synchronization Software, Semaphores, Classical problems of synchronization, Monitors, Synchronization examples.

**CPU Scheduling:** Scheduling-Criteria, Scheduling Algorithms- FCFS, Priority, SJF-Preemptive and Non-Preemptive, Round Robin.

**Threads:** Overview, Multithreading Models, Threading Issues.

**UNIT III**

**Deadlocks:** System Model, Deadlock characterization, Deadlock Handling Methods, Deadlock prevention, Deadlock Avoidance, Deadlock Detection and recovery.

**Memory Management:** Swapping, Contiguous Memory Allocation, Fragmentation, Segmentation, paging.

**Virtual memory:** Demand Paging, Page replacement Algorithms-FIFO, Optimal, LRU, Allocation of Frames, Thrashing.

**UNIT IV**

**Mass-storage structure:** Overview of Mass-Storage Structure, Disk structure, Disk scheduling Algorithms, RAID Structure.

**File System Interface:** Concept of File, File Access Methods, Directory Structure, File System Mounting, File Sharing.

**File system implementation:** File system structure, File System Implementation, Directory implementation, Allocation Methods, Free-Space Management.

**UNIT V**

**Protection:** Goals of Protection, Principles of Protection, Protection Domain, Protection Access matrix, Implementation of Protection Matrix- ACL, C-List.

**Security:** The Security Problem, Program threats, System and Network threats, Cryptography as a Security tool, User Authentication, Firewalling to protect system and networks, Computer-Security classifications**.**

**Text Books:**

1.Operating Systems Concepts, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Wiley, 8th Edition, 2014.

**References:**

1. Modern Operating Systems –by Andrew S Tanenbaum, 2nd edition, PHI.

**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**LIST OF EXPERIMENTS:**

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

**ADDITIONAL EXPERIMENTS:**

11. Load flow analysis of a given power system with STATCOM
12. Transient analysis of single machine infinite bus system with STATCOM

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## (18PC0216)SIMULATION-II LABORATORY

**Course Objective:**

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

**LIST OF EXPERIMENTS:**

1. a). ABCD parameters for t network
   b). ABCD parameters for long transmission network
2. a). Formation of y- bus using singular transformation method with and without mutual coupling
   b).Formation of 'Y- BUS' by inspection method
3. Z-bus building algorithm
4. Determination of power angle curve for non- salient pole synchronous machines
5. Determination of power angle curve salient pole synchronous machines
6. Program for swing curve when the fault is cleared
7. Swing curve for sustained fault and critical clearing angle & time
8. Formation of jacobian for the system not exceeding 4 buses (no pv buses) in polar coordinates
9. Gauss-seidel method
10. Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile.

**ADDITIONAL EXPERIMENTS:**

11. Formation for symmetric π /T configuration for Verification of $AD-BC=1$, Determination of Efficiency
    and Regulation.
12. Formation of Jacobian for a System not Exceeding 4 Buses (No PV Buses) in Polar Coordinates


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## PEC_VI
## (18PE0215) HIGH VOLTAGE ENGINEERING

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objective:**

To understand the various types of over voltages in power system and protection methods.

- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

**Course Outcome**:

- Ability to understand and analyze power system operation, stability, control and protection

**UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltage, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

**UNIT II DIELECTRIC BREAKDOWN**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

**UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

**UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

**UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

**Text Books:**

1. S.Naidu and V. Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill, Fifth Edition, 2013..

2. E. Kuffel and W.S. Zaengl, J.Kuffel, ‘High voltage Engineering fundamentals’, Newnes Second Edition Elsevier , New Delhi, 2005.

3. Subir Ray,’ An Introduction to High Voltage Engineering’ PHI Learning Private Limited, New Delhi, Second Edition, 2013.

**Reference Books:**

1. L.L. Alston, ‘High Voltage Technology’, Oxford University Press, First Indian Edition, 2011.

2. C.L. Wadhwa, ‘High voltage Engineering’, New Age International Publishers, Third Edition, 2010.


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# PEC_VI
# (18PE0215) CONTROL SYSTEMS DESIGN

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Outcome**:

After learning the course the students should be able to:

- Define fundamental control system design specifications and basic principles of controller design.
- Recognize the importance of observability and controllability for system design.
- Design modern controllers based on the state space techniques, optimal control and robust control techniques.

- Design cascade compensators based on time Domain and frequency domain analysis techniques; synthesize the controller using analog circuits.
- Design state feedback and optimal control.

**UNIT I**

**DESIGN OF FEEDBACK CONTROL SYSTEMS**

Introduction; Approaches to System Design; Cascade Compensation Networks; Phase-Lead Design Using the Bode Diagram; Phase-Lead Design Using the Root Locus; System Design Using Integration Networks; Phase-Lag Design Using the Root Locus; Phase-Lag , phase lead Design Using the Bode Diagram; Design on the Bode Diagram Using Analytical Methods; Systems with a Pre-filter; Design for Deadbeat Response.

**UNIT II**

**DESIGN OF STATE VARIABLE FEEDBACK SYSTEMS**

Introduction, State space representation of physical systems, State space models of some common systems like R-L-C networks, DC motor, inverted pendulum etc., Controllable Canonical Form, Observable Canonical Form, Diagonal Canonical Form, State transition matrix, Solution of state equations, Controllability and Observability, Full-State Feedback Control Design; Observer Design; Integrated Full-State Feedback and Observer; Tracking Reference Inputs; Internal Model Design;

**UNIT III**

**INTRODUCTION TO ROBUST CONTROL AND OPTIMAL CONTROL**

Robust control system and system sensitivities to parameter perturbations, analysis of robustness, systems with uncertain parameters, considerations in design of robust control system, robust PID controller.

**UNIT _IV**

**LYAPUNOV'S STABILITY AND OPTIMAL CONTROL**

Positive/negative definite, positive/negative semi-definite functions, Lyapunav stability criteria, introduction to optimal control, Riccatti Equation, Linear Quadratic Regulator

**UNIT V OPTIMAL CONTROL**

Introduction to optimal control – Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

**Text Books:**

1. Modern Control Engineering by K. Ogata, PHI.
2. Discrete Time Control Systems by K. Ogata, PHI.
3. Automatic Control Systems by B C Kuo, PHI.

**Reference Books:**

1. Control Systems, Principles and Design by M. Gopal, MC Graw Hill, 2012.

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**PEC_VI**

# (18PE0217) ADVANCED ELECTRIC DRIVES

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Outcome**:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

After learning the course, the students should be able to:

- Principles of electro-mechanics in detail.
- Analytical techniques for electric machinery
- Synchronous, induction, DC, variable-reluctance and stepper motors
  Single- and two-phase motors

**UNIT I SPECIAL ELECTRICAL MACHINES**

Brushless DC Machines Construction and working principle, Equivalent magnetic circuit, Type of converter and speed control, Comparison between the axial and radial permanent magnet motors, Applications. PMSM Introduction, Features of PMSM, industrial aspects, Construction and working of PMSM Linear Induction Machines Construction, Operation, Performance, control and applications SRM, PMAF Machine

**UNITII CONTROL SPECIAL ELECTRICAL MACHINES-I**

Stepper Motor: Characteristics – Open Loop and Closed Loop Control – Control Strategies -Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control Switched Reluctance Motor: Characteristics – Open Loop and Closed Loop Control – Control Strategies - Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control – Sensor less control Servo Motor: Characteristics – Open Loop and Closed Loop Control – Control Strategies - Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control

**UNIT III CONTROL OF SPECIAL ELECTRICAL MACHINES-II**

PMDC and BLDC Motor: Characteristics – Open Loop and Closed Loop Control – Control Strategies - Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control PMSM Motor: Characteristics – Open Loop and Closed Loop Control – Control Strategies - Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control PMAF Machine: Characteristics – Open Loop and Closed Loop Control – Control Strategies - Power Converter Circuit – Microprocessor, DSP and Microcontroller based Control

**UNIT IV LINEAR INDUCTION MACHINE**

Construction – Types – Working –Feature – Thrust Equation – Control – Application Linear Synchronous Machine: Construction – Types – Working –Feature – Thrust Equation – Control – Application DC Linear Motor:Construction – Types – Working –Feature – Thrust Equation – Control – Application Linear Reluctance Motor: Construction – Types – Working –Feature – Thrust Equation – Control – Application

**UNIT V ENERGY CONSERVATION IN ELECTRICAL DRIVES**

Standard motor efficiency, concept of Energy efficient motor, Efficiency evaluation technique, Direct Measurement method, Loss in Electric Drive System, Segregation method, Comparison, motor efficiency labeling, Energy efficient motor standards, Motor life cycle, Direct Savings and pay back analysis, Efficiency evaluation factor, Improvement of Power Factor, Quality of Supply, Harmonics Reduction and mitigation technique.

**Text Books:**

1.Special Electrical Machine **Author** : E. G. Janardanan

2.Brushless Permanent-Magnet Motor Design **Author** : D. C. Hanselman

3.Fundamental of Electrical Drives **Author** : G. K. Dubey

**Reference Books:**

1.Analysis of electric machinery and drive systems **Author** : Paul C.Krause, Oleg Wasynnczuk, and S.D. Sudhoff

2.Principles of Power Electronics **Author** : P. C. Sen

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## OEC_V
## (18OE0206) SMART GRID TECHNOLOGIES

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objectives:**

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

**Course Outcomes:**

Upon the completion of the subject, the student will be able to

- Understand technologies for smart grid
- Appreciate the smart transmission as well distribution systems
- Realize the distribution generation and smart consumption
- Know the regulations and market models for smart grid

**UNIT – I: INTRODUCTION TO SMART GRIDS**

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

**UNIT – II: SMART TRANSMISSION TECHNOLOGIES**

Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

**UNIT – III: SMART DISTRIBUTION TECHNOLOGIES**

Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

**UNIT – IV: DISTRIBUTED GENERATION AND SMART CONSUMPTION**

Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid

**UNIT – V: Regulations And Market Models For Smart Grid**

Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.

**TEXT BOOKS:**

**1.**Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009. **2.**Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

**REFERENCES:**

- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.
- India Smart Grid Knowledge Portal

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## OEC_V

# (18OE0507) INTERNET OF THINGS

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objectives:**

- To introduce the terminology, technology and its applications
- TointroducetheconceptofM2M(machine to machine)with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices.

**Course Outcomes:**

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.

- Illustratedifferentsensortechnologiesforsensingrealworldentitiesandidentifythe applications of IoT in Industry.

**UNITI**

Introduction to Internet of Things–Definition and Characteristics of IoT, Physical Design of IoT–IoT Protocols,IoT communication models, IoT Communication APIs, IoT enabled Technologies –Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs–Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

**UNITII**

IoT and M2M– Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG-NETCONF, YANG, SNMPNETOPEER.

**UNITIII**

IntroductiontoPython-LanguagefeaturesofPython,Datatypes,datastructures,Controlof flow,functions,modules,packaging,filehandling,data/timeoperations,classes,Exceptionhandling.Python packages-JSON,XML, HTTPLib, URLLib, SMTPLib.

**UNITIV**

IoT Physical Devices and Endpoints-Introduction to Raspberry PI-Interfaces (serial,SPI, I2C).Programming–Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading in put from pins.

**UNITV**

IoT Physical Servers and Cloud Offerings–Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application frame work. Designing a REST fulweb API. Case studies illustrating IoT Design.

**Text Books**

1. InternetofThings-A Hands-on Approach, Arshdeep Bahgaand Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

**References:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)

2. Getting Started with Raspberry Pi, MattRichardson & ShawnWallace, O'Reilly(SPD),2014, ISBN:9789350239759

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# OEC_V
# (18OE0508) BIG DATA ANALYSIS

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objectives:**

- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to various techniques for mining data stream.
- To understand the applications using Map Reduce Concepts.

**Course Outcomes:**

On completion of this course the student will able to

- Analyze the big data analytics techniques for useful business application.
- Design efficient algorithms for mining the data from large volumes.
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics.
- Explore on big data applications using Pig and Hive.

**UNIT I**

**Introduction to Big Data :** Introduction to Big Data Platform – Challenges of Conventional System – Intelligent data analysis – Nature of Data – Analytic Processes and Tool – Analysis vs Reporting – Modern Data Analytic Tool – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Prediction Error.

**UNIT II**

**Mining Data Streams:** Introduction To Stream Concepts – Stream Data Model and Architecture - Stream Computing – Sampling Data in a Stream – Filtering Stream – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) Applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

**UNIT III**

**Hadoop:** History of Hadoop- The Hadoop Distributed File System – Components of Hadoop – Analyzing the Data with Hadoop – Scaling Out – Hadoop Streaming – Design of HDFS- Java interfaces to HDFS Basics- Developing a Map Reduce Application – How Map Reduce Works – Anatomy of a Map Reduce Job run – Failures – Job Scheduling – Shuffle and Sort – Task Execution – Map Reduce Types and Formats – Map Reduce Features.

**UNIT IV**

**Hadoop Environment:** Setting up a Hadoop Cluster – Cluster specification – Cluster Setup and Installation –Hadoop Configuration – Security in Hadoop – Administering Hadoop – HDFS – Monitoring – Maintence – Hadoop Benchmarks – Hadoop in the Cloud.

**UNIT V**

**Frameworks:** Applications on Big Data Using Pig and Hive – Data Processing operators in Pig – Hive Services – Hive QL – Querying Data in Hive – fundamentals of HBase and Zookeeper – IBM Info Sphere Big Insights and Streams. Visualization - Visual data analysis techniques, interaction techniques; Systems and applications.

**Text Books:**

1. Michael Berthold, David J.Hand, Intelligent Data Analysis, Spingers, 2007.

2.Tom White, Hadoop: The Definitive Guide Third Edition, O'reilly Media, 2012.

3.Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGrawHill Publishing, 2012.

4.Anand Rajaraman and Jeffrey David UIIman, Mining of Massive Datasets Cambridge University Press, 2012.

**References:**

1.Bill Franks, Taming the big Data tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.

2.Glenn J. Myatt, Making Sense of Data , John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.

3. Jiawei Han, MichelineKamber, Data Mining Concepts and Techniques, Second Edition.

4. Elsevier, Reprinted 2008. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, Intelligent Data Mining, Springer, 2007.

5. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, Harness the Power of Big Data the IBM Big Data Platform, Tata McGraw Hill Publications, 2012.

6.Michael Minelli (Author), Michele Chambers (Author), AmbigaDhirraj (Author), Big Data, BigAnalytics.

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## OEC_VI

## (18OE0207) UTILIZATION OF ELECTRICAL ENERGY

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objective:**

- To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
- To acquaint with the different types of heating and welding techniques.
- To study the basic principles of illumination and its measurement.
- To understand different types of lightning system including design.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.

**Course Outcome**:

- Able to identify a suitable motor for electric drives and industrial applications
- Able to identify most appropriate heating or welding techniques for suitable applications.
- Able to understand various level of luminosity produced by different illuminating sources.

- Able to estimate the illumination levels produced by various sources and recommend the most efficient illuminating sources and should be able to design different lighting systems by taking inputs and constraints in view.
- Able to determine the speed/time characteristics of different types of traction motors.
- Able to estimate energy consumption levels at various modes of operation

**UNIT I**

**SELECTION OF MOTORS**

Choice of motor, type of electric drives, starting and running characteristics– Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization.

**UNIT II**

**ELECTRIC HEATING AND ELECTRIC WELDING**

**Electric Heating:** Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

**Electric Welding:** Electric welding–Resistance and arc welding–Electric welding equipment– Comparison between AC and DC Welding.

**UNIT III**

**ILLUMINATION FUNDAMENTALS**

Introduction, terms used in illumination–Laws of illumination–Polar curves– Integrating sphere–Lux meter–Sources of light.

**UNIT IV**

**VARIOUS ILLUMINATION METHODS**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

**UNIT V**

**ELECTRIC TRACTION**

**Electric Traction-I:** Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves..

**Electric Traction-II** Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion

**Text Books:**

- Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
- Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai & Sons.

**Reference Books:**

- Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

- Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997

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**OEC_VI**

**(18OE0511) DATABASE MANAGEMENT SYSTEMS**

| B.Tech | VIII SEMESTER | L | T | P | C |
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**Course Objectives:**

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- To understand and use data manipulation language to query, update, and manage a database
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

**Course Outcomes:**

- For a given query write relational algebra expressions for that query and optimize the developed expressions
- For a given specification of the requirement design the databases using E_R method and normalization.
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

- Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

**UNIT- I**

**Introduction**: Database System Applications, Purpose of Database Systems, View of Data - Data Abstraction, Data Independence , Data Models, Database Languages - DDL, DML, Database Architecture, Database Users and Administrators.

**Introduction to Data base design**: ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Conceptual Design with the ER Model.

**Relational Model: Integrity** Constraints over Relations, Logical data base Design, Introduction to Views destroying/ altering Tables and Views.

**UNIT- II**

**Relational Algebra and Calculus:** Relational Algebra - Selection and Projection, Set operations, Renaming, Joins, Division, Examples of Algebra Queries, Relational calculus - Tuple relational Calculus - Domain relational calculus.

**Form of Basic SQL Query-** Examples of Basic SQL Queries, Introduction to Nested Queries, Correlated Nested Queries, Set - Comparison Operators, Aggregate Operators, NULL values - Comparison using Null values - Logical connectives - AND, OR and NOT - Outer Joins, Triggers.

**UNIT -III**

**Introduction to Schema Refinement-** Problems Caused by redundancy, Functional Dependencies, Armstrong's axioms, Normal Forms - FIRST, SECOND, THIRD Normal forms - BCNF - Properties of Decompositions- Loss less join Decomposition, Dependency preserving Decomposition - FOURTH Normal Form, FIFTH Normal form.

**UNIT- IV**

**Transaction Management:** Transaction Concept, Transaction State, ACID Property, Serializability, Recoverability.

**Concurrency Control:** Lock - Based Protocols, Timestamp Based Protocols, Validation - Based Protocols, Multiple Granularities.

**Recovery System:** Log - Based Recovery, Buffer Management, Remote Backup systems.

**UNIT- V**

**Storage strategies and Indexing:** RAID Levels, Indices.

**Tree Structured Indexing:** Indexed Sequential Access Methods (ISAM) B+ Trees: Search, Insert, Delete.

**Hash Based Indexing:** Static Hashing, Extendable hashing, Linear Hashing, Extendible vs. Linear Hashing.

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models

**TEXT BOOKS:**

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, McGrawHill Education, 3rd Edition, 2003.

2. Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition, 2006.

**REFERENCE BOOKS:**

1. Database Systems, 6th edition, RamezElmasri, Shamkat B. Navathe, Pearson Education, 2013.

2. “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer Science Press.
3. Database Systems Concepts, Peter Rob & Carlos Coronel, Cengage Learning, 2008.
4. Introduction to Database Systems, C.J. Date, Pearson Education.
5. Database Management Systems, G.K. Gupta, McGraw Hill Education.

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**OEC_VI**
**(18OE0403) WAVELET TRANSFORMS**

| B.Tech | VIII SEMESTER | L | T | P | C |
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**COURSE OBJECTIVE**

- To expose the students to the basics of wavelet theory and to illustrate the use of wavelet processing for data compression and noise suppression.

**UNIT-I**

**CONTINUOUS WAVELET TRANSFORM**

Introduction, C-T wavelets, Definition of CWT, The CWT as a correlation. Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT

**UNIT-II**

**INTRODUCTION TO DISCRETE WAVELET TRANSFORM AND ORTHOGONAL WAVELET DECOMPOSITION**

Introduction: Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional liner vector space, (ii) Example of approximating

vectors in nested subspaces of an infinite dimensional linear vector space. Example MRA. (i) Bases for the approximations subspaces and Harr scaling function, (ii) Bases for detail subspaces and Haar wavelet

**UNIT-III**

**MRA, ORTHO NORMAL WAVELETS AND THEIR RELATIONSHIP TO FILTER BANKS**

Introduction: Formal definition of an MRA. Construction of a general orthonormal MRA, (i) scaling function and subspaces, (ii) Implication of dilation equation and orthogonality, a wavelet basis for MRA. (i) Two scale relations for (t), (ii) Basis for the detail subspace (iii) Direct sum decomposition, Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal

**UNIT-IV**

**Non - separable multidimensional wavelets**

Non - separable multidimensional wavelets, wavelet packets. Wavelets Transform and Data Compression: Introduction, transform coding, DTWT for image compression (i) Image compression using DTWT and run-length encoding.

**UNIT-V**

**CONSTRUCTION OF SIMPLE WAVELETS**

Construction of simple wavelets like Harr and DB1. Other Applications of Wavelet Transforms: Introduction, wavelet de-noising, speckle removal, edge detection and object isolation, Image fusions, Object detection by wavelet transforms of projections.

**TEXT BOOKS** :

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.

2. Wavelets and Sub band Coding, M.Vetterli and J.Kovacevic, Prentice Hall, 1995.

3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S.Bopardikar, Pearson Education Asia, 2000.

**REFERENCES**:

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.

2.Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John Wiley & Sons, 2010 .

3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.

4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.

5. A friendly guide to Wavelets, Gerald keiser, Springer, 2011.

6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004.

7. Wavelets: from math too practice, Desanka.P.Radunovik, springer, 2009.

8. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 200