# COURSE STRUCTURE AND SYLLABUS

For

# B.Tech

## ELECTRICAL AND ELECTRONICS ENGINEERING

(*Applicable for batches admitted from 2016-17*)

# PRAGATI ENGINEERING COLLEGE

**(AUTONOMOUS)**

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
# 1-378, ADB Road, Surampalem – 533 437
Near Peddapuram, E.G.Dist, Andhra Pradesh

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**I Year – I Semester**

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16BH1T01 | English–I | 3 | 1 | -- | 3 |
| 2 | 16BH1T03 | Mathematics- I | 3 | 1 | -- | 3 |
| 3 | 16BH1T12 | Applied Chemistry | 3 | 1 | -- | 3 |
| 4 | 16ME1T01 | Engineering Mechanics | 3 | 1 | -- | 3 |
| 5 | 16CS1T01 | Computer Programming Using C | 3 | 1 | -- | 3 |
| 6 | 16BH1T13 | Environmental Studies | 3 | 1 | -- | 3 |
| 7 | 16BH1L05 | Engineering/Applied Chemistry Lab | -- | -- | 3 | 2 |
| 8 | 16BH1L01 | English-Communication Skills Lab -I | -- | -- | 3 | 2 |
| 9 | 16CS1L10 | C-Programming Lab | -- | -- | 3 | 2 |
| **Total Credits** | | | | | | **24** |

**I Year – II Semester**

| S.No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16BH2T02 | English–II | 3 | 1 | -- | 3 |
| 2 | 16BH2T04 | Mathematics–II (Mathematical Methods) | 3 | 1 | -- | 3 |
| 3 | 16BH2T06 | Mathematics–III | 3 | 1 | -- | 3 |
| 4 | 16BH2T10 | Applied Physics | 3 | 1 | -- | 3 |
| 5 | 16EE2T01 | Network Theory-I | 3 | 1 | -- | 3 |
| 6 | 16ME2T02 | Engineering Drawing | 3 | 1 | -- | 3 |
| 7 | 16BH2L02 | English-Communication Skills Lab-II | -- | -- | 3 | 2 |
| 8 | 16BH2L03 | Engineering/Applied Physics Lab | -- | -- | 3 | 2 |
| 9 | 16BH2L04 | Engineering/Applied Physics–Virtual Lab-Assignments | -- | -- | 2 | -- |
| 10 | 16ME2L01 | Engineering Workshop & IT Workshop | -- | -- | 3 | 2 |
| **Total Credits** | | | | | | **24** |

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**I Year I Semester**

**Subject Code: 16BH1T01**

**ENGLISH – I**

**Introduction:**
In view of the growing importance of English as a tool for global communication and the consequent emphasis on training the students have to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competence of the students of Engineering. As far as the detailed Textbooks are concerned, the focus should be on the skills of listening, speaking, reading and writing. The non-detailed Textbooks are meant for extensive reading for pleasure and profit. Thus, the stress in the syllabus is primarily on the development of communicative skills and fostering of ideas.

**Objectives:**
To improve the language proficiency of the students in English with emphasis on LSRW skills.

1. To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theoretical and practical components.
2. To develop the communication skills of the students in both formal and informal situations.

LISTENING SKILLS:

**Objectives:**

1. To enable the students to appreciate the role of listening skill and improve their pronunciation.
2. To enable the students to comprehend the speech of people belonging to different backgrounds and regions.
3. To enable the students to listen for general content, to fill up information and for specific information.

SPEAKING SKILLS:

**Objectives:**

1. To make the students aware of the importance of speaking for their personal and professional communication.
2. To enable the students to express themselves fluently and accurately in social and professional success.
3. To help the students describe objects, situations and people.
4. To make the students participate in group activities like role-plays, discussions and debates.
5. To make the students participate in Just a Minute talks.

READING SKILLS:

**Objectives:**

1. To enable the students to comprehend a text through silent reading.
2. To enable the students to guess the meanings of words, messages and inferences of texts in given contexts.
3. To enable the students to skim and scan a text.
4. To enable the students to identify the topic sentence.
5. To enable the students to identify discourse features.

6. To enable the students to make intensive and extensive reading.

WRITING SKILLS:

**Objectives:**

1. To make the students understand that writing is an exact formal skills.
2. To enable the students to write sentences and paragraphs.
3. To make the students identify and use appropriate vocabulary.
4. To enable the students to narrate and describe.
5. To enable the students capable of note-making.
6. To enable the students to write coherently and cohesively.
7. To make the students to write formal and informal letters.
8. To enable the students to describe graphs using expressions of comparison.
9. To enable the students to write technical reports.

**Methodology:**

1. The classes are to be learner-centred where the learners are to read the texts to get a comprehensive idea of those texts on their own with the help of the peer group and the teacher.
2. Integrated skill development methodology has to be adopted with focus on individual language skills as per the tasks/exercise.
3. The tasks/exercises at the end of each unit should be completed by the learners only and the teacher intervention is permitted as per the complexity of the task/exercise.
4. The teacher is expected to use supplementary material wherever necessary and also generate activities/tasks as per the requirement.
5. The teacher is permitted to use lecture method when a completely new concept is introduced in the class.

**DETAILED TEXTBOOKS**:

- *ENGLISH FOR ENGINEERS AND TECHNOLOGISTS, Published by Orient Blackswan Pvt Ltd*
- *THE COP AND THE ANTHEM BY O. HENRY PUBLISHED BY PERFECTION LEARNING*

**NON-DETAILED TEXTBOOK:**

- *-PANORAMA: A COURSE ON READING, Published by Oxford University Press India*

The course content along with the study material is divided into six units.

**UNIT I:**

*1. 'Human Resources' from English for Engineers and Technologists.*

Objective:

To develop human resources to serve the society in different ways.

Outcome:

The lesson motivates the readers to develop their knowledge different fields and serve the society accordingly.

*2. 'An Ideal Family' from Panorama: A Course on Reading*

Objective:

To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills

**UNIT 2:**

*1. ' Transport: Problems and Solutions' from English for Engineers and Technologists.*

Objective:
To highlight road safety measures whatever be the mode of transport.
Outcome:
The lesson motivates the public to adopt road safety measures.

*2. 'War' from 'Panorama : A Course on Reading'*

Objective:
To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills

**UNIT 3:**

Unit 3 has two sections: Unit 3(A ) and 3(B )

**3(A):**

*1. 'Evaluating Technology' from English for Engineers and Technologists.*

Objective:
To highlight the advantages and disadvantages of technology.
Outcome:
The lesson creates an awareness in the readers that mass production is ultimately survival.

*2. 'The Verger' from 'Panorama : A Course on Reading'*

Objective:
To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills

*Unit 3(B )*

- *1. THE COP AND THE ANTHEM BY O.HENRY*

Objective:
To enable students to develop interest in reading and appreciating short stories of different genres.
Outcome:
This lesson motivates students to respond and express the ideas and feelings in the story through oral, written and performative means.

**UNIT 4:**

*1. 'Alternative Sources of Energy' from English for Engineers and Technologists.*

Objective:
To bring into focus different sources of energy as alternatives to the depleting sources.
Outcome:
The lesson helps to choose a source of energy suitable for rural India.

*2. ' The Scarecrow' from Panorama : A Course on Reading*

Objective:
To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills.

**UNIT 5:**

*1. 'Our Living Environment' from English for Engineers and Technologists.*

Objective:
To highlight the fact that animals must be preserved because animal life is precious.
Outcome:
The lesson creates an awareness in the reader as to the usefulness of animals for the human society.

*2. 'A Village Host to Nation' from Panorama : A Course on Reading*

Objective:
To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills

**UNIT 6:**

*1. ' Safety and Training' from English for Engineers and Technologists.*

Objective:
To highlight the possibility of accidents in laboratories, industries and other places and to follow safety measures.
Outcome:
The lesson helps in identifying safety measures against different varieties of accidents at home and in the workplace.

*2. 'Martin Luther King and Africa' from Panorama : A Course on Reading*

Objective:
To develop extensive reading skill and comprehension for pleasure and profit.
Outcome:
Acquisition of writing skills

**NOTE:**

All the exercises given in the prescribed lessons in both detailed and non-detailed textbooks relating to the theme and language skills must be covered.

**OVERALL COURSE OUTCOME:**

1. Using English languages, both written and spoken, competently and correctly.
2. Improving comprehension and fluency of speech.
3. Gaining confidence in using English in verbal situations.

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**I Year I Semester**

**Subject Code: 16BH1T03**

**MATHEMATICS – I**

**Course Objectives:**

1. The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

**Course Outcomes:At the end of the Course, Student will be able to:**

1. Determine rank, Eigenvalues and Eigen vectors of a given matrix and solve simultaneous linear equations.
2. Solve simultaneous linear equations numerically using various matrix methods.
3. Solve linear differential equations of first, second and higher order.
4. Calculate total derivative, Jocobian and minima of functions of two variables.

**UNIT I: Linear systems of equations**

Rank-Echelon form-Normal form – Solution of linear systems – Gauss elimination - Gauss Jordon- Gauss Jacobi and Gauss Seidel methods.

**Applications:** Finding the current inelectrical circuits.

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

Eigen values - Eigen vectors– Properties – Cayley-Hamilton theorem - Inverse and powersof a matrix by using Cayley-Hamilton theorem- Diagonalization.

**Applications**: Free vibration of a two-mass system.

**UNIT III–Quadratic forms**

Quadratic formsReduction of quadratic form to canonical form – Rank - Positive, negative and semi definite- Index – Signature.

**UNIT IV: Differential equations of first order and first degree**

Linear-Bernoulli-Exact-Reducible to exact.

**Applications:** Newton's Law of cooling-Law of natural growth and decay-Orthogonaltrajectories-Electrical circuits- Chemical reactions.

**UNIT V: Linear differential equations of higher order**

Non-homogeneous equations of higher order with constant coefficients with RHS term of the type$e^{a}$, $\sin ax, \cos ax,$ polynomials in $x$, ${}^{ax}V\ x$ , $xV(x) -$ Method of Variation ofparameters.

**Applications:** LCR circuit, Simple Harmonic motion.

**UNIT VI: Partial differentiation**

Introduction- Homogeneous function-Euler's theorem-Total derivative-Chain ruleGeneralized Mean value theorem for single variable (without proof)-Taylor's and McLaurent's series expansion of functions of two variables - Jacobian– Functional dependence.

**Applications:** Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

**Text Books:**

1. **B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali,** Engineering Mathematics, Lakshmi Publications.
3. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India

**Reference Books:**

1. **Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn
2. **Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
3. **Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
4. **Srimanta Pal, SubodhC.Bhunia**, Engineering Mathematics, Oxford UniversityPress.
5. **Dass H.K., RajnishVerma. Er**, Higher Engineering Mathematics, S. Chand Co.Pvt. Ltd, Delhi.

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**I year - I semester**

**Subject Code: 16BH1T12**

## APPLIED CHEMISTRY

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

### UNIT I: HIGH POLYMERS AND PLASTICS

Polymerisation:- Definition- Types of Polymers - Mechanism of polymerization- Stereo regular polymers- Methods of polymerization(emulsion and suspension)-Physical and Mechanical properties. Plastics as engineering materials: advantages and limitations- Thermoplastics and Thermosetting plastics Compounding and fabrication (Compression, Injection, Extrusion and Blown Techniques )- Preparation, properties and applications of polyethene, PVC, Bakelite Teflon, Poly methyl Methacrylate( PMMA) and polycarbonates

Elastomers :- Natural rubber- Disadvantages- Mastication - compounding and vulcanization - Synthetic rubbers : Buna S, Buna N, Thiokol and polyurethanes - Applications of elastomers. Composite materials & Fiber reinforced plastics - Biodegradable polymers - Conducting polymers.

Learning Objectives: Plastics are nowadays used in household appliances; They are also used as composites (FRP) in aerospace and automotive industries.

Outcomes: The advantages and limitations of plastic materials and their use in design would be understood.

### UNIT II: FUEL TECHNOLOGY

Fuels – Definition –Classification - Characteristics of a good fuel - Calorific value - HCV and LCV - Dulong's formula - Bomb calorimeter – Numerical problems - Coal -- Proximate and Ultimate analysis and their Significance - Liquid fuels - Petroleum- Origin and Refining - Cracking - Synthetic petrol -Petrol knocking - Diesel knocking - Octane and Cetane ratings - Anti-knock agents - Power alcohol – Bio diesel, Gaseous fuels: - Natural gas, LPG and CNG, Combustion - Calculation of air for the combustion of a fuel, Flue gas analysis – Orsat's apparatus - Numerical problems on combustion Explosives:- Rocket fuels

Learning Objectives: Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence are introduced to create awareness on the topics.

Outcomes: Fuels which are used commonly and their economics, advantages and limitations can be understood by the students and create awareness on the topics.

### UNIT III: ELECTROCHEMICAL CELLS AND CORROSION

Galvanic cells - Reversible and irreversible cells - Single electrode potential - Electro chemical series and uses of this series- Standard electrodes (Hydrogen ,Calomel and Glass electrode) - Concentration Cells - Batteries: Dry Cell - Ni-Cd cells - Ni-Metal hydride cells - Li cells - Zinc - air cells.

*Fuel cells:- Introduction - cell representation, $H_2$-$O_2$ fuel cell: Design and working, advantages and limitations. Types of fuel cells: Alkaline fuel cell - methanol-oxygen - phosphoric acid fuel cells - molten carbonate fuel cells.*

**Corrosion :**- Definition - Theories of Corrosion (chemical & electrochemical) - Formation of galvanic cells by different metals, by concentration cells, by differential aeration and waterline corrosion - Passivity of

metals -Pitting corrosion - *Corrosion under insulation* -Galvanic series - Factors which influence the rate of corrosion –Protection from corrosion -Design and material selection - Cathodic protection - Protective coatings: - Surface preparation - Metallic (galvanizing and tinning) coatings - Methods of application on metals ( Electroplating, Electroless plating),

**Learning Objectives:** The basics for the construction of galvanic cells are introduced to have understanding on the concepts. Understanding on the concept of Corrosion and Mechanism of Corrosion with Theories like Electrochemical theory. .

**Outcomes:** Corrosion – its theories and controlling methods can create Understanding and awareness on the topic.

**UNIT IV: CHEMISTRY OF ADVANCED MATERIALS**

Nano materials:- Introduction - Sol-gel method & chemical reduction method of preparation- Characterization by Braunear Emmett Teller(BET) method, Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM) methods - Carbon nano tubes : Types, preparation(*Laser ablation and Chemical vapour deposition method*), properties and applications, Fullerenes.

Liquid crystals:- Introduction - Types - Applications

Super conductors:-Type -I, Type II - Characteristics and applications

Green synthesis :- Principles of Green Chemistry - Methods of synthesis (Aqueous Phase Method, Super Critical Fluid Extraction and Phase Transfer Catalysis) with examples - $R_4M_4$ principles

Learning Objectives : With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials are introduced in Unit – IV.

Outcomes: The students will have awareness on now aware of materials like nano materials and fullerenes and their applications. Study on liquid crystals and superconductors can create understanding for their applications in various fields. The importance of green synthesis create better understanding for application and also can create better understanding compared to conventional methods is also explained

**UNIT V: SOLID STATE CHEMISTRY**

Types of solids - close packing of atoms and ions - BCC , CC, structures of rock salt cesium chloride-spinel - normal and inverse spinels, Non-elemental semiconducting Materials:- Stoichiometric, controlled valency & Chalcogen photo/semiconductors, Preparation of emiconductors - Semiconductor Devices:- p-n junction diode as rectifier - junction transistor.Insulators (electrical and electronic applications)

Magnetic materials:- Ferro and ferri magnetism. Hall effect and its applications.

Learning Objectives: Understanding of crystal structures will help to understand the conductivity, semiconductors and superconductors. Magnetic properties are also studied to have better Understanding.

Outcomes: Conductance phenomenon can be better understood

**UNIT VI: NON CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**

Solar Energy: - Introduction, application of solar energy, conversion of solar energy (Thermal conversion & photo conversion) - photovoltaic cell: design, working and its importance

Non-conventional energy sources

(i)Hydropower include setup a hydropower plant (schematic diagram)

(ii ) Geothermal energy: Introduction-schematic diagram of a geothermal power plant

(iii) Tidal and wave power: Introduction- Design and working-movement of tides andtheir effect on sea level.

(iv) Ocean thermal energy: Introduction, closed-cycle, ocean thermal energy conversion (OTEC), open cycle OTEC, hybrid OTEC, schematic diagram and explanation.

(v) Biomass and biofuels

Learning Objectives: With the increase in demand for power and also with depleting sources of fossil fuels, the demand for alternative sources of fuels is increasing. Some of the prospective fuel sources are introduced and the study can create a better understanding on the Non –Conventional Energy Sources and Storage Devices.

Outcomes: The students are exposed to some of the alternative fuels and their advantages and limitations.

**Text Books:**

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co.
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.

**Reference Books:**

1.Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
2.Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015 edition.
3.A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4.Applied Chemistry by H.D. Gesser, Springer Publishers
5.Text book of Nano-science and nanotechnology by B.S. Murthy, P.Shankar and others, University Press, IIM

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**I Year - I Semester**

**Subject Code: 16CS1T01**

## COMPUTER PROGRAMMING USING C

**Learning objectives:**

Formulating algorithmic solutions to problems and implementing algorithms in C.

- Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editingand executing programs in Linux.
- Understanding branching, iteration and data representation using arrays.
- Modular programming and recursive solution formulation.
- Understanding pointers and dynamic memory allocation.
- Understanding miscellaneous aspects of C.
- Comprehension of file operations.

**UNIT-I:**

**History and Hardware** - Computer Hardware, Bits and Bytes, Components, Programming Languages - Machine Language, Assembly Language, Low- and High-Level Languages, Procedural and Object-Oriented Languages, Application and System Software, The Development of C Algorithms The Software Development Process.

**UNIT-II:**

**Introduction to C Programming-** Identifiers, The main () Function, The printf () Function P**rogramming Style** - Indentation, Comments, Data Types**,** Arithmetic Operations, Expression Types, Variables and Declarations, Negation, Operator Precedence and Associativity, Declaration Statements, Initialization.

**Assignment** - Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.

**UNIT -III:**

**Control Flow-Relational Expressions - Logical Operators:**

**Selection**: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples.

**Repetition**: Basic Loop Structures, Pretest and Posttest Loops, Counter-Controlled and Condition-Controlled Loops, while Statement, for Statement, Nested Loops, do-while Statement.

**UNIT-IV**

**Modular Programming:** Function and Parameter Declarations, Returning a Value, Functions withEmpty Parameter Lists, Variable Scope, Variable Storage Class, Local Variable Storage Classes, Global Variable Storage Classes, Pass by Reference, Passing Addresses to a Function, Storing Addresses, Using Addresses, Declaring and Using Pointers, Passing Addresses to a Function.

**Case Study:** Swapping Values, Recursion - Mathematical Recursion, Recursion versus Iteration.

**UNIT-V:**
**Arrays & Strings**
**Arrays:** One-Dimensional Arrays, Input and Output of Array Values, Array Initialization, Arrays asFunction Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays- Matrices.
**Strings:** String Fundamentals, String Input and Output, String Processing, Library Functions

**UNIT-VI:**
**Pointers, Structures, Files**
**Pointers**: Concept of a Pointer, Initialization of pointer variables, pointers as function arguments,passing by address, Dangling memory, address arithmetic, character pointers and functions,pointers to pointers, Dynamic memory management functions, command line arguments.

**Structures**: Derived types, Structures declaration, Initialization of structures, accessing structures,nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bit-fields.

**Data Files**: Declaring, Opening, and Closing File Streams, Reading from and Writing to Text Files, Random File Access

**Outcomes:**
- Understand the basic terminology used in computer programming
- Write, compile and debug programs in C language.
- Use different data types in a computer program.
- Design programs involving decision structures, loops and functions.
- Explain the difference between call by value and call by reference
- Understand the dynamics of memory by the use of pointers
- Use different data structures and create/update basic data files.

**Text Books:**
1. ANSI C Programming, Gary J. Bronson, Cengage Learning.
2. Programming in C, B. L.Juneja, Anita Seth, Cengage Delmar Learning India Pvt.
3. The C programming Language, Dennis Richie and Brian Kernighan, Pearson Education.

**Reference Books:**
1. C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2. Programming with C, R S Bichkar, University Press, 2012.
3. Programming in C, ReemaThareja, Oxford.
4. C by Example, Noel Kalicharan, Cambridge University Press.

**URLs**

1. http://nptel.ac.in/courses/106104128/
2. http://students.iitk.ac.in/programmingclub/course/#notes
3. http://c-faq.com/~scs/cclass/cclass.html
4. http://www.youtube.com/watch?v=b00HsZvg-V0&feature=relmfu
5. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/

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**I year - I semester**

**Subject Code: 16BH1T13**

## ENVIRONMENTAL STUDIES

### UNIT – I

Course Learning Objectives: Basic understanding of the environment, global problems and ecosystems.
Course Outcomes: The importance of environment and global environmental problems. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.

**Multidisciplinary nature of Environment and Ecology:** Definition, Scope and Importance, *Introduction to Brief works of noted Environmentalists & Naturalists*(*Wangari Mathai*,*Salim Ali and Sunderlal Bahuguna)* ,Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, Carbon Credits, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.
**Ecosystems:** Concept of an ecosystem**,** Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. Classification of ecosystems- characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems: Estuaries and Mangroves

### UNIT – II

Course Learning Objectives: Overall understanding of the natural resources
Course Outcomes: The natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.
**Natural Resources:** Natural resources and associated problems
Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people
Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Sustainable mining of Granite, Laterite, Coal, Sea and River sands.
Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources Vs Oil and Natural Gas Extraction.
Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

### UNIT – III

Course Learning Objectives**:** Basic understanding of Biodiversity.
Course Outcomes: The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity

**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity.

**UNIT – IV**

Course Learning Objectives: Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
Course Outcomes: Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices
**Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, *Heavy Metal pollution*, Soil pollution, Noise pollution, Radioactive pollution: Sources and risks. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Style, Impact of Fire Crackers on Man and his well being.
**Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e - waste management.

**UNIT – V**

Course Learning Objectives: Awareness on the social issues, environmental legislation and global treaties
Course Outcomes: Social issues both rural and urban environment and the possible means to combat the challenges. The environmental legislations of India and the first global initiatives towards sustainable development.
**Social Issues and the Environment:** Urban problems related to energy -Water conservation- *Coastal Regulatory zone management*, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental 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.

**UNIT – VI**

Course Learning Objectives: An understanding of the environmental impact of developmental activities
Course Outcomes: About environmental assessment and the stages involved in EIA and the environmental audit. Self Sustaining Green Campus with Environment Friendly aspect of – Energy, Water and Wastewater reuse Plantation, Rain water Harvesting, Parking & Curriculum.
**Environmental Management**: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. *Environmental Modeling: Definition (Box Model and Gaussian Plume Modeling),* Ecotourism, Green Campus – Green business, Green politics *and Green Building*.
The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

## TEXT BOOKS:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P.N. Palanisamy, P. Manikandan, A. Geetha, and K.Manjula Rani; Pearson Education, Chennai

## REFERENCE:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014
5. Environmental pollution, Monitoring and Control by Khopkar.S.M, New Age Publishers.
6. *A Text Book of Fundamentals of Ecology, E.P.Odam, Philadelphia: W.B. Saunders Company.*

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**I year - I semester**

**Subject Code: 16BH1L05**

## ENGINEERING/APPLIED CHEMISTRY LAB

1. Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,
2. Trial experiment – Estimation of HCI using standard Na2co2 solutions
3. Estimation of KMnO4 using standard Oxalic acid solution.
4. Estimation of Ferric iron using standard K2Cr2O7 solution
5. Estimation of Copper using standard K2Cr2O7 solution.
6. Estimation of Total Hardness water using standard EDTA solution.
7. Estimation of Copper using standard EDTA solution.
8. Estimation of Copper using Colorimeter
9. Estimation of pH of the given sample solution using pH meter.
10. Conductometric Titrations between strong acid and strong base
11. Conductometric Titrations between strong acid and Weak base
12. Potentiometric Titrations between strong acid and strong base
13. Potentiometric Titrations between strong acid and Weak base
14. Estimatinog of Zinc using standard potassium ferrocyanide solution
15. Estimation of Vitamin – C

**STANDARD BOOKS :**


1. Dr.Jyotsna Cherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2. Chemistry Practical Manual, Lorven Publications
3. K. Mukkanti (2009) Practical Engineering Chemistry, B.S. Publication

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**I Year - I Semester**

**Subject Code:16BH1L01**

**ENGLISH - COMMUNICATION SKILLS LAB- I**

**PRESCRIBED LAB MANUAL FOR SEMESTER I:**
*'INTERACT: English Lab Manual for Undergraduate Students'*, Published by Orient Black swan Pvt Ltd.

**Objectives:**
To enable the students to learn through practice the communication skills of listening, speaking, reading and writing.

**Outcome:**
A study of the communicative items in the laboratory will help the students become successful in the competitive world. The course content along with the study material is divided into six units.

**UNIT 1:**
1. WHY study Spoken English?
2. Making Inquiries on the phone, thanking and responding to Thanks -- Practice work.

**UNIT 2:**
1. Responding to Requests and asking for Directions -- Practice work.

**UNIT 3:**
1. Asking for Clarifications, Inviting, Expressing Sympathy, Congratulating
2. Apologising, Advising, Suggesting, Agreeing and Disagreeing -- Practice work.

**UNIT 4:**
1. Letters and Sounds -- Practice work.

**UNIT 5:**
1. The Sounds of English -- Practice work.

**UNIT 6:**
1. Pronunciation
2. Stress and Intonation -- Practice wor

**Reference Books:**


1. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3. Unlock, Listening and speaking skills 2, Cambridge University Press
4. Spring Board to Success, Orient BlackSwan
5. A Practical Course in effective english speaking skills, PHI
6. Word power made handy, Dr shalini verma, SchandCompany
7. Let us hear them speak, Jayashree Mohanraj, Sage texts

8. Professional Communication, Aruna Koneru, Mc Grawhill Education
9. Cornerstone, Developing soft skills, Pearson Education

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**I Year - I Semester**

**Subject Code:16CS1L10**

## C PROGRAMMING LAB

**OBJECTIVES:**

- Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures a File programming.
- Acquire knowledge about the basic concept of writing a program.
- Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Role of Functions involving the idea of modularity.

**Programming**

**Exercise - 1** Basics
a) What is an OS Command, Familiarization of Editors - vi, Emacs
b) Using commands like mkdir, ls, cp, mv, cat, pwd, and man
c) Write a C Program to perform Adding, Subtraction, Multiplication and Division of two numbers from Command line

**Exercise - 2** Basic Math
a) Write a C Program to Simulate 3 Laws at Motion
b) Write a C Program to convert Celsius to Fahrenheit and vice versa

**Exercise - 3** Control Flow - I
a) Write a C Program to Find Whether the Given Year is a Leap Year or not.
b) Write a C Program to Add Digits & Multiplication of a number

**Exercise – 4** Control Flow - II
a) Write a C Program to Find Whether the Given Number is
   i. Prime Number
   ii. Armstrong Number
b) Write a C program to print Floyd Triangle
c) Write a C Program to print Pascal Triangle

**Exercise – 5** Functions
a) Write a C Program demonstrating of parameter passing in Functions and returning values.
b) Write a C Program illustrating Fibonacci, Factorial with Recursion without Recursion

**Exercise – 6** Control Flow - III
a) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using switch…case
b) Write a C Program to convert decimal to binary and hex (using switch call function the function)

**Exercise – 7** Functions - Continued

Write a C Program to compute the values ofsin x and cos x and e^x values using Series expansion. (use factorial function)

**Exercise – 8** Arrays
Demonstration of arrays
a) Search-Linear.
b) Sorting-Bubble, Selection.
c) Operations on Matrix.

**Exercises - 9** Structures
a) Write a C Program to Store Information of a Movie Using Structure
b) Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
c) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

**Exercise - 10** Arrays and Pointers
a) Write a C Program to Access Elements of an Array Using Pointer
b) Write a C Program to find the sum of numbers with arrays and pointers.

**Exercise – 11** Dynamic Memory Allocations
a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.
Understand the difference between the above two programs.

**Exercise – 12** Strings
a) Implementation of string manipulation operations **with** library function.
i) copy
ii) concatenate
iii) length
iv) compare
b) Implementation of string manipulation operations **without** library function.
i) copy
ii) concatenate
iii) length
iv) compare

**Exercise -13** Files
a) Write a C programming code to open a file and to print it contents on screen.
b) Write a C program to copy files

**Exercise - 14** Files Continue
a) Write a C program merges two files and stores their contents in another file.
b) Write a C program to delete a file.

**OUTCOMES:**

- Apply and practice logical ability to solve the problems.
- Understand C programming development environment, compiling, debugging, and linking and executing a program using the development environment
- Analysing the complexity of problems, Modularize the problems into small modules and then convert them into programs
- Understand and apply the in-built functions and customized functions for solving the problems.
- Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
- Document and present the algorithms, flowcharts and programs in form of user-manuals
- Identification of various computer components, Installation of software

**Note:**

**a) All the Programs must be executed in the Linux Environment. (Mandatory)**
**b) The Lab record must be a print of the LATEX (.tex) Format.**

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**I year - II semester**

**Subject Code: 16BH2T02**

## ENGLISH-II

**Introduction:**

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training the students have to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competence of the students of Engineering.

As far as the detailed Textbooks are concerned, the focus should be on the skills of listening, speaking, reading and writing. The non-detailed Textbooks are meant for extensive reading for pleasure and profit. Thus the stress in the syllabus in primarily on the development of communicative skills and fostering of ideas.

**Objectives:**

1. To improve the language proficiency of the students in English with emphasis on LSRW skills.
2. To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theoretical and practical components.
3. To develop the communication skills of the students in both formal and informal situations.

### LISTENING SKILLS

Objectives:

1. To enable the students to appreciate the role of listening skill and improve their pronunciation.
2. To enable the students to comprehend the speech of people belonging to different backgrounds and regions.
3. To enable the students to listen for general content, to fill up information and for specific information.

### SPEAKING SKILLS

Objectives:

1. To make the students aware of the importance of speaking for their personal and professional communication.
2. To enable the students to express themselves fluently and accurately in social and professional success.
3. To help the students describe objects, situations and people.
4. To make the students participate in group activities like role-plays, discussions and debates.
5. To make the students participate in Just a Minute talks.

### READING SKILLS

Objectives:

1. To enable the students to comprehend a text through silent reading.
2. To enable the students to guess the meanings of words, messages and inferences of texts in given contexts.
3. To enable the students to skim and scan a text.
4. To enable the students to identify the topic sentence.
5. To enable the students to identify discourse features.
6. To enable the students to make intensive and extensive reading.

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WRITING SKILLS

Objectives:

1. To make the students understand that writing is an exact formal skills.
2. To enable the students to write sentences and paragraphs.
3. To make the students identify and use appropriate vocabulary.
4. To enable the students to narrate and describe.
5. To enable the students capable of note-making.
6. To enable the students to write coherently and cohesively.
7. To make the students to write formal and informal letters.
8. To enable the students to describe graphs using expressions of comparison.
9. To enable the students to write technical reports.

**Methodology:**

1. The classes are to be learner-centred where the learners are to read the texts to get a comprehensive idea of those texts on their own with the help of the peer group and the teacher.
2. Integrated skill development methodology has to be adopted with focus on individual language skills as per the tasks/exercise.
3. The tasks/exercises at the end of each unit should be completed by the learners only and the teacher intervention is permitted as per the complexity of the task/exercise.
4. The teacher is expected to use supplementary material wherever necessary and also generate activities/tasks as per the requirement.
5. The teacher is permitted to use lecture method when a completely new concept is introduced in the class.

The following text books are recommended for study in I B.Tech II Semester (Common for all branches) of Pragati Engineering College, Surampalem from the academic year 2016-17 (R-16 Regulations)

**DETAILED TEXTBOOK:**

- *ENGLISH ENCOUNTERS Published by Maruthi Publishers.*

- A BETTER INDIA, A BETTER WORLD by N.R. Narayana Murthy,Published by: Penguin Books India Pvt. Ltd.

**DETAILED NON-DETAIL:**

- *THE GREAT INDIAN SCIENTISTS, Published by Cengage learning*

The course content along with the study material is divided into six units.

**UNIT 1:**

*1. ' The Greatest Resource- Education' from English Encounters*

Objective:

Schumacher describes the education system by saying that it was mere training, something more than mere knowledge of facts.

Outcome:

The lesson underscores that the ultimate aim of Education is to enhance wisdom.

*2. ' A P J Abdul Kalam' from The Great Indian Scientists.*

Objective:
The lesson highlights Abdul Kalam's contributions to Indian science and the awards he received.
Outcome:
Abdul Kalam's simple life and service to the nation inspires the readers to follow in his footsteps.

**UNIT 2:**

*1. ' A Dilemma' from English Encounters*

Objective:
The lesson centres on the pros and cons of the development of science and technology.
Outcome:
The lesson enables the students to promote peaceful co-existence and universal harmony among people and society.

*2. 'C V Raman' from The Great Indian Scientists.*

Objective:
The lesson highlights the dedicated research work of C V Raman and his achievements in Physics.

Outcome:
The Achievements of C V Raman are inspiring and exemplary to the readers and all scientists.

**UNIT 3:**

***Unit 3 has two sections: Unit 3(A) and 3(B)***

**3 (A)**

*1. 'Cultural Shock': Adjustments to new Cultural Environments from English Encounters.*

Objective:
The lesson depicts of the symptoms of Cultural Shock and the aftermath consequences
Outcome:
The lesson imparts the students to manage different cultural shocks due to globalization.

*2. 'Homi Jehangir Bhabha' from The Great Indian Scientists.*

Objective:
The lesson highlights Homi Jehangir Bhabha's contributions to Indian nuclear program as architect.
Outcome:
The seminal contributions of HomiJehangirBhabha to Indian nuclear program provide an aspiration to the readers to serve the nation and strengthen it.

Unit 3 (B)

1.'What can we learn from West?' from A Better India, A Better World

Objective:
To enable students to appreciate the differences in cultural perspectives.
Outcome:
This lesson motivates students to develop a multicultural outlook and appreciate the diverse cultures.

**UNIT 4:**

*1. 'The Lottery' from English Encounters.*

Objective:
The lesson highlights insightful commentary on cultural traditions.
Outcome:

The theme projects society's need to re examine its traditions when they are outdated.

*2. 'Jagadish Chandra Bose' from The Great Indian Scientists.*

Objective:

The lesson gives an account of the unique discoveries and inventions of Jagadish Chandra Bose in Science.

Outcome:

The Scientific discoveries and inventions of Jagadish Chandra Bose provide inspiration to the readers to make their own contributions to science and technology, and strengthen the nation.

**UNIT 5:**

*1. ' The Health Threats of Climate Change' from English Encounters.*

Objective:

The essay presents several health disorders that spring out due to environmental changes

Outcome:

The lesson offers several inputs to protect environment for the sustainability of the future generations.

*2. ' Prafulla Chandra Ray' from The Great Indian Scientists.*

Objective:

The lesson given is an account of the experiments and discoveries in Pharmaceuticals of Prafulla Chandra Ray.

Outcome:

Prafulla Chandra Ray's scientific achievements and patriotic fervour provide inspiration to the reader.

**UNIT 6:**

*1. ' The Chief Software Architect' from English Encounters*

Objective:

The lesson supports the developments of technology for the betterment of human life.

Outcome:

Pupil gets inspired by eminent personalities who toiled for the present day advancement of software development.

*2. ' Srinivasa Ramanujan' from The Great Indian Scientists.*

Objective:

The lesson highlights the extraordinary achievements of Srinivasa Ramanujan, a great mathematician and the most romantic figure in mathematics.

Outcome:

The lesson provides inspiration to the readers to think and tap their innate talents

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**I year - II semester**

**Subject Code: 16BH2T04**

# MATHEMATICS – II
# (Mathematical Methods)

**Course Objectives:**

1. The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

**Course Outcomes:At the end of the Course, Student will be able to:**

1. Solve the numerical problems which will be the platform for engineering problems.
2. Determine Fourier series, Fourier Transforms of the given functions.
3. Solving the higher order partial differential equations.

**UNIT I: Solution of Algebraic and Transcendental Equations**

Introduction- Bisection method – Method of false position – Iteration method – Newton-Raphson method (Onevariable and simultaneous Equations).

**UNIT II: Interpolation**

Introduction- Errors in polynomial interpolation – Finite differences- Forward differences- Backward differences –Central differences – Symbolic relations and separation of symbols - Differences of a polynomial-Newton'sformulae for interpolation – Interpolation with unequal intervals - Lagrange's interpolation formula.

**UNIT III: Numerical Integration and solution of Ordinary Differential equations**

Trapezoidal rule- Simpson's 1/3rd and 3/8th rule-Solution of ordinary differential equations by Taylor's seriesPicard's method of successive approximations-Euler's method - Runge-Kutta method (second and fourth order).

**UNIT IV: Fourier Series**

Introduction- Periodic functions – Fourier series of -periodic function - Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

**UNIT V: Fourier Transforms**

Fourier integral theorem (without proof) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

**UNIT VI: Partial Differential Equations**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations. Classification of second order partial differential equations.

**Applications:** Method of separation of Variables- Solution of One dimensional Wave, Heat and twodimensional Laplace equations.

**Text Books:**

1. **B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.
3. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

**Reference Books:**

1. **Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
2. **V.Ravindranath**and **P.Vijayalakshmi**, Mathematical Methods, Himalaya Publishing House.
3. **David Kincaid, Ward Cheney**, Numerical Analysis-Mathematics of Scientific Computing, 3rd Edition, Universities Press.
4. **Srimanta Pal, SubodhC.Bhunia**, Engineering Mathematics, Oxford University Press.
5. **Dass H.K., RajnishVerma. Er.**, Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

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**I year - II semester**

**Subject Code: 16BH2T06**

**MATHEMATICS – III**

**Course Objectives:**

1. The course is designed to equip the students with the necessary mathematical skillsand techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base todevelop analytic and design concepts.
3. Understand the most basic numerical methods to solve simultaneous linear equations.

**Course Outcomes: At the end of the Course, Student will be able to:**

1. Determine Laplace transform and inverse Laplace transform of various functions and use Laplace transforms to determine general solution to linear ODE.
2. Determine double integral over a region and triple integral over a volume.
3. Calculate gradient of a scalar function, divergence and curl of a vector function.Determine line, surface and volume integrals. Apply Green, Stokes and Gaussdivergence theorems to calculate line, surface and volume integrals.

**UNIT I: Laplace transforms**

Laplace transforms of standard functions-Shifting theorems - Transforms of derivatives and integrals – Unit step function –Dirac's delta function.

**UNIT II: Inverse Laplace transforms**

Inverse Laplace transforms – Shifting Theorems - Transforms of derivatives and integrals - Convolution theorem (without proof).

**Applications:** Solving ordinary differential equations (initial value problems) using Laplace transforms.

**UNIT III: Multiple integrals**

Curve tracing: Cartesian, Polar and Parametric forms.

Multiple integrals: Double and triple integrals – Change of variables – Change of order ofintegration.

**Applications:** Finding Areas and Volumes.

**UNIT IV: Special functions**

Beta and Gamma functions- Properties - Relation between Beta and Gamma functions -Evaluation of improper integrals.

**Application**s: Evaluation of integrals.

**UNIT V: Vector Differentiation**

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities.

**Applications:** Equation of continuity, potential surfaces

**UNIT VI: Vector Integration**

Line integral – Work done – Potential function – Area- Surface and volume integrals Vectorintegral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) andrelated problems.

**Applications:** Work done, Force.

**Text Books:**

1. **B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.
3. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

**Reference Books:**

1. **Greenberg**, Advanced Engineering Mathematics, 2nd edition, Pearson edn
2. **Peter O'Neil**, Advanced Engineering Mathematics,7th edition, Cengage Learning.
3. **D.W. Jordan and T.Smith**, Mathematical Techniques, Oxford University Press.
4. **Srimanta Pal, SubodhC.Bhunia**, Engineering Mathematics, Oxford University Press.
5. **Dass H.K., RajnishVerma. Er.**, Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

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**I year - II semester**

**Subject Code: 16BH2T10** **APPLIED PHYSICS**

**COURSE OBJECTIVES:** Physics curriculum which is re-oriented to the needs of Circuital branches of graduate engineering courses. That serves as a transit to understand the branch specific advanced topics. The courses are designed to:

- Impart Knowledge of Physical Optics phenomena like Interference, Diffraction and Polarization involving required to design instruments with higher resolution.
- Teach Concepts of coherent sources, its realization and utility optical instrumentation.
- Study the concepts regarding the bulk response of materials to the EM fields and their analytically study in the back-drop of basic quantum mechanics.
- Understand the physics of Semiconductors and their working mechanism for their utility in sensors.

## UNIT-I

***Objective: To impart knowledge on interference phenomenon and utilising it to design of instruments in Engineering applications.***

***Outcome: The students will learn to apply the concepts of interference undergo analysis of optical effects and contribute to engineering applications.***

**INTERFERENCE:** Introduction-Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry)- Interference in wedge shaped films – Newton's rings –working principle of Interferometer, applications

## UNIT-II

***Objective: To impart knowledge on diffraction phenomenon to design optical instruments for Engineering applications.***

***Outcome: The students will learn to study diffraction pattern of light to utilize in the analysis of the materials and their properties.***

**DIFFRACTION:** Introduction -Fraunhoffer diffraction at single slit - Cases of double slit, N-slits & Circular Aperture (Qualitative treatment only)-Grating equation - Resolving power of a grating, Telescope and Microscopes- applications.

## UNIT-III

***Objective:***

- ***To impart knowledge on types of polarization, types of polarizing materials and their effects to study and design of optical instruments.***
- ***To impart knowledge on the lasers & their working principle***

***Outcome: The students will learn polarization phenomenon, Lasers and their practical implications in engineering applications.***

**POLARIZATION**: Introduction -Types of Polarization – Methods of production – double refraction-Nicol Prism -Quarter wave plate and Half Wave plate – Working principle of Polari meter (Sacharimeter)-applications.

**LASERS:** Introduction- Characteristics– Stimulated emission – Einstein's Transition Probabilities-Pumping schemes - Ruby laser – Helium Neon laser-applications of lasers

## UNIT-IV

***Objective:***

- ***An overview of the Maxwell's Electromagnetic Field Equations & study the concepts regarding the response of materials to EM fields.***
- ***To impart knowledge on the Optical Fibers and transmission of signals through it.***

***Outcomes:***

- ***The students will learn to study diffraction pattern of light to utilize in the analysis of the materials and their properties.***
- ***The students will learn to analyze the applications of the Optical fibers in the field of communication.***

**ELECTROMAGNETIC FIELDS**: Introduction-Scalar and Vector Fields – Electric Potential- Gradient, Divergence of fields – Gauss and Stokes theorems-Propagation of EM waves through dielectric medium-Applications.

**FIBER OPTICS:** Introduction, Principle of Optical Fiber – Total Internal Reflection, Working principle of an Optical fiber, Numerical Aperture and Acceptance Angle-classification of Optical fibres-Applications.

**UNIT-V**

***Objective:***

- ***To impart knowledge on the discrepancy of classical mechanics & role of quantum mechanics in explaining phenomenon related to sub-microscopic particles..***

***Outcomes:***

- ***The students will learn the phenomenon of electrical & thermal conductivities related to sub-microscopic particles.***

**QUANTUM MECHANICS**: Introduction - Matter waves – Schrödinger Time Independent and Time Dependent wave equations – Particle in a box.

**FREE ELECTRON THEORY**: Introduction-Defects of Classical free electron theory –resistance of Conductor-Quantum Free electron theory - concept of Fermi Energy-Fermi Energy level of Conductors-Density of States.

**UNIT-VI**

***Objective:***

- ***To impart knowledge on the physics of semiconductors and their working principle for their utility in electronics.***

***Outcomes:***

- ***The students will be empowered to apply the basics of electronics in engineering applications.***

**BAND THEORY OF SOLIDS:** Introduction -Bloch's theorem (qualitative) – Kronig – Penney model – energy bands in crystalline solids – classification of crystalline solids– effective mass of electron & concept of hole.

**SEMICONDUCTOR PHYSICS:** Introduction-Conduction – Density of carriers in Intrinsic and Extrinsic semiconductors- Conductivity and Carrier concentration – Drift & Diffusion – relevance of Einstein's equation- Hall effect and its applications.

***COURSE OUTCOME:*** *Construction and working details of instruments, ie., Interferometer, Diffractometer and Polarimeter are learnt. Study EM-fields and semiconductors under the concepts of Quantum mechanics paves way for their optimal utility.*

***Text Books:***

*1. A Text book of Engineering Physics – by Dr. M.N.Avadhanulu and Dr.P.G.Kshira sagar, S.Chand & Company Ltd., (2014)*
*2. 'Solid State Physics' by A.J.Dekker, Mc Millan Publishers (2011)*

***Reference Books*** *:*

*1. Physics by Resnick,Halliday&Krane ,Volume I&II ,John Wiley&sons(2002)*
*2. Engineering Physics by D.K.Bhattacharya and Poonam Tandon , Oxford press (2015)*
*3. Applied Physics by P.K.Palanisamy , Scitech publications (2014)*
*4. Lasers and Non-Linear optics by B.B.Laud , Newage international publishers (2008*

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**I year - II semester**

**Subject Code: 16EE2T01**

# NETWORK THEORY –I

**Preamble**: This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, network theorems, transient analysis, network topology and Electrical Wiring.

**Course Objectives:**

This course enables the students to

- Study the concepts of passive elements, types of sources and various network reduction techniques.
- Understand the applications of network topology to electrical circuits.
- Study the concept of magnetic coupled circuit.
- Understand the behavior of RLC networks for sinusoidal excitations.
- Study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance. and learn the basic techniques for wiring.
- Understand the applications of network theorems for analysis of electrical networks.

**UNIT-I Introduction to Electrical Circuits**

Passive components and their V-I relations. Sources (dependent and independent) -Kirchoff's laws, Network reduction techniques(series, parallel, series - parallel, star-to-delta and delta- to-star transformation). source transformation technique, nodal analysis and mesh analysis.

**UNIT-II Network topology**

Definitions of Graph and Tree, Basic cut set and ties et matrices for planar networks, Loop and nodal methods of analysis of networks with dependent and independent voltage and current sources, Duality and Dual networks.

**UNIT-III Magnetic Circuit**

Basic definition of MMF, flux and reluctance. Analogy between electrical and magnetic circuits.Faraday's laws of electromagnetic induction Concept of self and mutual inductance. Dot convention - coefficient of coupling and composite magnetic circuit. Analysis of series and parallel magnetic circuits.

**UNIT-IV Single Phase A.C Systems**

Periodic waveforms (determination of rms, average value and form factor).Concept of phase angle and phase difference – Waveforms and phasor diagrams for lagging, leading networks. Complex and polar forms of representations, steady state analysis of R, L and C circuits. Power Factor and its significance real, reactive power and apparent power, waveform of instantaneous power triangle and complex power.

**UNIT-V Analysis of AC Networks and Components of Electrical Wiring**

Extension of node and mesh analysis to AC networks, Numerical problems on sinusoidal steady state analysis, Series and parallel resonance, Selectivity, band width and Quasi factor, Introduction to locus diagram. Basic components in electrical wiring, Types of wiring, Connection diagrams of SPST, Staircase, Gowdon, ceiling fan and Tube light connection, Purpose of earthing

**UNIT-VI Network theorems (DC & AC Excitations)**

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

**Text Books**:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley and Steven M.Durbin,Tata McGraw Hill Company,Sixth Edition
2. Network Analysis: M.E.Van Valkenburg; Prentice-Hall of India Private Ltd Third Edition
3 Electrical Wiring ,Estimating & costing by S.L.Uppal Khanna Publishers , 1987

**References**:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, Tata McGraw Hill Education (India) Third Edition
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications Second Edition
3. Electric Circuits– (Schaum's outlines) by MahmoodNahvi& Joseph Edminister,By Kumar Rao Fifth Edition – Tata McGraw Hill.
4. Electric Circuits by David A. Bell, Oxford publications
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications
6. Circuit Theory(Analysis and Synthesis) by A.Chakrabarthi,DhanpatRai &Co.Sixth Revised Edition
7. Electrical wiring, Estimating & costing by J.B.Gupta Khanna Publishers ,2003.
8. Problems of Electrical Engineering by Parkers Smith,9th Edition, CBS Publications.
9. http://pdf-ebooks-for-free.blogspot.in/2015/01/network-theory-by-alaxender-and-sadiku.html
**10.** www.nptel.ac.in/courses/117106101/www.electricaltechnology.org/2013/09/electrical-wiring.html

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Analyze various electrical networks in presence of active and passive elements. | Analysis |
| **CO2** | Employ the network topology concepts on electrical networks. | Application |
| **CO3** | Solve any magnetic circuit with various dot conventions. | Evaluate |
| **CO4** | Analyze any R, L, C network with sinusoidal excitation. | Analysis |
| **CO5** | Identify any R, L,C network with variation of any one of the parameters i.e. R, L, C. and f. and get explore on the basic techniques for wiring. | Comprehend |
| **CO6** | Apply the principles of network theorems to the electrical networks. | Application |

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

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

**I year - II semester**

**Subject Code: 16ME2T02**

## ENGINEERING DRAWING

**Objective:** Engineering drawing being the principle method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

**Unit I**
**Objective:** To introduce the students to use drawing instruments and to draw polygons, Engineering Curves.
**Polygons:** Constructing regular polygons by general methods, inscribing and describing polygons on circles.
**Curves:** Parabola, Ellipse and Hyperbola by general methods, cycloids, involutes, tangents & normals for the curves.
**Unit II**
**Objective:** To introduce the students to use scales and orthographic projections, projections of points.
**Scales:** Plain scales, diagonal scales and vernier scales
**Orthographic Projections:** Horizontal plane, vertical plane, profile plane, importance of reference lines, projections of points in various quadrants. Projections of lines, lines parallel either to the reference planes (HP, VP or PP)
**Unit III**
**Objective:** The objective is to make the students draw the projections of simple lines inclined to one or both the planes.
Projections of lines inclined to both the planes, determination of true lengths, angle of inclination and traces- HT, VT.
**Unit IV**
**Objective:** The objective is to make the students draw the projections of the plane inclined to both the planes.
Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.
**Unit V**
**Objective:** The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.

**Unit VI**
**Objective:** The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.
Conversion of isometric views to orthographic views, Conversion of orthographic views to isometric views.

**TEXT BOOKS:**

1. Engineering Drawing by N.D. Bhatt, Chariot Publications
2. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age International

**REFERENCE BOOKS:**

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
5. http://nptel.ac.in/courses/112103019/
6. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
7. http://www.engineeringdrawing.org

**Course Outcomes:**

- Provides the students with a background in descriptive geometry, orthographic & isometric projection, engineering drawing techniques. Points, lines and plane relationships in projection, multi-view engineering drawings, basic dimensioning, engineering applications.
- Student's ability to perform basic sketching techniques will improve. Students will be able to draw orthographic projections.
- Student's ability to convert sketches to engineered drawings will increase.

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

**I year - II semester**

**Subject Code: 16BH2L2**

**ENGLISH - COMMUNICATION SKILLS LAB- II**

PRESCRIBED LAB MANUAL FOR SEMESTER II:
*'INTERACT: English Lab Manual for Undergraduate Students'* Published by Orient Blackswan Pvt Ltd.
OBJECTIVES: To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.
OUTCOME: A study of the communicative items in the laboratory will help the students become successful in the competitive world.
The course content along with the study material is divided into six units.

**UNIT-1:**

1.Debating- Practice work

**UNIT-2:**

1.Group Discussion- Practice work

**UNIT-3:**

1.Presentation Skills- Practice work

**UNIT-4:**

1.Interview Skills- Practice work

**UNIT-5:**

1. Email
2. Curriculum Vitae- Practice work

**UNIT-6:**

1. Idiomatic Expressions
2. Common Errors in English- Practice work

**Reference Books:**


1. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3. Unlock, Listening and speaking skills 2, Cambridge University Press
4. Spring Board to Success, Orient BlackSwan
5. A Practical Course in effective english speaking skills, PHI
6. Word power made handy, Dr shalini verma, Schand Company
7. Let us hear them speak, Jayashree Mohanraj, Sage texts
8. Professional Communication, Aruna Koneru, Mc Grawhill Education
9. Cornerstone, Developing soft skills, Pearson Education

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

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

**I year - II semester**

**Subject Code: 16BH2L03**

## ENGINEERING/APPLIED PHYSICS LAB

**(only 10 out of 14 Experiments prescribed)**

1. To verify the Laws of Transverse vibrations of a stretched string using sonometer
2. To determine the Rigidity Modulus of a given wire using Torsional Pendulum
3. To determine the velocity of sound in air using Volume Resonator Method
4. To determine the acceleration due to gravity using Compound Pendulum
5. To determine the frequency of an electric tuning fork using Melde's Apparatus
6. To Study the V-I Characteristics and determine the breakdown voltage of a Zener Diode
7. To determine the wavelength of a given source using diffraction Grating in Normal Incidence Method
8. To determine the energy Band Gap of a Semiconductor using P-N Junction diode
9. To Study the variation of the Magnetic field along the axis of a current carrying circular coil using Stewart and Gee's Apparatus
10. To study the R-I Characteristics of a Themistor
11. To determine the refractive index of the medium of the film using the formation of Newton's Rings.
12. To determine the thickness of a paper using the formation of parallel fringes
13. To Determine Planck's constant using photoconductor
14. To determine the refractive index of the Prism using spectrometer

**Reference** :


1. Engineering Physics Lab Manual by Dr.Y.Aparna & Dr.K.Venkatesswara Rao.(V.G.S. Book Links)
2. Physics Manual cum Observation book (College Designed Manual).

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

**I year - II semester**

**Subject Code: 16BH2L04**

**ENGINEERING/APPLIED PHYSICS-VIRTUAL LAB ASSIGNMENTS**

(Constitutes 5 marks of 40 marks of Internal-component)

List of Experiments
1. Hall Effect
2. Crystal Structure
3. Hysteresis
4. Brewster's angle
5. Numerical Aperture of Optical fiber
6. Photoelectric Effect
7. Simple Harmonic Motion
8. LASER – Beam Divergence and Spot size
9. B-H curve
10. Michelson's interferometer

URL : www.vlab.co.in

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
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| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

**I year - II semester**

**Subject Code: 16ME2L01**

## ENGINEERING WORKSHOP

**Course Objective:** To impart hands-on practice on basic engineering trades and skills.
**Note:** At least two exercises to be done from each trade.

**Trade:**

**Carpentry**

1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

**Fitting**

1. V Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

**Black Smithy**

1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

**House Wiring**

1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Florescent Lamp Fitting
4. Measurement of Earth Resistance

**Tin Smithy**

1. Taper Tray
2. Square Box without lid
3. Open Scoop
4. Funnel

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
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# IT WORKSHOP

**OBJECTIVES:**

- Understand the basic components and peripherals of a computer.
- To become familiar in configuring a system.
- Learn the usage of productivity tools.
- Acquire knowledge about the netiquette and cyber hygiene.
- Get hands on experience in trouble shooting a system?

1. **System Assembling, Disassembling and identification of Parts / Peripherals**
2. **Operating System Installation**-Install Operating Systems like Windows, Linux along with necessary Device Drivers.
3. **MS-Office / Open Office**
    a. **Word -** Formatting, Page Borders, Reviewing, Equations, symbols.
    b. **Spread Sheet -** organize data, usage of formula, graphs, charts.
    c. **Power point -** features of power point, guidelines for preparing an effective presentation.
    d. **Access**- creation of database, validate data.
4. **Network Configuration & Software Installation**-Configuring TCP/IP, proxy and firewallsettings. Installing application software, system software & tools.
5. **Internet and World Wide Web**-Search Engines, Types of search engines, netiquette, cyber hygiene.
6. Trouble Shooting-Hardware trouble shooting, Software trouble shooting.
7. **MATLAB-** basic commands, subroutines, graph plotting.
8. **LATEX**-basic formatting, handling equations and images.

**Outcomes:**

- PC Hardware introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers.
- Internet & World Wide Web introduces the different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet.
- Usage of web browsers, email, newsgroups and discussion forums, awareness of cyber hygiene, i.e., protecting the personal computer from getting infected with the viruses, worms and other cyber attacks will be introduced.
- Productivity tools will enable the students in crafting professional word documents, excel spread sheets and power point presentations using the Microsoft suite of office tools and LaTeX.
- Basic usage of MATLAB toolboxes will be introduced.

**Text Books:**

1. Computer Hardware, Installation, Interfacing, Troubleshooting and Maintenance, K.L. James, Eastern Economy Edition.
2. Microsoft Office 2007: Introductory Concepts and Techniques, Windows XP Edition by Gary B. Shelly, Misty E. Vermaat and Thomas J. Cashman (2007, Paperback).
3. LATEX- User's Guide and Reference manual, Leslie Lamport, Pearson, LPE, 2/e.
4. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudraprathap, Oxford University Press, 2002.
5. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson, 2008
6. The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech.
7. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech.
8. Introduction to Information Technology, ITL Education Solutions limited, PearsonEducation.

# PRAGATI ENGINEERING COLLEGE
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**Department of Electrical and Electronics Engineering**

## II Year – I Semester

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE3T04 | Network Theory -II | 3 | 1 | -- | 3 |
| 2 | 16EE3T05 | Electrical Machines-I | 3 | 1 | -- | 3 |
| 3 | 16EE3T06 | Electro Magnetic Fields | 3 | 1 | -- | 3 |
| 4 | 16EE3T07 | Basic Electronics and Devices | 3 | 1 | -- | 3 |
| 5 | 16ME3T09 | Thermal and Hydro Prime Movers | 3 | 1 | -- | 3 |
| 6 | 16BH3T14 | Managerial Economics & Financial Analysis | 3 | 1 | -- | 3 |
| 7 | 16EE3L01 | Networks Lab | -- | -- | 3 | 2 |
| 8 | 16ME3L03 | Thermal and Hydro Lab | -- | -- | 3 | 2 |
| **Total Credits** | | | | | | **22** |

## II Year – II Semester

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE4T08 | Electrical Machines-II | 3 | 1 | -- | 3 |
| 2 | 16EE4T09 | Control Systems | 3 | 1 | -- | 3 |
| 3 | 16EE4T10 | Power Systems-I | 3 | 1 | -- | 3 |
| 4 | 16EE4T11 | Switching Theory and Logic Design | 3 | 1 | -- | 3 |
| 5 | 16EE4T12 | Pulse and Digital Circuits | 3 | 1 | -- | 3 |
| 6 | 16BH4T15 | Management Science | 3 | 1 | -- | 3 |
| 7 | 16EE4L04 | Electrical Machines-I Lab | -- | -- | 3 | 2 |
| 8 | 16EE4L05 | Electronic Devices and Circuits Lab | -- | -- | 3 | 2 |
| **Total Credits** | | | | | | **22** |

# PRAGATI ENGINEERING COLLEGE
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**Department of Electrical and Electronics Engineering**

**II Year - I Semester**

| | L | T | P | C |
|---|---|---|---|---|
| **NETWORK THEORY – II (16EE3T04)** | **3** | **1** | **0** | **3** |

**Preamble:**
To enrich the students to acquire knowledge about the three phase systems, transient analysis, two port networks, network synthesis, Fourier series & Transforms and evaluating circuit performance by using SPICE.

**Course Objectives:**
This course enables the students to

- Understand the three phase balanced circuits to get more power than single phase circuits.
- Understand the three phase unbalanced circuits to measure the power in different loading conditions.
- Study the transient behavior of electrical networks having dynamic elements with comprehension based on energy redistribution.
- Formulate two port networks, particularly in transmission lines and estimate the performance using other parameters.
- Study the design of circuit for the given excitation – response function..
- Understand the frequency domain behavior with periodic and aperiodic excitations by using Fourier series, Fourier transforms

**UNIT-I : Steady State analysis of Balanced Three phase 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 three phase systems. Analysis with PSPICE simulation.

**UNIT-II : Steady State analysis of Unbalanced Three phase circuits**
Analysis of three phase unbalanced circuits: Millman's method, Loop method – Star-Delta transformation technique, Two wattmeter method for measurement of three phase power. Analysis with PSPICE simulation.

**UNIT-III : Transient Analysis in DC and AC circuits**
Transient response of R-L, R-C, R-L-C circuits for DC and AC excitations, Solution using differential equations and Laplace transforms. Analysis with PSPICE simulation.

**UNIT-IV : Two Port Networks**
Two port network parameters – Z, Y, ABCD and hybrid parameters and their relations, Cascaded networks - poles and zeros of network functions. Network functions for the Two-Port bridged – T, Pie and Lattice networks. Analysis with PSPICE simulation.

**UNIT-V : Network synthesis**
Positive real function, Testing of driving point functions, even and odd functions - basic synthesis procedure - LC immittance functions - RC impedance functions and RL admittance function - RL impedance function and RC admittance function - Foster and Cauer methods. Analysis with PSPICE simulation.

**UNIT-VI : Fourier analysis, Fourier Transforms**

Fourier theorem- Trigonometric form and exponential form of Fourier series, Conditions of symmetry- line spectra and phase angle spectra, Analysis of electrical circuits to non sinusoidal periodic waveforms. Fourier integrals and Fourier transforms – properties of Fourier transforms physical significance of the Fourier Transform and its application to electrical circuits. Analysis with PSPICE simulation.

**Text Books:**

1. Engineering Circuit Analysis by William Hayt and Jack E. Kemmerley, Mc Graw Hill Company, 6th edition.
2. Network synthesis: Van Valkenburg; Prentice-Hall of India Private Ltd.
3. A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", Second Edition, Tata McGraw-Hill, 2002.

**References:**

1. Introduction to circuit analysis and design by Tildon Glisson. Jr, Springer Publications.
2. Circuits by A. Bruce Carlson , Cengage Learning Publications.
3. Network Theory Analysis and Synthesis by Smarajit Ghosh, PHI publications.
4. Networks and Systems by D. Roy Choudhury, New Age International publishers.
5. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, Dhanpat Rai&co.
6. John Bird, Electrical Circuit Theory and Technology, 3E, Elsevier, Gurgaon, India.
7. Spice for circuits and electronics using PSPICE by Muhammad H. Rashid, PHI publications.
8. Problems of Electrical Engineering by Parkers Smith,9th Edition.
9. http://nptel.ac.in/courses/108105065/4
10. www.electrical4u.com/network-synthesis-hurwitz-polynomial-positive-real-functions

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Analyze the three phase balanced circuits to measure the power in power systems. | Analysis |
| **CO2** | Illustrate the behavior of three phase unbalanced circuits. | Application |
| **CO3** | Analyze the transient response of electrical networks applied to power systems with different types of excitations. | Analysis |
| **CO4** | Formulate the parameters of different types of two port networks and interpret the relation among network parameters. | Synthesis |
| **CO5** | Design the various electrical networks by using elementary synthesis procedure. | Analysis |
| **CO6** | Enable different harmonics components from the response of a electrical network using Fourier series and Fourier transforms. | Evaluate |

**PRAGATI ENGINEERING COLLEGE**
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| | L | T | P | C |
|---|---|---|---|---|
| **II Year - I Semester** | **3** | **1** | **0** | **3** |

## ELECTRICAL MACHINES - I (16EE3T05)

**Preamble:**
This is a basic course on electrical machines. This course covers the topics related to principles, performance, applications of transformers and dc machines.

**Course objectives:**
This course enables the students to

- Determine the performance of single phase transformers with equivalent circuit models.
- Learn the testing methods of transformer and know its performance.
- Analyze the three phase transformers and achieve three phase to two phase conversion.
- Understand construction, principle of operation & performance of DC generators.
- Learn the characteristics and performance of DC motors.
- Learn the methods of speed control and testing methods of DC motors.

**UNIT–I : Single-phase Transformers -I**
Types and constructional details - principle of operation - emf equation - operation on no load and on load – lagging, leading and unity power factors loads - phasor diagrams of transformers – equivalent circuit – regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – All day efficiency.

**UNIT-II : Single-phase Transformers-II**
Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test – separation of losses – parallel operation with equal voltage ratios – auto transformer - equivalent circuit – comparison with two winding transformers.

**UNIT- III : Three - Phase Transformers**
Polyphase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ - Third harmonics in phase voltages - three winding transformers: determination of Zp, Zs and Zt - transients in switching - off load and on load tap changers - Scott connection.

**UNIT–IV: DC Generators**
Construction and principle of operation of DC machine –EMF equation for generator –Classification of DC generators based on excitation – Characteristics of DC generators.

**UNIT–V: D.C. Motors**
Torque and back-emf equations of dc motors– Armature reaction and commutation – characteristics of shunt, series and compound motors - losses and efficiency- applications of dc motors.

## UNIT-VI : Starting, Speed Control and Testing of D.C. Machines

Necessity of starter – Starting by 3 point starter, Speed control by armature voltage and field control - testing of DC machines - brake test, Swinburne's method – retardation test - principle of regenerative or Hopkinson's method–Field's test- separation of losses.

**Text Books:**

1. Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald,Charleskingsley,StephenD.Umans, TMH

**References:**

1. Electrical Machines by D. P.Kothari, I .J .Nagarth,McGrawHill Publications, 4th edition
2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition.
3. Electrical Machinery by Abijith Chakrabarthi and SudhiptaDebnath,McGraw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010.
5. Electric Machines by Mulukutla S. Sarma & Mukeshk. Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J. B. Guptha. S. K. Kataria& Sons
7. Electrical Machines by Ashfaq Hussain, Second Edition, Dhanapat Rai & Sons.
8. http://www.electrical4u.com/principle-of-dc-generator/
9. http://www.electrical4u.com/single-three-phase-transformer-vs-bank-of-three-single-phase-transformers/

**Course outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Analyze the performance of single phase transformers. | Analysis |
| **CO2** | Employ parallel operation of transformers; improve the load sharing capabilities and reliability. | Application |
| **CO3** | Arrange the equivalent circuits of three phase transformers for analysis of power systems. | Synthesis |
| **CO4** | Analyze the characteristics of DC generators and to assess its performance. | Analysis |
| **CO5** | Identify the various types of DC motors for their particular application. | Comprehend |
| **CO6** | Assess the performance of various DC machines. | Evaluate |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

| | L | T | P | C |
|---|---|---|---|---|
| **II Year - I Semester** | **3** | **1** | **0** | **3** |

## ELECTRO MAGNETIC FIELDS (16EE3T06)

**Preamble:** Electromagnetic fields is the foremost pre-requisite course for most of the subjects in Electrical Engineering. This course introduces the concepts of electric field and magnetic fields and their applications which will be utilized in the development of the theory for power transmission lines and electrical machines.

**Course Objectives:**
This course enables the students to

- Study the coordinate system and study the production of electric field and potentials due to different configurations of static charges.
- Understand the behavior of electrostatic fields in conductors and dielectrics.
- Study the magnetic fields produced by currents in different configurations.
- Understand the concepts of moving charges on magnetic fields.
- Identify the magnetic potential and its properties.
- Impart knowledge on concepts of Faraday's laws, induced emf.

**UNIT – I : Electrostatics:**

Orthogonal Coordinate Systems & Review of Vector Calculus: Rectangular, Cylindrical, Spherical coordinate systems. differential length, area and volume. Electrostatic Fields – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge – Work done in moving a point charge in an electrostatic field – Electric Potential, Potential gradient – gauss's law in terms of (integral form and point form) Maxwell's first law, div(D )=ρv Laplace's and Poison's equations and Solution of Laplace's equation in one variable.

**UNIT – II : Electrostatic Field in Materials:( Conductors – Dielectrics and Capacitance)**

Electric dipole – Dipole moment – potential and EFI due to an electric dipole Torque on an Electric dipole in an electric field –Behaviour of conductors in an electric field – Conductors and Insulators Polarization – Boundary conditions between conduction to Dielectric and dielectric to dielectrics capacitance – capacitance of parallel plates, spherical and coaxial cables with composite dielectrics– Energy stored and energy density in a static electric field – Current density – conduction and Convection current densities–Ohm's law in point form – Equation of continuity-

**UNIT – III : Magneto statics and Ampere's Law:**

Static magnetic fields – Biot-Savart's law – Oesterd's experiment –Magnetic field intensity (MFI) – MFI due to a straight current carrying filament – MFI due to circular, square and solenoid current – Carrying wire – Relation between magnetic flux, magnetic flux density and MFI –Maxwell's second Equation, div(B)=0 –Ampere's circuital law and its applications comparison of electrostatics and Magnetostatics, MFI due to an infinite sheet of current and a long filament carrying conductor – Point form of Ampere's circuital law –Field due to a circular loop, rectangular and square loops, Maxwell's third equation, Curl (H)=J.

**UNIT – IV : Force in Magnetic fields:**

Magnetic force - Moving charges in a Magnetic field – Lorentz force equation – force on a current element in a magnetic field – Force on a straight and a long current carrying conductor in a magnetic field – Force between two straight long and parallel current carrying conductors – Magnetic dipole and dipole moment – a differential current loop as a magnetic dipole – Torque on a current loop placed in a magnetic field.

**UNIT – V : Self and Mutual inductance :**

Scalar and vector magnetic potentials. Inductance and energy stored and density in a magnetic field. Self and Mutual inductance determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane.

**UNIT – VI : Time Varying Fields:**

Time varying fields – Faraday's laws of electromagnetic induction – Its integral and point forms, - Displacement current – Maxwell's fourth equation, Curl (E)=-∂B/∂t – Statically and Dynamically induced EMFs – Simple problems, Modification of Maxwell's equations for time varying fields– Poynting Theorem and Poynting vector.

**Text books:**

1. Introduction to electro dynamics by D.J. Griffiths, Mc Graw Hill Publications.
2. Engineering Electro Magnetics by William H. Hayt Jr., Mc Graw Hill Publications.

**References:**

1. "Principles of Electro Magnetics" by Sadiku, Oxford Publications,4$^{th}$edition.
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson.
3. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford higher education.
4. Electro magnetism : Problems with solutions by Ashutosh Pramanik, PHI Publications.
5. https://onlinecourses.nptel.ac.in/noc16_ph03/preview
6. https://docs.google.com/file/d/0B21HoBq6u9TsZnQ5d2pEc2dxcnc/edit
7. http://bookboon.com/en/essential-electromagnetism-ebook

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Learn mathematical operations related to magnetic and electric fields. | Knowledge |
| **CO2** | Identify the properties of materials under the influence of electric field. | Comprehend |
| **CO3** | Analyze magnetic fields using Biot-Savart's Law and Ampere's Circuital law. | Analysis |
| **CO4** | Calculate the magnetic forces and torque produced by currents in magnetic fields. | Evaluate |
| **CO5** | Evaluate self, mutual inductances and the energy stored in the magnetic field. | Evaluate |
| **CO6** | Compute the induced emf under the time varying fields using Maxwell equation. | Evaluate |

# PRAGATI ENGINEERING COLLEGE
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**Department of Electrical and Electronics Engineering**

| | L | T | P | C |
|---|---|---|---|---|
| **II Year - I Semester** | **3** | **1** | **0** | 3 |

## BASIC ELECTRONICS AND DEVICES (16EE3T07)

**Preamble:** This course introduces the concepts of semi-conductor physics and operation of various semi-conductor devices. Realization of rectifiers, amplifiers and oscillators using semi-conductor devices and their analysis is also introduced in this course.

**Course Objectives:**

This course enables the students

Learn the basics of semiconductor physics.

- Study the construction details, operation and characteristics of various semiconductor diodes.
- Study the characteristics of PN junction diodes and special diodes
- Understand the operation and analysis of rectifiers with and without filters.
- Analyze transistor amplifiers using h-parameters.
- Understand the basics of Thyristors, Power IGBTs and Power MOSFETs.
- Understand the concepts of positive and negative feedbacks and their role in amplifiers and oscillators.

**UNIT-I Review of Semi Conductor Physics**: Insulators, Semi conductors, and Metals classification using Energy Band Diagrams, Mobility and Conductivity, Electrons and holes in Intrinsic Semi conductors, Extrinsic Semi Conductor, (P and N Type semiconductor) Hall effect, Generation and Recombination of Charges, Diffusion, Continuity Equation, Injected Minority Carriers, Law of Junction, Introduction to fermi level in Intrinsic, Extrinsic semi conductors with necessary mathematics characteristic, Temperature dependence on V-I characteristics, Transition and Diffusion capacitances.

**UNIT-II Junction Diode Characteristics**

Operation and characteristics of p-n junction diode. Current components in p- n diode, diode equation. Temperature dependence on V–I characteristic, diffusion capacitance and diode resistance (static and dynamic), energy band diagram of p-n diode. Special Diodes: Avalanche and Zener break down, Zener characteristics, tunnel diode, characteristics with the help of energy band diagrams, Varactor diode, LED, Photo diode.

**UNIT-III Rectifiers and Regulators**

Half wave rectifier, ripple factor, full wave rectifier (with and without (transformer), harmonic components in a rectifier circuit, inductor filter, capacitor filter, L-section filter, Π- section filter, and comparison of various filter circuits in terms of ripple factors. Simple circuit of a regulator using Zener diode. Types of regulators-series and shunt voltage regulators, over load voltage protection. Compensation techniques

**UNIT-IV : Transistors**

Junction transistor, transistor current components, transistor as an amplifier and switch. Characteristics of transistor (CE, CB and CC configurations). Transistor biasing and thermal stabilization (to fixed bias, collector to base bias, self bias). Compensation against variation in base emitter voltage and collector current. Thermal runaway. Hybrid model of transistor. Analysis of transistor amplifier using h-parameters- FET: JFET Characteristics, Low frequency model of FET, FET as an amplifier.

**UNIT-V Power semiconductor devices**

Principle of operation and characteristics of Thyristors, Silicon control rectifiers, power IGBT and power MOSFET their ratings. Comparison of power devices.

MOFET Characteristics–static and Transfer (enhancement and depletion mode). Characteristics of UJT.

**UNIT-VI Amplifiers and oscillators:**

Feedback Amplifiers -classification, feedback concept, transfer gain and general characteristics of negative feedback amplifiers, effect of feedback on input and output resistances. Methods of analysis of feedback amplifiers. Power Amplifiers – Classification, push-pull amplifiers, Introduction to harmonics (distortion factor).

Oscillators – Condition for oscillation, RC-phase shift oscillator. Wien bridge oscillator, Crystal oscillator. Frequency and amplitude stability of oscillators.

**Text Books:**

1. Electronic Devices and Circuits – J. Millman, C.C. Halkias, Tata Mc-Graw Hill.
2. Electronic Devices and Circuits – Balbir Kumar, Shail B. Jain, Second Edition, PHI.

**References:**

1. Electronic Devices and Circuits by David A. Bell, Oxford University Press.
2. Electronic Devices and Circuits – Salivahanan, Kumar, Vallavaraj, TATA Mc Graw Hill, Second Edition.
3. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, 9thEdition, 2006.
4. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits,PPH,2004.
5. http://nptel.ac.in/courses/117103063/
6. http://www.electronicshub.org/tutorials/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Get explore on the basic concepts of semiconductor physics, which are useful to understand the operation of diodes and transistors | Respond |
| **CO2** | Analyze the characteristics of P-N junction diode and special diodes such as photo diode, LED | Analysis |
| **CO3** | Examine the rectifiers with and without filters and regulators | Evaluate |
| **CO4** | Analyze small signal model of BJT amplifier using h-parameter and low frequency model of FET amplifier. | Analysis |
| **CO5** | Demonstrate power semiconductors and its V-I characteristics | Application |
| **CO6** | Characterize feedback amplifiers and power amplifiers and design oscillators such as RC-phase shift oscillators, Wien bridge oscillator. | Characterize |

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| **II Year - I Semester** | **3** | **1** | **0** | 3 |

**THERMAL AND HYDRO PRIMEMOVERS (16ME3T09)**

***Course Objectives:***

The objectives of the course are to make the students understand the various types of prime movers which can be connected to generators for power production, to impart the knowledge of various types of pumps.

**Course outcomes:**

Upon completion of this course the student will be able to describe the basic components of steam power plants and working principles of different types of steam turbines, able to explain the working principle of different types of gas turbines, able to identify the main components of diesel power plant and explain the working principle of diesel engines, able to discuss the working principle of different types of hydraulic turbines, able to illustrate the working principle of centrifugal and reciprocating pumps

**PART-A: THERMAL PRIMEMOVERS**

**UNIT – I**

***Learning Objective****: To impart the knowledge on I.C. Engines which can be connected to generators for power production and obtain the skills of performing the necessary calculations with respect to the functioning of the I.C. Engines.*

**IC ENGINES**: Classification, working principles valve and port timing diagrams - air standard –cycles Engine systems: fuel injection, carburetion, ignition, cooling and lubrication – Engine performance evaluation.

**UNIT – II**

***Learning Objective****: The students learn the basics of thermodynamics and to train the student in the aspects of steam formation and its utilities through the standard steam data tables and charts. To make the student correlate between the air-standard cycles and the actual cycles that governs the steam turbines. To train the student to calculate the performance of steam turbines using velocity diagrams.*

**BASICS OF THERMODYNAMICS**: Thermodynamic Systems and State, Process, and Cycle. Laws of thermodynamics(statements only)- First Law of Thermodynamics and Analysis of Various Thermodynamic Processes; study state energy balance equation.

**STEAM PROPERTIES**: Properties of steam use of steam tables by using temperature to entropy and enthalpy- entropy diagrams.

**VAPOR POWER CYCLES:** Carnot Cycle-Rankine Cycle- Thermodynamic Variables Effecting Efficiency and Output Of Rankine Cycle Analysis Of Simple Rankine Cycle And Re-Heat Cycle.

**STEAM TURBINES:** Schematic Layout Of Steam Power Plant Classification Of Steam Turbines-Impulse Turbine And Reaction Turbine- Compounding In Turbines- Velocity Diagrams For Simple Impulse. Work Done & Efficiency.(Taken from JNTU.K R13)

**UNIT – III**

***Learning Objective:*** *To impart the knowledge of gas turbine fundamentals, the governing cycles and the methods to improve the efficiency of gas turbines.*

**GAS TURBINES**: Simple gas turbine plant-ideal cycle, closed cycle -open cycle-Efficiency, Work ratio and optimum pressure ratio for simple gas turbine cycle. Actual cycle, analysis of simple cycles & cycles with inter cooling, reheating and Regeneration.

**PART-B: HYDRO PRIMEMOVERS**

**UNIT – IV**

***Learning Objective****: To teach the student about the fundamental of hydraulics and properties of fluids, fluid dynamic and equations. Also to impart the knowledge on impact of jets.*

**PROPERTIES OF FLUIDS:** Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Surface Tension and Capillarity. Simple problems

**IMPACT OF JETS AND PUMPS**: Impulse momentum equation, Impact of Jet on stationary vanes (flat and curved), And Impact of Jet on moving vanes (flat and curved).

**UNIT – V**

*Learning Objective: To make the student learn about the constructional features, operational details of various types of hydraulic turbines and governing of turbines. Also learn site selection for hydraulic power plant.*

HYDRAULIC TURBINES: Classification of turbines; Working principle, Efficiency calculation and Design principles for Pelton Wheel, Francis and for Kaplan turbines; Performance equations of turbine; Governing of turbines; site selection and layout of Hydro- electric power plant; Components of Hydro- electric power plant.

**UNIT – VI**

***Learning Objective****: To impart the knowledge of various types of pumps, their constructional features, working and performance.*

**HYDRAULIC PUMPS**

**Centrifugal pumps**: Types of pumps, Main components, working principle, Multi stage pumps, Performance and characteristic curves.

**Reciprocating pumps**: Types of pumps, main components working principle, performance single acting double acting reciprocating pumps, Performance and characteristic curves.

**TEXT BOOKS:**

1. Thermal Engineering by Rajput, Lakslunipublications
2. A text book of Fluid mechanics and hydraulic machines by Rajput, Lakslunipublications

**REFERENCE BOOKS:**

1. Thermal engineering by M.L.Mathur and F.S.Mehta, JainBrothers.
2. "Hydraulics & Fluid Mechanics", P.N. Modi and S.M. Seth, (Standard book) House,
3. "Fluid Mechanics & Hydraulic Machinery" A.K.Jain, Khanna Publishers,Delhi.
4. "Fluid Mechanics" by Victor.L.Streeter
5. "Introduction to Fluid Mechanics" Edward .J. ShaughnessyJr.
6. "Fluid Mechanics & Its Applications", Vijay Gupta,Santhosh.k.Gupta
7. http://nptel.ac.in/courses/112105123/
8. http://nptel.ac.in/courses/112108148/
9. http://nptel.ac.in/courses/112104113/
10. http://nptel.ac.in/courses/112104033/
11. http://nptel.ac.in/courses/112104118/
12. http://nptel.ac.in/courses/112105171/

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | The students will be able to **define** and classify IC engine systems and their working. | KNOWLEDGE & COMPREHENSION |
| CO2 | The students will be able to **relate** the correlations on basics of thermodynamics, steam properties, vapour power cycles and steam turbines. | ANALYSIS |
| CO3 | The students will be able to **illustrate** the gas turbines and **evaluate** their performance. | KNOWLEDGE & COMPREHENSION |
| CO4 | The students will be able to **define** different fluid\ properties and **analyse** hydro dynamic forces on different vanes. | KNOWLEDGE & ANALYSIS |
| CO5 | The students will be able to **categorize** various turbines and **evaluate** the performance. | ANALYSIS & EVALUATION |
| CO6 | The students will be able to **categorize** various pumps and **evaluate** the performance. | ANALYSIS & EVALUATION |

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|---|---|---|---|---|
| **II Year - I Semester** | **3** | **1** | **0** | **3** |

## MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS (16BH3T14)

**Unit – I**

**Introduction to Managerial Economics and demand Analysis:**

Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Basic Economic Tools used in Managerial Economics-Concepts of Demand-Types-Determinants-Law of Demand its Exception-Elasticity of Demand-Types and Measurement- Law of Supply -Demand forecasting and it's Methods.

**Unit – II**

**Production and Cost Analysis:**

Production function – Isoquants and Isocosts-Law of Variable proportions- Laws of Returns to Scale-Cobb-Douglas Production function-Economies of Scale-Cost Concepts- Fixed vs Variable Costs-Out of Pocket Costs vs Imputed Costs-Cost Volume Profit analysis- Determination of Break-Even Point (Simple Problems)

**Unit – III**

**Introduction to Markets, Theories of the Firm & Pricing Policies:**

Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price, Output Determination – Managerial Theories of firm: Marris and Williamson's models – Methods of Pricing: Limit Pricing, Market Skimming Pricing, Internet Pricing: Flat Rate Pricing, Usage sensitive, Transaction based pricing, Priority Pricing.

**Unit – IV**

**Types of Business Organization and Business Cycles:**

Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycle.

**Unit – V**

**Introduction to Accounting:**

Introduction to Double Entry Systems-Journal-Ledger- Trail Balance - Preparation of Financial Statements - Analysis and Interpretation of Financial Statements-Ratio Analysis – liquidity ratios, profitability ratios, solvency ratios, turnover ratios – Preparation of the Funds flow Statement (Simple Problems)

**Unit – VI**

**Capital and Capital Budgeting:** Capital Budgeting: Meaning of Capital- Capitalization- Sources of Finance (with special reference to Shares and Debentures)- Meaning of Capital Budgeting-Need for Capital Budgeting – Techniques of Capital Budgeting- Traditional and Modern Methods.

**TEXT BOOKS:**

1. Dr. N. Appa Rao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2011
2. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011
3. Prof. J.V.Prabhakara rao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.

**REFERENCES:**

1. V. Maheswari: Managerial Economics, Sultan Chand.
2. Suma Damodaran: Managerial Economics, Oxford 2011.
3. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
4. Vanitha Agarwal: Managerial Economics, Pearson Publications 2011.
5. Sanjay Dhameja: Financial Accounting for Managers, Pearson.
6. Maheswari: Financial Accounting, Vikas Publications.
7. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012

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| **II Year - I Semester** | **0** | **0** | **3** | **2** |

## NETWORKS LAB (16EE3L01)

**Course Objectives:**

To verify and demonstrate various theorems, locus diagrams, resonance and two port networks. To determine MMF, Reluctance, self and mutual inductance of a magnetic circuit, time constant of RL and RC circuits, measurement of 3- phase power.

**ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED**

1. Simulation of AC & DC circuits.
2. Verification of Thevenin's and Norton's Theorems.
3. Verification of Superposition theorem and Maximum Power Transfer Theorem.
4. Verification of Compensation Theorem.
5. Verification of Reciprocity, Millman's Theorems.
6. Locus Diagrams of RL and RC Series Circuits.
7. Series and Parallel Resonance.
8. Determination of Self, Mutual Inductances and Coefficient of coupling.
9. Z and Y Parameters.
10. Time response of RL & RC series circuits.
11. Measurement of three phase active power using two wattmeter method for balanced and unbalanced loads.
12. Determination of MMF for maximum flux density and Reluctance of a transformer core.

**Course outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Employ various theorems applied to electrical circuits | Application |
| **CO2** | Determination of MMF, Reluctance, self and mutual inductances, two port parameters of a given electric circuits, time constant of RL and RC circuits and measurement of 3- phase power. | Evaluate |

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|---|---|---|---|---|
| **II Year - I Semester** | **0** | **0** | **3** | **2** |

## THERMAL AND HYDRO LAB (16ME3L03)

***Course Objective:***

*To impart practical knowledge on the performance evaluation methods of various internal combustion engines, flow measuring equipment and hydraulic turbines and pumps.*

***Course Outcome:***

*The student able to evaluate the performance of various internal combustion engines, flow measuring equipment and hydraulic turbines and pumps.*

**SECTION-A:**

**THERMAL ENGINEERING LAB**

1. I.C. Engines valve / port timing diagrams.
2. Engines performance test on 4 -stroke Diesel engine.
3. I.C. Engines performance test on 2-stroke petrol engine.
4. Evaluation of engine friction by .conducting Morse test on 4-stroke multi cylinder petrol engine.
5. Determination of PHP by retardation and motoring test on IC engine
6. I.C. Engines heat balance on petrol / Diesel engines.
7. Economical speed test of an IC engine
8. Study of boilers

**SECTION- B :**

**HYDRAULIC MACHINES LAB**

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Single Stage Centrifugal Pump.
5. Performance Test on Reciprocating Pump.
6. Calibration of Venturi meter.
7. Calibration of Orifice meter.
8. Determination of loss of head due to sudden contraction in a pipeline.

Note: To conduct a minimum of 12 experiments by conducting a minimum of six from each section.

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| **II Year - II Semester** | **3** | **1** | **0** | **3** |

## ELECTRICAL MACHINES - II (16EE4T08)

**Preamble:**

This course essentially covers AC machines, which have wide range of applications in industry. The main aim of the course is to provide a detailed analysis of operation and performance of 3-phase induction motor, 1- phase machines and synchronous machines. In addition, it also covers voltage regulation and parallel operation of synchronous generators.

**Course objectives:**

This Course enables the students to

- Understand the principle of operation and determine the equivalent circuit parameters of 3-phase induction motor.
- Deal with the detailed analysis of 3-phase induction motors and quantify the performance of induction motor and induction generator in terms of torque and slip.
- Understand the construction, operation and types of single phase motors, Shaded pole motor, AC Series motors and their applications for house hold/ Industrial purposes
- Study various methods of finding the regulation of non-salient and salient pole alternators
- Understand the concept of parallel operation and factors effecting the load shared by alternators
- Impart knowledge on principle of operation and factors effecting the performance of synchronous motor.

**UNIT-I: 3-phase Induction Motors**

Constructional details – Types of rotors - production of rotating magnetic field - principle of operation-rotor emf and rotor frequency – rotor current and pf at standstill and during running conditions – rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram

**UNIT-II: Characteristics, starting and testing methods of Induction Motors**

Torque equation - expressions for maximum torque and starting torque - torque slip characteristic– Speed control methods - no load and blocked rotor tests - circle diagram for predetermination of performance– starting methods- DOL, Star-delta, Auto transformer– performance characteristics - double cage and deep bar rotors - crawling and cogging- induction generator operation.

**UNIT–III: Single Phase Motors**

Single phase induction motors – Constructional features, Problems of starting–Double revolving field theory- Starting methods, equivalent circuit. Shaded pole motor, AC Series motor, Applications.

**UNIT –IV: Synchronous generators**

Constructional features of Cylindrical type and salient pole type – Armature windings –Distributed and concentrated windings – Distribution– Pitch and winding factors –E.M.F equation– Improvements of waveform and armature reaction–Voltage regulation - synchronous impedance method, MMF method and Potier triangle method–Phasor diagrams–- Two reaction analysis of

salient pole machines and phasor diagram. Torque angle characteristics for cylindrical and salient pole alternators.

**UNIT–V: Parallel operation of synchronous generators**

Parallel operation of alternators, synchronization with grid – Synchronizing power – Load sharing – Control of real and reactive power– Numerical problems.

**UNIT –VI: Synchronous motors**

Synchronous Motor principle and theory of operation– Methods of starting -Phasor diagram – Starting torque–Variation of current and power factor with excitation –Synchronous condenser – Mathematical analysis for power developed–Hunting and its suppression — Applications.

**Text Books:**

Electrical Machines – P.S. Bhimbra, Khanna Publishers
Electric Machinery by A. E. Fitzgerald, Charles kingsley, Stephen D.Umans, TMH

**References:**

1. Electrical Machines by D. P. Kothari, I .J .Nagarth, McGrawHill Publications, 4th edition
2. Electrical Machines by R. K. Rajput, Lakshmi publications,5th edition
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, McGraw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
5.Electric Machines by Mulukutla S. Sarma & Mukeshk. Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J. B. Guptha. S. K. Kataria& Sons.
7. Alternating Current Machines by M. G. Say, Longman Scientific and Technical, 5th Edition.
8. http://www.electricaleasy.com/
9. http://electrical-engineering-portal.com/rotating-magnetic-field-ac-machines
11. http://nptel.ac.in/courses/108106072/pdf/2_6.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Determine the factors effecting the performance of 3-phase Induction Motor from it's equivalent circuit. | Comprehension |
| CO2 | Analyze the performance of 3-phase Induction Motor under different operating conditions using circle diagram. | Analysis |
| CO3 | Identify the suitable motor such as 1-phase Induction Motor, Shaded pole motor and AC Series Motor, for Industrial applications. | Comprehension |
| CO4 | Evaluate the regulation of non-salient pole and salient pole alternators using various methods. | Synthesis |
| CO5 | Debate on the factors effecting the load sharing of alternators running in parallel such as prime mover input and excitation. | Analysis |
| CO6 | Draw the power circles and excitation circles of synchronous motor to determine optimum operating point | Synthesis |

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## CONTROL SYSTEMS (16EE4T09)

**Preamble :**

This course introduces the elements of linear control systems and their analysis. Classical methods of design using frequency response are included. The state space approach for modeling and analysis is the added feature of this course.

**Course Objectives:**

This course enables the students to

- Learn the mathematical modeling of physical systems to determine overall transfer function.
- Study the behavior of a control system in time domain.
- Learn the stability of control system using various techniques.
- Study the behavior of a control system in frequency domain.
- Discuss basic aspects of design and compensation of linear control systems.
- Understand the state space models of various electrical systems.

**UNIT-I : Mathematical Modeling of Control Systems**

Open Loop and closed loop control systems and their differences, Classification of control systems, Feedback Characteristics, transfer function of linear system, Differential equations of electrical networks, Translational and Rotational mechanical systems, Transfer Function of DC Servo motor - AC Servo motor - Synchro-transmitter and Receiver. Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula.

**UNIT-II : Time Response Analysis**

Standard test signals - Time response of first order systems –Time response of second order systems - Time domain specifications - Steady state errors, Static error constants. Effect of adding poles and zeros on time domain specifications. P, PI, PD and PID control actions.

**UNIT-III : Stability and Root locus Technique**

The concept of stability – Routh- Hurwitz stability criterion, limitations – Root locus concept, construction of root loci.

**UNIT-IV : Frequency Response Analysis**

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

**UNIT-V : Classical control design techniques**

Lag, Lead, Lag-Lead compensators, Design of compensators – using Bode plots.

**UNIT-VI : State Space Analysis Of Continuous Systems**

Concepts of state, state variables and state model, state space representation of transfer function, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties – Concepts of Controllability and Observability.

**TEXT BOOKS:**

1. Control System Engineering by I. J. Nagarath and M. Gopal – Fifth Edition, New Age International Publishers.
2. Modern Control Engineering, Kotsuhiko Ogata, Prentice Hall of India.
3. Automatic control systems, Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

**References:**

1. Control Systems, Manik Dhanesh N, Cengage publications .
2. Control Systems principles and design, M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
3. Control Systems Engineering, S.Palani, Tata Mc Graw Hill Publications.
4. www.electrical4u.com/control systems
5. www.electrical4u.com/state space analysis

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Analyze the transfer function of physical systems for modeling of control systems. | Analysis |
| **CO2** | Determination of the time domain specifications to the second order systems. | Evaluate |
| **CO3** | Analyze the stability of control systems to know the behavior of the system. | Analysis |
| **CO4** | Analyze the stability of LTI systems in frequency domain | Analysis |
| **CO5** | Design Lag, Lead, Lag-Lead compensators to improve system performance of control systems. | Synthesis |
| **CO6** | Summerize the physical systems as state models and determine the response. | Comprehend |

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## POWER SYSTEMS-I (16EE4T10)

**Preamble:**

Electrical Power plays significant role in day to day life of entire mankind. The aim of this course is to allow the students to understand the concepts of the generation and distribution of power along with economic aspects.

**Course Objectives:**

This course enables the students to

- Introduce the concepts and phenomenon of different sources of Power Generation.
- Study the importance of different types of power stations with their components .
- Give an idea about the functioning of various substations.
- Give an idea about the fundamental concepts of electrical power distribution systems, both AC & DC.
- Study the underground cables based upon their insulating material and grading techniques involved on underground cables.
- Understand the economic aspects of power generation along with concepts related to tariff.

**UNIT-I : Thermal Power Plants**

Power Plant, Types of Energy Sources, Selection of site, General layout of a thermal power plant showing paths of coal, steam, water, air, ash and flue gasses, ash handling system, Brief description of components: Boilers, Super heaters, Economizers, electrostatic precipitators steam Turbines : Impulse and reaction turbines, Condensers, feed water circuit, Cooling towers and Chimney.

**UNIT-II : Hydro, Gas and Nuclear Power Plants**

Hydro Power Plant: Selection of site, Layout and working, Types of hydroelectric power plants, Advantages of hydro generation.

Gas power plant: Layout, Components of a gas turbine, Open and Combined cycle power stations.

Nuclear power plants: Working principle, Components: Moderators, Control rods, Reflectors and Coolants. Types of Nuclear reactors and brief description of PWR, BWR and FBR, Radiation: Radiation hazards and Shielding, nuclear waste disposal.

**UNIT-III : Substations**

**Air Insulated Substations (AIS) -** Indoor & Outdoor substations, Layout - Substation equipments and their purpose.

**Bus bar arrangements in the Sub-Stations**: Single bus bar, sectionalized single bus bar, Double bus bar arrangements.

**Gas Insulated Substations (GIS)** – Advantages of GIS, Comparison with AIS.

**UNIT-IV : Distribution Systems**

Classification, Design features, radial and ring main distribution systems, voltage drop calculations: DC distributors for radial DC distribution systems fed at single and both ends (equal / unequal voltages), stepped distributor and AC distribution, comparison of DC and AC distribution.

**UNIT-V : Underground Cables**

Types of Cables, Construction, Types of insulating materials, Calculation of insulation resistance, stress in insulation and power factor of cable, Numerical Problems. Capacitance of single and 3-Core belted Cables, Numerical Problems. Grading of Cables-Capacitance grading and Inter-sheath grading, Numerical Problems.

**UNIT-VI : Economic Aspects of Power Generation & Tariff**

**Economic Aspects -** Load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, Base and peak load plants, Numerical problems.

**Tariff Methods** - Costs of Generation and their division into Fixed, Semi fixed and Running Costs, Desirable Characteristics of a Tariff Method, Tariff Methods: Simple rate, Flat Rate, Block-Rate, two-part, three–part, and power factor tariff methods, Numerical problems.

**Text Books**:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd.
2. Generation, Distribution and Utilization of Electric Energy by C. L. Wadhwa New age International(P) Limited, Publishers.

**References:**

1. Electrical Power Distribution Systems by - V. Kamaraju, Tata Mc Graw Hill, New Delhi.
2. Elements of Electrical Power Station Design by – M V Deshpande, PHI, New Delhi.
3. A Course in Power Systems by J.B. Gupta, S. K. Kataria & sons, 2009 Edition.
4. www.electrical4u.com/electrical-distribution-system

## Course Outcomes:

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Identify the different components of thermal power plants. | Comprehend |
| **CO2** | Memorise the operation of conventional generating stations. | Knowledge |
| **CO3** | Sketch the layout of substation | Comprehend |
| **CO4** | Estimate voltage drops in AC and DC distribution systems | Synthesis |
| **CO5** | Outline the layout of substation and underground cables . | Analysis |
| **CO6** | Evaluate the power tariff methods. | Evaluate |

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| **II Year - II Semester** | **3** | **1** | **0** | **3** |

## SWITCHING THEORY AND LOGIC DESIGN (16EE4T11)

**Preamble**:

Students will be exposed to various logic and combinational circuits, multiplexers, Flip-flops, Encoders, Decoders, and various sequential circuits which are gaining importance in industry. This course requires a Prerequisite Knowledge on Basic Electronics and Electronic Devices and Digital Circuits.

**Course Objectives:**

This course enables the students to

- Explain the operation of various combinational circuits and the application of various logical operations.
- Explain the minimization techniques involved by the application of K-map.
- Understand on the design of logic circuits involved in the operation of Boolean expressions.
- Understand the significance of PLD's in industrial applications.
- Understand the importance of sequential circuits.
- Gain knowledge about the significance of designing of sequential circuits.

**UNIT – I: REVIEW OF NUMBER OF SYSTEMS & CODES:**

i) Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed members, problem solving.
ii) 4 bit codes, BCD, Excess-3, 2421, 84-2-1 9's compliment code etc.,

iii) Logic operations and error detection & correction codes; Basic logic operations -NOT, OR, AND, Universal building blocks, EX-OR, EX-NOR - Gates, Standard SOP and POS, Forms, Gray code, error detection, error correction codes (parity checking, even parity, odd parity, Hamming code) NAND-NAND and NOR-NOR realizations. Floating point representation, Fixed point representation.

**UNIT – II :MINIMIZATION TECHNIQUES:**

Boolean theorems, principle of complementation & duality, De-morgan theorems, minimization of logic functions using Boolean theorems, minimization of switching functions using K-Map up to 6 variables, tabular minimization, problem solving (code-converters using K-Map etc..).

**UNIT – III : COMBINATIONAL LOGIC CIRCUITS DESIGN :**

Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders, 4-bit binary subtractor, adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit, look-a-head adder circuit, Design of decoder, demultiplexer, 7 segment decoder, higher order demultiplexing, encoder, multiplexer, higher order multiplexing, realization of Boolean functions using decoders and multiplexers, priority encoder, 4-bit digital comparator.

**UNIT – IV : INTRODUCTION OF PLD's :**

PROM, PAL, PLA-Basics structures, realization of Boolean function with PLDs, programming tables of PLDs, merits & demerits of PROM, PAL, PLA comparison, realization of Boolean functions using PROM, PAL, PLA, programming tables of PROM, PAL, PLA.

**UNIT – V : SEQUENTIAL CIRCUITS I:**

Classification of sequential circuits (synchronous and asynchronous) , Level mode and Pulse mode sequential circuits, basic flip-flops, truth tables and excitation tables (nand RS latch, nor RS latch, RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals).

Conversion from one flip-flop to flip-flop. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

**UNIT – VI :SEQUENTIAL CIRCUITS II :**

Finite state machine; Capabilities and limitations of FSM. Analysis of clocked sequential circuits, state diagrams, state tables, reduction of state tables and state assignment, design procedures. Realization of circuits using various flip-flops. Meelay to Moore conversion and vice-versa.

**Text Books**:

1. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition.
2. Switching and Finite automata Theory by Zvi Kohavi, Second Edition, Tata Mc Graw Hill.
3. A.P. Malvino and D.P. Leach, "Digital Principles and Applications", TMH, 2006.
4. M.MorrisMano,"Digital Logic and Computer Design", PHI,2007.

**References**:

1. Switching Theory and Logic Design by A. Anand Kumar.
2. Floyd & Jain, "Digital Fundamentals",Pearson Education, 2007.
3. William Gothmann,"Digital Electronics,:An Introduction to Theory and Practice",2nd edition,PHI-2008.
4. Micro electronics by Milliman MH edition.
5. http://nptel.ac.in/courses/108106069/
6. http://cse.iitkgp.ac.in/~goutam/pds/pdsLect/lect15.pdf
7. http://www.ee.surrey.ac.uk/Projects/CAL/seqswitching/synchronous_and_asynchronous_cir.ht m#Asynchronous circuits:

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Apply the fundamental concepts of combinational circuits and the application of various logical operations. | Application |
| **CO2** | Employ minimization techniques involved by the application of K-map. | Application |
| **CO3** | Design the logic circuits. | Analysis |
| **CO4** | Explored on the significance of PLD's in industrial applications. | Respond |
| **CO5** | Remember the importance of sequential circuits. | Knowledge |
| **CO6** | Demonstrate about the significance of designing of sequential circuits. | Application |

# PRAGATI ENGINEERING COLLEGE
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| | L | T | P | C |
|---|---|---|---|---|
| **II Year - II Semester** | **3** | **1** | **0** | **3** |

## PULSE & DIGITAL CIRCUITS (16EE4T12)

**Preamble**:

This course is exposed to various Wave Shaping circuits, highpass, lowpass RC circuits, clippers, clampers, comparators, multivibrators, timebase generators which are gaining importance in industry. This course requires a Pre requisite Knowledge on Basic Electronic Devices and Circuits, Network Theory.

**Course Objectives:**

This course enables the students to

- Explain the operation of high-pass; low pass RC circuits, attenuators.
- Explain the design of clipper, clamper and comparators.
- Analyze different types of multivibrators.
- Understand the significance of Digital circuits.
- Understand the importance of time base generators in electronic circuits
- Gain knowledge about the significance of pulse synchronization and frequency division .

**UNIT-I**

**Linear Wave Shaping:** Highpass, lowpass RC circuits-response to sinusoidal, step, pulse, square and ramp inputs. RC circuit as differentiator and integrator.

**Attenuators:** Basic attenuator circuit ,compensated attenuator circuit.

**Switching characteristics of devices:** Diode as a switch, transistor as a switch transistor at cutoff, the reverse collector saturation current $I_{CBO}$, its variation with the junction temperature. The transistors with in saturation. Design of transistor switch.

**UNIT-II : Nonlinear wave shaping:** Diode clippers, Transistor clipper, clippers at two independent levels-transfer characteristics of clippers-emitter coupled clipper, clamping operation, diode clamping circuits with source resistance and diode resistance-transient and steady state response for a square wave input, clamping circuit theorem-practical clamping circuit. Comparators.

**UNIT-III : Multivibrators: Bistable Multivibrators:**

A basic binary circuit-explanation. Fixed-bias transistor binary, self-biased transistor binary, binary with commutating capacitors-analysis. Non-saturated binary–symmetrical triggering, schmitt trigger circuit-emitter coupled binary circuit.

**Monostable multivibrator:**

Basic circuit-collector coupled monostable multivibrator- emitter coupled monostable multivibrator-triggering of monostable multivibrator.

**Astable multivibrator:**

The Astable collector coupled multivibrator, the Astable emitter coupled multivibrator.

**UNIT-IV : Digital logic circuits**

Introduction, positive and negative logic, Diode OR gate, Diode AND gate, An inverter circuit with transistor, DTL, TTL, ECL, AOI logic, NMOS logic, PMOS logic, CMOS logic - analysis and problem solving.

**UNIT-V:Time base generators:**

**Voltage time base generators**- Introduction, definitions of sweep speed error, displacement error, transmission error, various methods of generating time-base waveforms, UJT time base generator, transistor constant current sweep.

**Miller time base generators:** General considerations, The miller sweep- general considerations of boot strap time base generator-basic principles, transistor boot strap time base generator

**UNIT-VI : Synchronization and frequency division**

Pulse synchronization of relaxation devices, frequency division of the sweep circuit-synchronization of Astable, Monostable multivibrator, synchronization of sweep circuit with symmetrical signals-sine wave frequency division with a sweep circuit.

**Sampling Gates:** Basic operating principle, Unidirectional diode gate circuits, bi-directional gates using transistors. A bidirectional diode gate, Four-diode gate. Applications of sampling gates.

**Text Books**:

1. Pulse, Digital and switching waveforms by Milliman and Taub Mc Graw Hill.
2. Micro electronics by MilliMan–Mc Graw Hill.
3. Solid state Pulse Circuits-David A.Bell

**References**:

1. M S Prakash Rao"Pulse and Digital Circuits" Tata Mc Graw Hill.
2. David J. Comer, "Digital Logical State Machine Design", Oxford university press, 2008,thirdedition.
3. Venkatrao, K. Rama sudha, K. Manmadharao.G, "Pulse and Digital Circuits", Pearson education,2010.
4. Digital Design – Morris Mano, PHI, 3rd Edition, 2006.
5. Pulse and digital circuits by Anandkumar, PHI.
6. http://nptel.ac.in/courses/117103064/
7. http://www.iitg.ac.in/apvajpeyi/ph218/Lec-18.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Evaluate the response of RC high pass and low pass circuits to sinusoidal, step, pulse, square and ramp inputs, design attenuators and also analyze the switching characteristics of devices. | Evaluate |
| **CO2** | Construct clippers for single level and two independent level, clampers and comparators. | Synthesis |
| **CO3** | Analyze the different types of multivibrators. | Analysis |
| **CO4** | Design digital logic circuits using diodes, transistors, DTL, TTL, ECL, AOI logic, NMOS logic, PMOS logic, CMOS logic and problem solving. | Analysis |
| **CO5** | Get explore on time base generators in electronic circuits. | Knowledge |
| **CO6** | Demonstrate synchronization and frequency division of sweep circuit and multivibrator and develop sampling gates such as unidirectional and bidirectional sampling gates using diodes and transistors. | Respond |

# PRAGATI ENGINEERING COLLEGE
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**II Year - II Semester**

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

## ELECTRICAL MACHINES – I LAB (16EE4L04)

**Course Objective:**

Able to perform the experiments which are necessary to determine the parameters and the performance characteristics of DC machines and transformers.

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**ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED**

1. Speed control of DC shunt motor by Field and armature Control.
2. Swinburne's test and Brake Test on DC Shunt Motor.
3. Magnetization characteristics of DC shunt generator.
4. Load Test on DC shunt Generator.
5. Hopkinson's test on DC shunt machines.
6. Fields test on DC series machines.
7. OC & SC test on single phase transformer.
8. Direct Load test on single phase transformer.
9. Sumpner's or Back to back test on identical single phase transformers.
10. Separation of core losses of a single phase transformer.
11. Parallel operation of single Phase Transformers.
12. Scott connection of single phase transformers.

**Course Outcome:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Propose the performance characteristics of DC Machines and transformers which are suitable for industrial needs. | Synthesis |

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| **II Year - II Semester** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **0** | **0** | **3** | **2** |

## ELECTRONIC DEVICES AND CIRCUITS LAB (16EE4L05)

**Course Objective:**

To plot the characteristics of semi conductor devices. To analyze the operation of rectifiers (Half and Full wave) with and without filters.

**ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED**

1. Study of various devices.
   i) Function Generator.
   ii) Digital Voltmeter.
   iii) Regulated Power Supply.
   iv) CRO front Panel.

2. P-N Junction Diode Characteristics

3. Zener Diode Characteristics and load characteristics.
4. Rectifiers (without filter) Part A: Half – wave Rectifier
   Part B: Full-wave Rectifier
5. Rectifiers (with filter) Part A: Half – wave Rectifier & Shunt Capacitance filter
   Part B: Full-wave Rectifier & Shunt Capacitance Filter
6. BJT Characteristics(CE Configuration) Part A: Input Characteristics
   Part B: Output Characteristics
7. JFET Characteristics.
8. UJT Characteristics
9. CRO : Lissagus figures, Gearwheel pattern and phase shift (RC)
10. Frequency response of CE Amplifier with and without feedback.
11. CC Amplifier – Input and Output Impedance measurements.
12. Frequency response of FET CS Amplifier

**Course Outcome:**

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

| **CO#** | **Statement** | **Cognitive Level** |
|---|---|---|
| **CO1** | Plot the characteristics of semi conductor devices. | Characterize |
| **CO2** | Analyze the operation of rectifiers (Half and Full wave) with and without filters. | Analysis |

# PRAGATI ENGINEERING COLLEGE
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## Department of Electrical and Electronics Engineering

**III Year – I Semester**

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE5T13 | Power Systems-II | 3 | 1 | -- | 3 |
| 2 | 16EE5T14 | Electrical Measurements | 3 | 1 | -- | 3 |
| 3 | 16EE5T15 | Power Electronics | 3 | 1 | -- | 3 |
| 4 | 16EE5T16 | Signals and Systems | 3 | 1 | -- | 3 |
| 5 | 16CS5T12 | Data Structures | 3 | 1 | -- | 3 |
| 6 | 16EE5L06 | Electrical Machines-II Lab | -- | -- | 3 | 2 |
| 7 | 16EE5L07 | Control Systems Lab | -- | -- | 3 | 2 |
| 8 | 16CS5L06 | Data Structures Lab | -- | -- | 3 | 2 |
| 9 | 16BH5T16 | IPR & Patents | -- | 2 | -- | - |
| 10 | 16EE5M01 | MOOCS | -- | 2 | -- | - |
| **Total Credits** | | | | | | **21** |

**III Year – II Semester**

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE6T17 | Power Electronic Controllers and Drives | 3 | 1 | -- | 3 |
| 2 | 16EE6T18 | Power System Analysis | 3 | 1 | -- | 3 |
| 3 | 16EE6T19 | Linear IC Applications | 3 | 1 | -- | 3 |
| 4 | 16EC6T20 | Microprocessors & Microcontrollers | 3 | 1 | -- | 3 |
| 5 | 16EE6E01 | **Open Elective**<br>1. Neural Networks and Fuzzy Logic | 3 | 1 | -- | 3 |
| | 16EE6E02 | 2. Energy Audit, Conservation & Management | | | | |
| | 16EC6E05 | 3.VLSI Design | | | | |
| | 16ME6E01 | 4.Robotics | | | | |
| | 16CS6E03 | 5. Unix and Shell Programming | | | | |
| | 16IT6E03 | 6. OOPS Through JAVA | | | | |
| 6 | 16EE6L08 | Power Electronics Lab | -- | -- | 3 | 2 |
| 7 | 16EE6L09 | Electrical Measurements Lab | -- | -- | 3 | 2 |
| 8 | 16EE6P01 | Mini Project/Term Paper | -- | -- | 3 | 2 |
| 9 | 16BH6T17 | Professional Ethics & Human Values | -- | 2 | - | - |
| **Total Credits** | | | | | | **21** |

# PRAGATI ENGINEERING COLLEGE
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**Department of Electrical and Electronics Engineering**

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

**III Year –I Semester**

## POWER SYSTEMS– II (16EE5T13)

**Preamble:**

This course is an extension of Power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cables, insulators.

**Course Objectives:**

This course enables the students to

- Compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- Study the short and medium length transmission lines, their models and performance.
- Study the performance and modeling of long transmission lines.
- Learn the effect of travelling waves on transmission lines.
- Observe the factors affecting the performance of transmission lines.
- Discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators

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**UNIT–I: Transmission Line Parameters**:

Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors-Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines- Bundled conductors.

**UNIT–II: Performance of Short and Medium Length Transmission Lines** : Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks–Mathematical Solutions to estimate regulation and efficiency of all types of lines.

**UNIT–III : Performance of Long Transmission Lines**:

Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D Constants– Interpretation of the Long Line Equations, regulation and efficiency– Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves – Representation of Long Lines – Equivalent-T and Equivalent Pie network models.

**UNIT – IV: Power System Transients**:

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.

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**UNIT–V: Various Factors governing the Performance of Transmission line:**

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current –Shunt Compensation –Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference.

**UNIT–VI: Sag and Tension Calculations and Overhead Line Insulators**:

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–Types of Insulators – String efficiency and Methods for improvement– Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

**Text Books:**

1. Electrical power systems – by C. L. Wadhwa, New Age International (P) Limited Publishers, 1998.
2. Modern Power System Analysis by I. J. Nagarath and D. P. Kothari, Tata McGraw Hill, 2nd Edition.

**References:**

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4thedition
2. Power System Analysis and Design by B. R. Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar A. Chakrabarthy, Dhanpat Rai& Co Pvt. Ltd.
4. Electrical Power Systems by P.S.R. Murthy, B. S. Publications.
5. http://nptel.ac.in/courses/108102047/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Compute resistance, inductance and capacitance values of transmission lines. | Comprehension |
| CO2 | Analyze the performance of short and medium transmission lines. | Analysis |
| CO3 | Estimate the performance of long transmission lines | Comprehension |
| CO4 | Derive expressions for reflection and refraction coefficients with various terminations of lines | Analysis |
| CO5 | Study the performance of transmission lines under various conditions like Skin, Proximity, Ferranti effect, Corona, Over voltages, Radio Interference…etc | Comprehension |
| CO6 | Illustrate sag and tension in transmission lines and the use of different types of line insulators for voltage distribution | Application |

**PRAGATI ENGINEERING COLLEGE**
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| | L | T | P | C |
|---|---|---|---|---|
| **III Year –I Semester** | **3** | **1** | **0** | **3** |

## ELECTRICAL MEASUREMENTS (16EE5T14)

**Preamble:**
To enrich the students with knowledge on various measuring techniques for finding resistance, inductance, capacitance, various basic analog and digital measuring instruments for measurement of various electrical quantities.

**Course Objectives:**
This course enables the students to

- Classify different types of meters based on working principle.
- Understand the constructional details on operation of different electrical meters
- Understand the principle operation of Potentiometers.
- Determine the circuit parameters using AC and DC bridges.
- Understand the magnetic measurements and compute iron losses.
- Understand the basic principle of operation of Digital meters.

**UNIT-I : Measuring Instruments**
Classification – Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type, dynamometer and electro static instruments – Expression for the deflecting torque and control torque – Errors and compensations– Extension of range using shunts and series resistance - Current Transformers and Potential transformers - Ratio error and phase angle error.

**UNIT-II : Measurement of Power and Energy**
Single phase and three phase dynamometer wattmeter– LPF and UPF –Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced three phase systems – Type of P.F. Meters – Single phase and three phase dynamometer, moving iron type- Single phase induction type energy meter – Driving torque and braking torque – errors and compensation methods –Testing by phantom loading using R.S.S. meter– Three phase energy meter – Tri vector meter – Maximum demand meters–Electrical resonance type frequency meter.

**UNIT-III** : **Potentiometers:**
Principle and operation of D.C. Crompton's potentiometer – Standardization– Measurement of unknown resistance, Current, Voltage – AC Potentiometers**:** polar and coordinate types –Standardization – Calibration of various types of measuring instruments, Applications.

**UNIT-IV : Bridge Measurements**
Methods of measuring low, medium and high resistance – Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance– Loss of charge method for measurement of high resistance – Megger– Measurement of earth resistance – Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge –Anderson's bridge–Measurement of capacitance and loss angle –Desauty bridge–Schering Bridge–Wagner's earthing device–Wien's bridge.

**UNIT-V: Magnetic Measurements**

Ballistic galvanometer – Equation of motion – Flux meter – Constructional details–Determination of B–H Loop methods of reversals six point method –AC testing – Iron loss of bar samples– Core loss measurement using bridges and potentiometers.

**UNIT-VI : Digital meters**

Digital Voltmeter–Successive approximation –Ramp and integrating type–Digital frequency meter, Digital phase angle meter–Digital multimeter–Digital Tachometer.

**Text Books:**

1. A. K. Sawhney, A Course in Electrical and Electronics Measurements and Instruments- Dhanpat Rai and Sons,Delhi,2005.
2. F. W. Golding and Widdis, Electrical Measurements and Measuring Instruments, 5th Edition-2010.

**References:**

1. Measurement and Instrumentation theory and application, Alan S.Morris and Reza Langari, Elsevier
2. Reissland, M.U, "Electrical Measurements: Fundamentals, Concepts, Applications" 1st ed., New Age International (P) Ltd. Publishers, 2010.
3. Measurements Systems, Applications and Design – by D O Doeblin
4. Principles of Measurement and Instrumentation – by A.S Morris, Pearson/Prentice Hall of India
5. Modern Electronic Instrumentation and Measurement techniques – by A.D Helfrickand W.D. Cooper, Pearson/Prentice Hall of India.
6. http://nptel.ac.in/syllabus/108106070/
7. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and-measurement-spring-2006/index.htm

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Select the right type of instrument for measurement of voltage and current for AC and DC. | Evaluate |
| CO2 | Describe the construction and principle of operation of instruments for measurement of Power, energy, power-factor and power frequency. | Comprehension |
| CO3 | State the principle of operation of DC and AC Potentiometers. | Analysis |
| CO4 | Calculate the unknown resistance, inductance, capacitance by using bridges. | Analysis |
| CO5 | Develop magnetic test circuit for analyzing magnetic materials and measure core losses by Potentiometer and Bridge methods. | Synthesis |
| CO6 | Design digital meters for the measurement of voltage, frequency and speed. | Synthesis |

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**Department of Electrical and Electronics Engineering**

| | L | T | P | C |
|---|---|---|---|---|
| **III Year-I Semester** | **3** | **1** | **0** | **3** |

## POWER ELECTRONICS (16EE5T15)

**Preamble:**
The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semi conductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply(dc/ac converter) is also discussed in detail in this course.

**Course Objectives:**
This course enables the students to
- Study the characteristics of various power semiconductor devices and designing the firing circuits for SCR.
- Understand the operation of single phase half and fully controlled converters.
- Study the operation of three phase fully controlled converters and semi converters.
- Analyze the operation of high frequency DC–DC converters.
- Understand the working of inverters and application of PWM techniques for voltage control.
- Study the operation of AC – AC converters.

**UNIT – I : Power Semi Conductor Devices:**
Thyristors– Silicon controlled rectifiers (SCR's) – Static characteristics of SCR–Turn on and turn off methods–Dynamic characteristics of SCR. Snubber circuit design–Basic requirements of gate triggering circuits for SCR. Characteristics of power MOSFET and power IGBT.

**UNIT – II : Single Phase AC- DC Converters:**
1-phase half controlled rectifiers – R load and RL load with and without freewheeling diode – 1-phase fully controlled rectifiers – center tapped configuration and bridge configuration- R load and RL load with and without freewheeling diode – continuous and discontinuous conduction – Effect of source inductance and infinitely large load inductance – Dual Converter for four quadrant operation.

**UNIT – III : Three Phase AC–DC Converters:**
Three-phase diode bridge rectifier, natural commutation of diodes, half controlled and Fully controlled rectifiers with R and RL load with/without freewheeling diodes - Effect of source inductance.

**UNIT – IV:DC–DC Converters:**
Buck converter, Boost converter, Buck-Boost converter - Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) – steady state analysis - Output voltage, converter gain in CCM & DCM operation - output voltage ripple and inductor current ripple (for CCM) – Principle of forward and flyback converters (in CCM).

**UNIT – V: DC–AC Converters:**
Single phase half bridge and full bridge inverters–Unipolar and bipolar switching–Three phase Square wave Inverters- $120^0$ conduction mode, $180^0$ conduction mode –Pulse Width Modulation techniques– Quasi-square wave – Sinusoidal pulse width modulation- shoot through fault in Voltage Source Inverter (VSI) – Current Source Inverter (CSI).

**UNIT – VI: AC- AC Converters:**

Static V-I characteristics of TRIAC and modes of operation – 1-phase AC-AC regulator, phase angle control, integrated cycle control with R and RL loads – Continuous and discontinuous conduction-Single phase Midpoint type and Bridge type cyclo converter with R and RL loads- 3-Phase AC-AC regulators (with R load).

**Text books:**

1. Power Electronics : Circuits, Devices and Applications–by M.H. Rashid, Prentice Hall of India, 2nd edition,1998.
2. Power Electronics by M. D. Singh & K.B. Kanchandhani, TMH,2ndEdition, 1997.
3. Power Electronics– by P. S. Bhimbra, Khanna Publishers.
4. Power Electronics, V.R. Moorthi, Oxford University Press.

**References:**

1. Elements of Power Electronics–Philip T. Krein. oxford.
2. Modern Power Electronics, P.C. Sen., Chand & Co.
3. Thyristorised Power Controllers– by G. K. Dubey, S. R. Doradla, A. Joshiand R.M.K. Sinha, New Age International (P)Limited Publishers,1996.
4. Power Electronics handbook by Muhammad H. Rashid,Elsevier
5. Power Electronics by Vedam Subramanyam, New Age International Pvt. Limited, 1st Edition, 2006.
6. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
7. Power Electronics: converters, applications &design -by Nedmohan, Tore M.Undeland, Robbins by Wiley India Pvt. Ltd.
8. Power Electronics: Essentials & Applications by L. Umanand, Wiley, Pvt. Limited, India, 2009
9. http://nptel.ac.in/courses/108101038/
10. https://www.electrical4u.com/concept-of-power-electronics/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Interpret the characteristics of various power semiconductor and design firing circuits for SCR. | Comprehension |
| CO2 | Distinguish the operation of single phase half, fully controlled converters and dual converter. | Analysis |
| CO3 | Relate the operation of three phase fully converters. | Knowledge |
| CO4 | State the operation of dc–dc converters. | Understand |
| CO5 | Analyze the working of inverters and application of PWM techniques for voltage control. | Analysis |
| CO6 | Describe the operation of AC-AC converters. | Comprehension |

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**III Year - I Semester**

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## SIGNALS AND SYSYTEMS (16EE5T16)

**Preamble:**

The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semi conductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

**Course Objectives:**

This course enables the students to

- Introduce the concepts and techniques associated with the understanding of signals and systems.
- Introduce the concept of sampling and reconstruction of signals.
- Analyze the linear systems in time and frequency domains.
- Understand the concepts of convolution and correlation of signals.
- Study Laplace transform as mathematical tool to analyze signals and systems.
- Study z-transform as mathematical tool to analyze discrete-time signals and systems.

**UNIT- I: INTRODUCTION:**

Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on Signals and Systems. Basic Signals (impulse function, step function, signum function, ramp function, Complex exponential and sinusoidal signals). Representation of periodic signals in frequency domain using Fourier series.

**UNIT –II: SAMPLING THEOREM**:

Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Graphical and analytical proof for Band Limited Signals, impulse sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling.

**UNIT-III: ANALYSIS OF LINEAR SYSTEMS:**

Linear system, impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

**UNIT –IV: CONVOLUTION AND CORRELATION OF SIGNALS:**

Concept of convolution in time domain and frequency domain using integral equations. Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

**UNIT –V: LAPLACE TRANSFORMS:**

Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

**UNIT –VI: Z–TRANSFORMS:**

Fundamental difference between continuous-time and discrete-time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms.

**Text Books:**

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and systems by A. Anand Kumar, PHI

**References:**

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
2. Signals and systems by A. Nagoor Kani,Mc Graw Hill Education, 1st Edition, 2010.
3. Signals and Systems – T K Rawat , Oxford University press, 2011
4. http://nptel.ac.in/courses/117101055/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Characterize the signals and systems and principles of vector spaces, Concept of Orthogonality. | Characterize |
| CO2 | Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back. | Application |
| CO3 | Outline the relationships among the various representations of LTI systems. | Knowledge |
| CO4 | Interpret signals and analyze system response using convolution integral. | Analysis |
| CO5 | Analyze Continuous time signals using Laplace Transforms in the complex frequency plane. | Analysis |
| CO6 | Apply z-transform to analyze discrete-time signals and systems. | Analysis |

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## DATA STRUCTURES (16CS5T12)

**Learning Objectives**

1. Choose the appropriate data structure and algorithm design method for a specified application.
2. Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps binary search trees, and graphs and writing programs for these solutions.

**Course Outcomes:**

**At the end of the course student should be able to -**

1. Analyze recursive algorithms. **(Analyze)**
2. Design linear data structures with stacks and queues**.(Create)**
3. Illustrate the operations of linked lists**.(Analyze**)
4. Construct nonlinear data structures(Trees) for its applications.**(Apply)**
5. Make use of graph data structure to solve real world problems.**(Apply)**
6. Justify the best searching and sorting techniques for a given data set.**(Evaluate)**

**UNIT - I**

Data structure- Definition, types of data structures.

**Recursion:** Definition, Design Methodology and Implementation of recursive algorithms, Linear and binary recursion, recursive algorithms for factorial function, GCD computation, Fibonacci sequence.

**UNIT - II**

**Stacks and Queues:** Basic Stack Operations, Representation of a Stack using Arrays, Stack Applications: Infix to postfix Transformation, Evaluating Arithmetic Expressions.

**Queues:** Basic Queues Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack, Circular Queues.

**UNIT - III**

**Linked Lists:** Introduction, singly linked list, representation of a linked list in memory, Operations on a singly linked list, Reversing a singly linked list, Advantages and disadvantages of singly linked list, Circular linked list, Doubly linked list.

**UNIT - IV**

**Trees:** Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays and linked lists, operations on a Binary tree, Binary Tree Traversals (recursive), Creation of binary tree from in, pre and post order traversals.

**UNIT - V**

**Graphs:** Basic concepts, Representations of Graphs: using Linked list and adjacency matrix, Graph algorithms, Graph Traversals (BFS & DFS), applications: Dijkstra's shortest path, Minimum Spanning Tree using Prim's Algorithm.(Algorithmic Concepts Only, No Programs required).

**UNIT-VI**

List Searches using Linear Search, Binary Search, Fibonacci Search

**Sorting Techniques:** Basic concepts, Sorting by: insertion (Insertion sort), selection (heap sort), exchange (bubble sort, quick sort), merging (merge sort) Algorithms.

**Text Books**

1. "Data Structures using C", Reema Thareja, Oxford ,2nd edition 2014
2. "Data Structures: A Pseudocode Approach with C", Richard F, Gilberg, Forouzan, Cengage, 2nd edition, 2007.
3. "Data structures using C", Aaron M.Tenenbaum, Y.Langsam, M.J. Augenstein, Pearson Publications 9th edition.
4. Data Structures and Algorithms: Concepts, Techniques and Applications, G.A.VPai, TMH, 2015.

**Reference Books**

1. "Data Structure with C", Seymour Lipschutz, TMH, 1steditio
2. Classic Data Structures, 2/e, Samanta and SamantaDebasis, PHI Learning Pvt. Ltd., 2009
3. Fundamentals of Data Structure in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press.

**URLs**

1. http://nptel.ac.in/courses/106102064/1
2. http://www.academictutorials.com/data-structure/data-structure-linear.asp
3. http://www.geeksforgeeks.org/data-structures

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**III Year –I Semester**

## ELECTRICAL MACHINES –II LAB (16EE5L06)

**Course objectives:**
This course enables the students to

- Understand the performance of various types of AC machines -induction motors, alternators and synchronous motors.

**ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED**

1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance & m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of $X_d$ and $X_q$ of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three phase alternator by loading with three phase induction motor.
10. Power factor improvement of single phase induction motor by using capacitors
11. Load test on single phase induction motor.
12. Study of three phase Slip ring Induction motor.

**Course outcomes:**
At the end of the Course, the student should be able to:

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Distinguish the performance of single phase induction motors, three phase induction motors with suitable test method and provide equivalent circuit. | Analysis |
| CO2 | Analyze the performance of synchronous motors through $X_d$-$X_q$, V-inverted V curves. | Analysis |
| CO3 | Determine the regulation of alternator by various methods. | Evaluation |

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**III Year –I Semester**

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## CONTROL SYSTEMS LAB (16EE5L07)

**Course objectives:**

This course enables the students to

- Understand time response of second order system and effect of different controllers on it.
- Understand the characteristics of AC servo motor, DC servo motor and synchros.

**ANY TEN EXPERIMENTS ARE TO BE CONDUCTED**

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – characteristics of stepper motor
4. Effect of feedback on DC servo motor
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lag and lead compensation – Magnitude and phase plot
7. DC position control system
8. Transfer function of DC motor
9. Temperature controller using PID
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. Characteristics of magnetic amplifiers

**Course outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Expertise the response of second order system and effect of P, PI, PID controllers on it | Analysis |
| CO2 | Calculate the transfer function of DC motor and characteristics of AC servo motor, DC servo motor and synchro's. | Analysis |

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## DATA STRUCTURES LAB (16CS5L06)

**Learning objectives:**

This course is aimed to provide hands on experience to implement basic linear and nonlinear data structures- stack, queue, linked lists and searching & sorting techniques.

**Course Outcomes:**

**At the end of this course student will be able to-**

1. Implement linear and nonlinear data structures using C language.
2. Develop C programs for searching and sorting techniques.

**List of Experiments**

1. a) Write a Program to Implement Stack Operations by using Array.
   b) Write a Program to implement the operations of Queue using array.
2. Write a Program to Implement Singly Linked List and its operations.
3. a) Write a Program to Implement Stack Operations by using Linked List.
   b) Write a Program to implement the operations of Queue using linked list.
4. Write a Program to Implement Circular Queue Operations by using Array.
5. Write a Program to Perform the Tree Traversal Techniques by using recursion.
6. Write a program for implementing the Depth First Search graph traversal algorithm.
7. Write a program for implementing the Breadth First Search graph traversal algorithm.
8. a) Write a Program to implement linear search algorithm.
   b) Write a Program to implement binary search algorithm.
9. Write a Program to Sort the set of elements by using
   i) Quick Sort. ii) Merge Sort.

**Note: Use Classes and Objects to implement the above programs.**

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## INTELLECTUAL PROPERTY RIGHTS AND PATENTS (16BH5T16)

### Unit I

**Introduction to Intellectual Property Law** – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration –WTO-WIPO- Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.

### Unit II

**Introduction to Copyrights** – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works – Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law- Semiconductor Chip Protection Act.

### Unit III

**Introduction to Patent Law** – Rights and Limitations – Rights under Patent Law – Patent Requirements – Product Patent and Process Patent- Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – New developments in Patent Law

### Unit IV

**Introduction to Trade Mark** – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.

### Unit V

**Introduction to Trade Secrets** – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation- Service Level Agreements – Breach of Contract – Applying State Law.

## Unit VI

**Introduction to Cyber Law** – Information Technology Act - Cyber Crime and E-commerce –Security- Data Security – Confidentiality –Data Privacy in India Vs Rest of the World.

Relevant Cases Shall be dealt where ever necessary.

**REFERENCE BOOKS:**

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning, New Delhi.
2. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
3. Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press).
4. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections.
5. Prabhuddha Ganguli: ‘Intellectual Property Rights” Tata Mc-Graw – Hill, New Delhi.
6. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
7. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
8. M.Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right” Serials Pub.

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**III Year –II Semester**

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## POWER ELECTRONIC CONTROLLERS AND DRIVES (16EE6T17)

**Preamble:**
This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

**Course Objectives:**
This course enables the students to

- Learn the fundamentals of electric drive and different electric braking methods.
- Analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- Discuss the converter control of dc motors in various quadrants.
- Understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- Learn the principles of static rotor resistance control and various slip power recovery schemes.
- Understand the speed control mechanism of synchronous motors

**UNIT-I: Fundamentals of Electric Drives**
Electric drive – Fundamental torque equation – Load torque components –Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

**UNIT-II: Controlled Converter Fed DC Motor Drives**
Single phase Separately excited and self excited dc motor drives controlled by half and full converters– Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Principle of operation of dual converters and dual converter fed DC motor drives.

**UNIT-III : DC–DC Converters Fed DC Motor Drives**
Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operation – Closed loop operation (Block Diagram Only).

**UNIT-IV: Stator side control of 3-phase Induction motor Drive**
Control of Induction Motor by AC Voltage Controllers – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by voltage source inverter – PWM control – Closed loop v/f control of induction motor drives (Block Diagram Only).

**UNIT-V : Rotor side control of 3-phase Induction motor Drive**
Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

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## UNIT-VI : Control of Synchronous Motors

Separate control &self control of synchronous motors – Operation of self controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (Block Diagram Only) –Variable frequency control–Pulse width modulation.

## Text Books:

1. Fundamentals of Electric Drives – by G K Dubey , Narosa Publications
2. Power Semiconductor Drives, by S.B. Dewan, G. R. Slemon, A. Straughen, Wiley-India Edition.
3. Electric Drives by N.K. De & P.K. Sen, PHI

## References:

1. Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H. Rashid, PHI.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.
5. Electrical Drives-Concepts and Applications by Vedam Subramanyam, McGraw Hill Education, 2nd edition, 2011.
6. Electrical drives: Modeling, Analysis and Control by R. Krishnan, Prentice Hall of India., 1stEdition, 2007.
7. Modern Power Electronics and AC Drives by B.K.Bose, Prentice Hall of India, 1st Edition, 2008.
8. A First course on Electrical Drives by S K Pillai, New Age International (P) Ltd, 2ndEdition, 1989.
9. http://nptel.ac.in/courses/108108077/

## Course Outcomes:

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Express the torque of drive to process requirement and different electric braking methods | Comprehension |
| CO2 | Execute the four quadrant operation of three phase converter and dual converters. | Application |
| CO3 | Relate the Drives continuous operation at various quadrants in converter control. | Knowledge |
| CO4 | Implementation of AC voltage controllers and voltage source inverters in the induction Motor drives for speed control mechanism. | Application |
| CO5 | Clarify the stator side control and rotor side control of three phase induction motor. | Understand |
| CO6 | Generalize the Control mechanism of speed requirement in industrial domain machines like synchronous motors. | Understand |

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**III Year –II Semester**

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## POWER SYSTEM ANALYSIS (16EE6T18)

**Preamble:**

The course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, formation of $Z_{bus}$ and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability.

**Course Objectives:**

This course enables the students to

- Develop the per unit impedance diagram (p.u) and formation of $Y_{bus}$
- Study the concept of the $Z_{bus}$ building algorithm.
- Obtain load flow solution using different load flow methods.
- Evaluate short circuit currents for symmetrical faults
- Analyze the effect of unsymmetrical faults on system behavior.
- Learn different methods of stability for analysis.

**UNIT –I: Per Unit Representation & Topology**:

Per Unit Quantities–Single line diagram– Impedance diagram of a power system–Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y–bus matrix by singular transformation and direct inspection methods.

**UNIT –II : Power Flow Studies**

Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form –Decoupled and Fast Decoupled methods – Algorithmic approach – Problems on 3–bus system only.

**UNIT –III : Z–Bus formulation**

Formation of Z–Bus: Partial network– Algorithm for the Modification of Zbus 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 buses - Modification of Z–Bus for the changes in network.

**UNIT – IV: Symmetrical Fault Analysis**

Transients on a Transmission line-Short circuit of synchronous machine(on no-load)– 3- Phase short circuit currents and reactances of synchronous machine–Short circuit MVA calculations -Series reactors – selection of reactors.

**UNIT –V: Symmetrical Components & Fault analysis**

Definition of symmetrical components - symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances – Synchronous generator – Transmission line and transformers – Sequence networks –Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system.

**UNIT – VI : 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 –Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion–Applications of Equal Area Criterion–Methods to improve steady state and transient stability.

**Text Books:**

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I. J. Nagrath & D. P. Kothari: Tata Mc Graw–Hill Publishing Company, 2nd edition.
3. Electrical Power Systems by P. S. R. Murthy, B. S. Publications
4. Power System Analysis and Design by J. Duncan Glover, M. S. Sarma, T.J. Overbye – Cengage Learning publications.

**References:**

1. Power System Analysis – by A. R. Bergen, Prentice Hall, Inc.
2. Power System Analysis by Hadi Saadat – TMH Edition.
3. Power System Analysis by B. R. Gupta, Wheeler Publications.
4. https://www.electrical4u.com/electrical-fault-calculation-positive-negative-zero-sequence-impedance/
5. http://nptel.ac.in/courses/108105067/
6. https://www.electrical4u.com/power-system-stability/

**Course Outcomes:**

At the end of the Course, the student should be able to

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Formulate incidence, network matrices, per unit impedance diagrams and Y-bus matrix | Comprehension |
| **CO2** | Analyze the behavior of the power system under steady state conditions using various load flow methods | Analysis |
| **CO3** | Develop $Z_{bus}$ matrix for changes in the network configurations such as Addition of element from a new bus to reference, from a new bus to an old bus, between an old bus to reference & between two old buses | Application |
| **CO4** | Analyze the behavior of the power system under short circuit conditions | Analysis |
| **CO5** | Design the proper protective equipment for the power system under asymmetrical fault conditions | Synthesis |
| **CO6** | Suggest the methods for improving the stability of the power system under various operating conditions | Analysis |

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**III Year - II Semester**

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## LINEAR IC APPLICATIONS (16EE6T19)

**Preamble:** The analog circuits are developed on circuit Concept basis. The advancement of Technology in Fabrication Field gain prominence by using I.C Technology. On a Single chip millions of transistors are fabricated using Very Large Scale IC. In This context Operational Amplifies which is an analog device plays an important role for Analog IC Design. Operational Amplifies performs Mathematical operations. Therefore these Operational Amplifiers design goes into System design instead of circuit design. So Linear IC applications plays vital role in the electronic field.

**Course Objectives:**

This course enables the students to

- Study the types of I.C's, basic operation & performance parameters of differential amplifiers.
- Study the measuring techniques and the performance parameters of OP-AMP.
- Study the linear and non-linear applications of operational amplifiers.
- Study the analysis & design of different types of active filters using op amps.
- Study the internal structure, operation and applications of different analog ICs.
- Study the various converter circuits and their specifications.

**UNIT – I: INTEGRATED CIRCUITS:**

**Types, Classification of I.C's,** Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configuration - Dual Input Unbalanced Output, Single Ended Input – Balanced/ Unbalanced Output, DC Coupling and Cascade Differential Amplifier Stages, Level translator.

**UNIT – II: OP-Amps:**

Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.

**UNIT – III: LINEAR and NON-LINEAR APPLICATIONS OF OP-AMPS:**

Inverting and Non inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.

**UNIT – IV: ACTIVE FILTERS, ANALOG MULTIPLIERS AND MODULATORS:**

Design &Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters. Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.

**UNIT – V: TIMERS & PHASE LOCKED LOOPS**:

Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of individual blocks, 565

PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566).

**UNIT – VI: DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS:**
Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications, Specifications AD 574 (12 bit ADC).

**Text books:**

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition, 2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1987.

**References:**

1. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition.
2. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971
3. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons;2nd Edition,2012
4. http://nptel.ac.in/courses/117106030/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Acquire the knowledge on operational amplifiers in the design of mathematical circuits for various applications. | Knowledge |
| CO2 | Employ the Op-amp circuits for active filters. | Application |
| CO3 | Analyze the linear and non-linear characteristics of Op- amps and their applications. | Analysis |
| CO4 | Design of Filter circuits for I.C's. | Synthesis |
| CO5 | Identify the gain bandwidth and frequency response of the amplifier configurations. | Application |
| CO6 | Discuss the working of operational amplifiers with linear integrated circuits. | Comprehend |

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**III YEAR – II SEMESTER**

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## MICROPROCESSORS AND MICROCONTROLLERS (16EC6T20)

**Course objectives:** The student will

1. Study the organization and architecture of 8086 Micro Processor.
2. Study addressing modes to access memory, programming principles for 8086.
3. Study the interfacing of 8086 MP with I/O as well as other devices.
4. Study 8051 micro controller architecture & I/O ports.
5. Study the concept of PIC Microcontrollers like register & I/O ports.
6. Study the concept of Programming in C for PIC microcontroller.

**UNIT–I:**

**Introduction to Microprocessor Architecture:** Introduction and evolution of Microprocessors– Architecture of 8086–Register Organization of 8086–Memory organization of 8086– General bus operation of 8086–Introduction to 80286–80386 and 80486 and Pentium.

**UNIT–II:**

**Minimum and Maximum Mode Operations:** Instruction set, Addressing modes– Minimum and Maximum mode operations of 8086–8086 Control signal interfacing–Read and write cycle timing diagrams.

**UNIT–III:**

**I/O Interface:** 8255 PPI- Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086–DMA controller (8257)–Architecture– Interfacing 8257 DMA controller– Programmable Interrupt Controller (8259)–Command words and operating modes of 8259– Interfacing of 8259–Keyboard/display controller (8279)–Architecture–Modes of operation–Command words of 8279– Interfacing of 8279.

**UNIT–IV:**

**80386 AND 80486 MICROPROCESSORS-**Introduction, programming concepts, special purpose registers, memory organization, moving to protected mode, virtual mode, memory paging mechanism, architectural differences between 80386 and 80486 microprocessors.

**UNIT– V:**

**Introduction to 8051 Micro Controller-**Overview of 8051 Micro Controller– Architecture– Register set– I/O ports and Memory Organization– Interrupts–Timers and Counters–Serial Communication. Applications in power systems

**UNIT– VI:**

**PIC Architecture-**Block diagram of basic PIC 16F8XX micro controller, registers I/O ports. **Programming in C for PIC-** Data types, I/O programming, logical operations, data conversion

**Text Books**

1. Microprocessors and Interfacing – Programming and Hard ware -Douglas V Hall, SSSP Rao, 3rd Edition, Tata McGraw Hill Education Private Limited.
2. The 8051 Microcontroller & Embedded Systems Using Assembly and C - Kenneth J.Ayala, Dhananjay V.Gadre,Cengage Learninbg , India Edition.

**References**

1. The Intel Microprocessors-Architecture, Programming, and Interfacing - Barry B.Brey, Eighth Edition,Pearson, -2012.
2. Microprocessors and Microcontrollers-Architecture, Programming and System Design- Krishna Kant, Second Edition , PHI Learning Private Limited,2014.
3. Microprocessors and Microcontrollers- N.Senthil Kumar, M.Saravanan and S.Jeevananthan, Seventh Impression, Oxford University Press, 2013

**Course outcomes:**

After going through this course the student will be able to

1. Analyze the concepts of architecture and key features of 8086 Microprocessor.
2. Build the knowledge about different addressing modes & Instruction sets of 8086 microprocessor.
3. Implement the concept of Interfacing 8086 microprocessor with other I/O peripherals.
4. Analyze the advances in Microprocessors (80386 & 80486) and their architectural differences.
5. Apply the concepts of 8051 microcontroller for simple applications.
6. Implement the concepts of PIC microcontroller & USART in Project applications.

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**III Year –II Semester**

## NEURAL NETWORKS AND FUZZY LOGIC (16EE6E01)
## (Open Elective)

**Preamble:**This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks. Also introduces Fuzzy sets and Fuzzy Logic system components and Genetic Algorithms. The Neural Network, Fuzzy Network System and Genetic Algorithms applications to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

**Course Objectives:**

This course enables the students to

- Study various methods of AI.
- Study the models and architecture of artificial neural networks.
- Understand the fundamental concept of ANN and Different architectures, Learning/Training algorithms and methodologies.
- Understand the concepts of Fuzzy sets and Fuzzy logic controllers.
- Understand the basics in Genetic algorithm.
- Gain knowledge in neuro-fuzzy control and its applications in power systems and power electronics.

**Unit – I: Introduction to Neural Networks**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking euron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential, Applications of ANN.

**Unit- II: Essentials of Artificial Neural Networks**

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

**Unit–III:**

**Multilayer feed forward Neural Networks**

Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements, Radial Basis Function (RBF) Neural Network – Kohonen Self Organising feature Map (KSOM).

**Associative Memories**

Bidirectional Associative Memories (BAM)-Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network, Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

## UNIT– IV: Classical & Fuzzy Sets:

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

## UNIT – V:Fuzzy Logic Modules:

Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

## UNIT–VI : Neural network and fuzzy logic Applications

**Neural network applications:** Process identification, control, fault diagnosis and load forecasting.

**Fuzzy logic applications:** Load frequency control and Fuzzy classification

## Text Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S. Rajasekaran and G.A. Vijayalakshmi Rai – PHI Publication.
2. Principles of soft computing Techniques by S. N. Sivanandam, S. N. Deepa - wiley India publication.
3. Introduction to Artificial Neural Systems – Jacek M. Zurada, Jaico Publishing House, 1997.
4. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH.

## References:

1. Neural Networks- James A Freeman and Davis Skapura, Pearson Education,2002.
2. Neural Networks -Simon Hakins, Pearson Education.
3. Neural Engineering by C.Eliasmith and CH.Anderson,PHI.
4. Neural Networks and Fuzzy Logic Systems by Barat kosko, PHI Publications.
5. Fundamentals of Neural Networks Architectures, Algorithms and Applications - by laureneFausett, Pearson.
6. https://svn-d1.mpi-inf.mpg.de/AG1/MultiCoreLab/papers/ebook-fuzzy-mitchell-99.pdf
7. http://neuralnetworksanddeeplearning.com/chap1.html
8. http://www.learnartificialneuralnetworks.com/
9. http://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_tutorial.pdf

## Course Outcomes:

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Differentiate various models of Artificial Neuron. | Analysis |
| CO2 | Memorise difference between knowledge based systems and Algorithmic based systems. | Knowledge |
| CO3 | Analyze Multi-layer feed-forward network. | Analysis |
| CO4 | Compare classical sets with fuzzy sets. | Comprehension |
| CO5 | Apply different modules of Fuzzy logic controller. | Application |
| CO6 | Apply soft computing techniques for real-world problems. | Application |

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**III Year –II Semester**

## ENERGY AUDIT, CONSERVATION & MANAGEMENT (16EE6E02)
## (Open Elective)

**Preamble:**

This is an open elective course developed to cater the current needs of the industry, this course covers topics such as energy conservation act and energy conservation. It also covers energy efficient lighting design. The student will learn power factor improvement techniques, energy efficiency. In addition, the economic aspects such as payback calculations, life cycle costing analysis is covered in this course.

**Course Objectives:**

This course enables the students to

- Understand energy efficiency, scope, conservation and technology.
- Design energy efficient lighting systems.
- Estimate power factor of systems and propose suitable compensation techniques.
- Understand space heating and ventilation methods.
- Calculate life cycle costing analysis and return on investment on energy efficient technologies.
- Understand the concepts and compute the economic aspects of energy consumption.

**UNIT–I: Energy Scenario and Basic Principles of Energy Audit, Management**

Energy audit – Definitions – Concept – Types of audit –Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential– Principles of energy management – Initiating, planning, controlling, promoting, monitoring and reporting – Energy manager – Qualities and functions.

**UNIT–II : Lighting**

Definition of terms and units. Luminous efficiency – Polar Curve-Calculation of illumination level – Illumination of inclined surface to beam– Luminance or brightness-Types of Lightning, Electric lighting fittings (luminaries)- -Flood lightening – White Lightening and conducting polymers- Energy conservation measures.

**UNIT–III: Power Factor and Energy Instruments**

Power factor – Methods of improvement – Location of capacitors– Power factor with non linear loads – Effect of harmonics on Power factor –Numerical problems. Energy Instruments Watt–hour meter – Data loggers– Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

**UNIT – IV: Space Heating and Ventilation**

Ventilation – Air–Conditioning (HVAC) and Water Heating: Introduction – Heating of buildings – Transfer of Heat–Space heating methods — Insulation – Cooling load – Electric water heating systems.

**UNIT–V: Economic Aspects and Financial Analysis**

Understanding energy cost - Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient

motors (basic concepts) – Economics of energy efficient motors and systems.

**UNIT–VI: Computation of Economic Aspects**

Need of investment, appraisal and criteria - Calculation of simple payback period–Return on investment – Net present value – Internal rate of return -Applications of life cycle costing analysis–Return on investment.

**Text Books:**

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Energy Conservation by P. Diwan and P. Dwivedi, Pentagon Press, 2008.
4. Industrial Energy Management: Principles and Applications by Giovanni and Petrecca, The Kluwer international series-207 (1999)

**References:**

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill
3. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.
5. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.
6. http://www.energymanagertraining.com/download/Gazette_of_IndiaPartIISecI-37_25-08-2010.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Analyze the principles of energy auditing along with energy conservation schemes and management methods. | Analysis |
| CO2 | Employ different illumination and energy conservation methods for effective lighting. | Application |
| CO3 | Acquire knowledge on power factor with improvement methods. | Knowledge |
| CO4 | Differentiate space heating and ventilation methods. | Analysis |
| CO5 | Calculate life cycle costing analysis and return on investment on energy efficient motors | Analysis |
| CO6 | Determination of recovery investment on energy efficient technologies. | Evaluate |

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**III YEAR – II SEMESTER**

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## VLSI DESIGN (16EC6E05)

**Course objectives: The main objectives of this course are:**

1. To enable the student to visualize MOS fabrication technologies and to understand electrical properties of MOS, CMOS and Bi CMOS circuits.
2. To train the student to draw integrated circuit layouts and stick diagrams following Lambda based design rules.
3. To gain knowledge in Basic circuit concepts and scaling for advanced VLSI design technology.
4. To learn input and output circuits of a Chip and testing and verification in VLSI design .
5. To understand the types of Architectures, Technologies and Families related to FPGA Design
6. To provide knowledge for the students on the importance to go for Low power VLSI and design applications .

**UNIT-I: Introduction and Basic Electrical Properties of MOS Circuits:** Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

**UNIT-II: MOS and Bi-CMOS Circuit Design Processes:** MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams Translation to Mask Form.

**UNIT-III: Basic Circuit Concepts:** Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, Some area Capacitance Calculations, The Delay Unit, Inverter Delays, Driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.
**Scaling of MOS Circuits**: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density. Switch logic, Gate logic.

**UNIT-IV: Chip Input and Output circuits:** ESD Protection, Input Circuits, Output Circuits and L(di/dt) Noise, On-Chip clock Generation and Distribution.
**Design for Testability:** Fault types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based Techniques and Built-In Self Test techniques.

**UNIT-V:**

**FPGA Design:** FPGA design flow, Basic FPGA architecture, FPGA Technologies, FPGA families- Altera Flex 8000FPGA, Altera Flex 10FPGA, Xilinx XC4000 series FPGA, Xilinx Spartan XL FPGA, Xilinx Spartan II FPGAs, Xilinx Vertex FPGA. Case studies: FPGA Implementation of Half adder and full adder.

**Introduction to synthesis:** Logic synthesis, RTL synthesis, High level Synthesis.

**UNIT-VI:**

**Introduction to Low Power VLSI Design:** Introduction to Deep submicron digital IC design, Low Power CMOS Logic Circuits: Over view of power consumption, Low –power design through voltage scaling, Estimation and optimisation of switching activity, Reduction of switching capacitance. Interconnect Design, Power Grid and Clock Design.

**Test books**

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGrawHill Education, 2003.

**References**

1. Advanced Digital Design with the Verilog HDL, Michael D.Ciletti, Xilinx Design Series, Pearson Education
2. Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3’rd edition, David Hodges

**Course outcomes:** On successful completion of the course, students will be able to

1. Demonstrate a clear understanding of CMOS fabrication flow and impact of electrical properties of MOS circuits in semiconductor industry.
2. Know three sets of design rules with which NMOS and CMOS design may be fabricated.
3. Identify the interactions between process parameters, device structures, circuit performance for system design.
4. Design complex digital systems using VLSI design methodology through testing and verification.
5. Comprehend the types of FPGA’s and their programming technologies, programmable logic block architectures and their interconnect.
6. Estimate the power dissipation in VLSI circuits through study of Switching capacitance, interconnect and clock.

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**III Year –II Semester**

## ROBOTICS (16ME6E01)

***Course Objectives:***

*To make the students aware of:*

1. *Robot applications, classifications, controlling systems and automation.*
2. *Robot components, their architecture, work envelope and types of drive systems.*
3. *Homogeneous transformations and Manipulator Kinematics of robots.*
4. *Robotic arm motion by using Mathematical approach.*
5. *Trajectory planning for a manipulator by avoiding obstacles and programming languages, software packages for path description to robots.*
6. *Functioning of sensors, actuators and Robot applications in manufacturing.*

**UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

**UNIT – II**

**Components of the Industrial Robotics:** Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

**UNIT – III**

**Motion Analysis:** Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

**UNIT – IV**

Differential transformations and manipulators , Jacobians–problems. **Dynamics:** Lagrange – Euler and Newton – Euler formulations – Problems.

**UNIT V**

General considerations in path description and generation Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages-description of paths with a robot programming languages.

**UNIT VI**

**Robot actuators and Feedback components:**

**Actuators:** Pneumatic, Hydraulic actuators, electric & stepper motors.

**Feedback components:** position sensors – potentiometers, resolvers, encoders – Velocity sensors.

**Robot Application in Manufacturing:** Material Transfer - Material handling, loading and unloading Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

**TEXT BOOKS:**


1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

**REFERENCES:**

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
4. Introduction to Robotics / John J Craig / Pearson Edu.
5. http://www.nptel.ac.in/courses/112101099/1#

***Course outcomes:***

*Students will be able to:*

1. *classify the coordinate systems and control systems of a robot.*
2. *explain the architecture of a robot.*
3. *analyze kinematics of a serial manipulator.*
4. *analyze dynamics of serial manipulator.*
5. *develop the trajectory planning algorithms using programming languages.*
6. *illustrate the applications of robots in manufacturing, select the actuators and feedback components for a given robot application.*

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**III Year - II Semester**

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## UNIX AND SHELL PROGRAMMING (16CS6E03)

**Learning Objective:**

Introduction to UNIX Operating System and its File System and to gain an understanding of important aspects related to the SHELL and the process utilities and service utilities.

**Course Outcomes:**

**At the end of the course student should be able to -**

1. Make use of basic Unix commands . (Apply)
2. Analyze file system architecture to organize the file system.(Analyze)
3. Analyze shell command line structure (Analyze).
4. Design of filters in AWK language. (Create)
5. Implement commands using Shell Programming. (Create)
6. Create IPC between parent- child in Linux environment (Create)

**UNIT-I**

Introduction to UNIX -Brief History-What is Unix-Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving Multiple Commands.

**UNIT-II**

The File system –The Basics of Files-What's in a File-Directories and File Names-Permissions-I Nodes-The Directory Hierarchy, File Attributes and Permissions-The File Command knowing the File Type-The chmod Command Changing File Permissions-The chown Command Changing the Owner of a File-The chgrp Command Changing the Group of a File.

**UNIT-III**

Using the Shell-Command Line Structure-Met characters-Creating New Commands-Command Arguments and Parameters-Program Output as Arguments-Shell Variables- -More on I/O Redirection-Looping in Shell Programs.

**UNIT-IV**

Filters-The Grep Family-Other Filters-The Stream Editor Sed-The AWK Pattern Scanning and processing Language-Good Files and Good Filters.

**UNIT-V**

Shell Programming-Shell Variables-The Export Command-The Profile File a Script Run During Starting-The First Shell Script-The read Command-Positional parameters-The $? Variable knowing the exit Status-More about the Set Command-The Exit Command-Branching Control Structures-Loop Control Structures-The Continue and Break Statement

**UNIT-VI**

The Process-The Meaning-Parent and Child Processes-Types of Processes-More about Foreground and Background processes-Internal and External Commands-Process Creation-The Trap Command-The stty Command-The Kill Command-Job Control.

**TEXT BOOKS:**

1. The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson.
2. Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson.

**REFERENCE BOOKS:**

1. Unix and shell Programmingby B.M. Harwani, OXFORD university press.

**URL**

1. https://www.tutorialspoint.com/unix/unix_tutorial.pdf
2. https://nptel.ac.in/courses/106108101/pdf/PPTs/Mod_13.pdf
3. https://www.youtube.com/watch?v=z3Nw5o9dS7Q
4. http://nptel.ac.in/courses/117106113/
5. https://www.tutorialspoint.com/unix_commands/index.htm

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## OOPS through JAVA (16IT6E03)

### COURSE OBJECTIVES:

- To make the students understand the fundamentals of Java programming and how to use Java to write applications.
- To train the learners to implement and use inheritance and polymorphism, including interfaces and abstract classes, Packages.
- To make the students to design appropriate Exception Handling in Java methods.
- To make the students to understand the concepts of Threads, Files and I/O Streams, Applets in java.

### COURSE OUTCOMES:

| The Student will be able to: | |
|---|---|
| CO1 | Write, debug, and document well-structured java applications. |
| CO2 | Implement java classes from specifications. |
| CO3 | Build applications by using Inheritance. |
| CO4 | Write programs by using threads and exception handling. |
| CO5 | Develop applets. |
| CO6 | Explore AWT and event handling package. |

### UNIT I:

**Introduction to OOP:** Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, C++ vs. Java, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features, Program structures, Installation of JDK1.6Variables , Primitive Data types, Identifiers- Naming Conventions, Keywords, Literals.

### UNIT II:

**Programming Constructs Operators**- Binary, Unary and ternary, Expressions, Precedence rules and Associative, Primitive Type Conversion and Casting, Flow of control- Conditional, loops., **Classes and Objects-** Classes, Objects, Creating Objects, Methods, constructors-Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments.

### UNIT III:

**Inheritance:** Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class

**Interfaces, Packages and Enumeration:** Interface-Extending interface, Interface vs. Abstract classes, Packages-Creating packages, using Packages, Access protection, java.lang package.

**UNIT IV:**

**Exceptions & Assertions –** Introduction, Exception handling techniques-try...catch, throw, throws, finally block, user defined exception, Exception Encapsulation and Enrichment, Assertions

**Multi-Threading:** java.lang.Thread, the main Thread, Creation of new threads, Thread priority, Multithreading- Using isAlive() and join(), Synchronization, suspending and Resuming threads, Communication between Threads

**UNIT V:**

**Input/output:** reading and writing data, java.io package
**Applets-** Applet class, Applet structure, An Example Applet Program, Applet Life Cycle, paint(), update() and repaint().

**UNIT VI:**

**Event Handling:** Introduction, Event Delegation Model, java.awt.event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes

**Abstract Window Toolkit:** Why AWT?, java.awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar

**TEXT BOOKS:**

1. The Complete Reference Java, 9ed, Herbert Schildt, TMH
2. Programming in JAVA, Sachin Malhotra, Saurabh choudhary, Oxford.

**REFERENCE BOOKS:**

1. JAVA Programming, K.Raj kumar. Pearson
2. Object oriented programming with JAVA, Essentials and Applications, Raj KumarBuyya, Selvi, Chu TMH
3. Introduction to Java Programming, 7/e, Y Daniel Liang, Pearson.
4. Core Java Volume 1.Fundamentals, 8ed, Cay S.Horstmann, Gray Cornell, Pearson.
5. Advanced Programming in Java2: Updated to J2SE6 with Swing, Servlet and RMI, K.Somasundaram.
6. A Java Programming Book by N.B.Venkateswarlu

**WEB LINKS:**

1. https://www.tutorialspoint.com/java/java_object_classes.htm
2. http://beginnersbook.com/2015/07/java-swing-tutorial/
3. http://www.realapplets.com/tutorial/
4. https://www.youtube.com/watch?v=aUlwgdakBug
5. http://beginnersbook.com/2013/04/java-exception-handling/and words in a text file.

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**III Year –II Semester**

## POWER ELECTRONICS LAB (16EE6L08)

**Course objectives:**

This course enables the students to

- Study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- Analyze the performance of single–phase half and three–phase full converters with both resistive and inductive loads.
- Understand the operation of AC voltage controller with resistive and inductive loads.

**ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED**

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. Gate triggering circuits for SCR's.
3. Single -Phase half controlled bridge converter with R and RL loads.
4. Single -Phase AC Voltage Controller with R and RL Loads.
5. Single -Phase Cyclo–converter with R and RL loads.
6. Single -Phase Bridge Inverter with R Load.
7. Three- Phase full converter with RL load.
8. Four quadrant operation of chopper.
9. Three -phase PWM inverter.
10. Forced commutation circuits (Class A, Class B, Class C, Class D).
11. Single phase Dual converter with R & RL loads (Circulating & Non-Circulating modes).
12. PWM Inverter based speed control of Induction motor.

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Memorize the characteristics of various power semi conductor and firing circuits of SCR. | Analysis |
| CO2 | Analyze the operation of dc converters | Analysis |
| CO3 | Examine the operation of AC-AC converters | Evaluate |

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**III Year –II Semester**

## ELECTRICAL MEASUREMENTS LAB (16EE6L09)

**Course objectives:**

This course enables the students to

- Understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuit through appropriate methods.

## ANY TEN OF THE FOLLOWING EXPERIMENTS ARE TO BE CONDUCTED

1. Testing of single phase Energy Meter using phantom loading.
2. Calibration of dynamometer type UPF wattmeter using phantom loading.
3. Calibration of PMMC ammeter and voltmeter using Crompton D.C. Potentiometer.
4. Measurement of resistance and Determination of Tolerance using Kelvin's double Bridge.
5. Capacitance Measurement using Schering bridge.
6. Inductance Measurement using Anderson bridge.
7. Measurement of reactive power in 3-phase balanced loads using single phase wattmeter.
8. Calibration of LPF wattmeter by direct loading.
9. Measurement of 3- phase active power using single watt meter and C.Ts.
10. Calibration of Dynamometer Type Power Factor Meter.
11. Measurement of choke coil Parameters by using 3-ammeter and 3-Voltmeter method.
12. Measurement of Active Power by 3 Voltmeter and 3 Ammeter methods.

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance | Analysis |
| CO2 | Measure the parameters of inductive coil | Analysis |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

**III Year –II Semester**

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

**PROFESSIONAL ETHICS AND HUMAN VALUES (16BH6T17)**

## Unit I

**Professional Ethics and Human values:** Ethics -History of Ethics-Types of Ethics, Professional Ethics and its forms-Significance-Personal ethics vs Professional Ethics, Morals, Values – Integrity – Work Place Ethics and Business Ethics –Ethics in HRM, Finance, Marketing Management – Civic Virtue –Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time –Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

## Unit II

**Engineering Ethics:** Engineering Ethics-Meaning & Purpose of Engineering Ethics-Consensus and Controversy –Profession, Professional and Professionalism –Key Characteristics of Engineering Professionals–Professional Roles to be played by an Engineer-Self Interest, Customs and Religion- Ethical Theories-Meaning & Uses of Ethical Theories-Types of Inquiry -Theories of moral Development-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

## Unit III

**Engineering as Social Experimentation:** Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering- Ethical issues involved in Clinical Trials.

## Unit IV

**Engineers' Responsibility for Safety and Risk:** Concept of Safety-Types of Safety, Risk-Types of Risks, Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences-Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

## Unit V

**Engineers Responsibilities and Rights:** Collegiality-Techniques for Achieving Collegiality –Loyalty -Two Senses of Loyalty-obligations of Loyalty-Misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems - Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives-Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.

## Unit VI

**Global Issues:** Globalization-Problems of globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behavior-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics-Weapons Development-Ethics and Research-Analyzing Ethical Problems in Research-Food and Drug Adulteration.

Relevant case studies shall be dealt where ever necessary.

**Reference Books:**

1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. “Professional Ethics and Morals” by Prof.A.R.Aryasri, DharanikotaSuyodhana- Maruthi Publications.
3. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications
4. “Professional Ethics and Human Values” by Prof.D.R.Kiran-
5. “Indian Culture, Values and Professional Ethics” by PSR Murthy-BS Publication
6. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger -Tata McGraw-Hill -2003
7. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

# PRAGATI ENGINEERING COLLEGE
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## Department of Electrical and Electronics Engineering

**IV Year – I Semester**

| S.No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE7T20 | Utilization of Electrical Energy | 3 | 1 | -- | 3 |
| 2 | 16EE7T21 | Renewable Energy Sources | 3 | 1 | -- | 3 |
| 3 | 16EE7T22 | Power System Operation and Control | 3 | 1 | -- | 3 |
| 4 | 16EE7T23 | Power System Protection | 3 | 1 | -- | 3 |
| 5 | 16EE7D01 | **Elective–I:** 1.Electrical Machine Modeling and Analysis | 3 | 1 | -- | 3 |
| | 16EE7D02 | 2.Advanced Control Systems | | | | |
| | 16EE7D03 | 3.Industrial Automation and Control | | | | |
| | 16EE7D04 | 4.Instrumentation | | | | |
| 6 | 16EE7D05 | **Elective–II:** 1. Electric Power Quality | 3 | 1 | -- | 3 |
| | 16EE7D06 | 2.Special Electrical Machines | | | | |
| | 16ME7D07 | 3. Optimization Techniques | | | | |
| 7 | 16EE7L10 | Power Systems and Simulation Lab | -- | -- | 3 | 2 |
| 8 | 16EC7L08 | Microprocessors & Microcontrollers Lab | -- | -- | 3 | 2 |
| **Total Credits** | | | | | | **22** |

**IV Year – II Semester**

| S. No. | Subject Code | Subjects | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 16EE8T24 | Digital Control Systems | 3 | 1 | -- | 3 |
| 2 | 16EE8T25 | HVDC Transmission | 3 | 1 | -- | 3 |
| 3 | 16EE8T26 | Electrical Distribution Systems | 3 | 1 | -- | 3 |
| 4 | 16EE8D07 | **Elective–III:** 1.High Voltage Engineering | 3 | 1 | - | 3 |
| | 16EE8D08 | 2.Flexible Alternating Current Transmission Systems | | | | |
| | 16EE8D09 | 3.Power System Deregulation | | | | |
| 5 | 16EE8S01 | Seminar | -- | 3 | -- | 2 |
| 6 | 16EE8P02 | Project Work | -- | -- | -- | 10 |
| **Total Credits** | | | | | | **24** |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

| | L | T | P | C |
|---|---|---|---|---|
| **IV Year –I Semester** | **3** | **1** | **0** | **3** |

## UTILIZATION OF ELECTRICAL ENERGY (16EE7T20)

**Preamble:**
This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Demand side management concepts are also introduced as a part of this course.

**Course Objectives:**
This course enables the students to

- Understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
- Study the basic principles of illumination and its measurement.
- Understand different types of lightning system including design.
- Acquaint with the different types of heating and welding techniques.
- Understand the basic principle of electric traction including speed–time curves of different traction services.
- Understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.

**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 : Illumination fundamentals**
Introduction, terms used in illumination–Laws of illumination–Polar curves– Integrating sphere–Lux meter–Discharge lamps, Mercury Vapour and Sodium Vapour lamps – Lumen or flux method of Calculation-Sources of light

**UNIT – III : Various Illumination Methods**
Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting – Conservation of energy.

**UNIT – IV: Electric Heating and Welding**
Advantages and methods of electric heating–Resistance heating, induction heating and dielectric heating, Arc Furnaces- Direct arc furnaces and Indirect arc furnaces.
Electric welding–Resistance and arc welding–Electric welding equipment– Comparison between AC and DC Welding.

**UNIT – V : Electric Traction – I**

System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

**UNIT – VI : 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–Principles of energy efficient motors.

**Text Books:**

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.

**References:**

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.
3. Utilization of Electrical Power and Electric Traction by G. C. Garg, Khanna Publishers, 2004.
4. http://nptel.ac.in/courses/108105060/
5. http://nptel.ac.in/courses/108104011/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Recognize the suitable motor for electric drives and industrial applications | Understand |
| CO2 | Initiate the various level of illuminisity produced by different illuminating sources. | Evaluate |
| CO3 | Design approach to different lighting systems by taking recommended efficient inputs and constraints in view. | Characterization |
| CO4 | Judge the appropriate heating or welding techniques for suitable applications. | Evaluate |
| CO5 | Revise the speed/time characteristics of different types of traction motors. | Evaluate |
| CO6 | Express energy consumption levels at various modes of operation. | Comprehension |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

| **IV Year –I Semester** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **3** | **1** | **0** | **3** |

## RENEWABLE ENERGY SOURCES (16EE7T21)

**Preamble:**
This course gives a flavor of renewable sources and systems to the students. It introduces solar energy its radiation, collection, storage and its applications. This covers generation, design, efficiency and characteristics of various renewable energy sources including solar, wind, hydro, biomass, fuel cells and geothermal systems.

**Course Objectives:**
This course enables the students to

- Study the solar radiation data, extra terrestrial radiation, radiation on earth's surface.
- Understand the solar thermal collections.
- Study the solar photo voltaic systems.
- Observe the maximum power point techniques in solar PV and wind energy.
- Get knowledge on wind energy conversion systems, Betz coefficient, tip speed ratio.
- Study basic principle and working of hydro, tidal, biomass, geothermal and fuel cell systems.

**UNIT–I : Fundamentals of Energy Systems and Solar energy**
Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – instruments for measuring solar radiation and sun shine.

**UNIT–II : Solar Thermal Systems**
Liquid flat plate collectors: Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants.

**UNIT–III : Solar Photovoltaic Systems**
Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

**UNIT–IV: Wind Energy**
Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

**UNIT–V : Hydro and Tidal power systems**

Basic working principle – Classification of hydro systems: Large, small, micro – measurement of head and flow – Energy equation – Types of turbines. Tidal power – Basics – Kinetic energy equation – Turbines for tidal power -Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

**UNIT–VI : Biomass, fuel cells and geothermal systems**

**Biomass Energy:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.

**Fuel cell:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics.

**Geothermal:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation.

**Text Books:**

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.
3. Non conventional Energy Sources by G. D. Rai, Khanna Publishers, 4th Edition,2008.
4. Non-conventional energy source –B.H. Khan- TMH-2nd edition.

**References:**

1. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university. press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – ChetongSingh Solanki, PHI.
6. n*ptel.ac.in/courses/112105050/m1l1.pdf*
7. https://en.wikipedia.org/wiki/Tidal_power#Tidal_power_issues
8. http://nptel.ac.in/courses/108108078/pdf/chap2/student_slides01.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface. | Analysis |
| CO2 | Design solar thermal collectors for solar based thermal Applications. | Synthesis |
| CO3 | Develop photo voltaic system using maximum power point tracking algorithm. | Application |
| CO4 | Determine the output power of the wind energy conversion topologies. | Analysis |
| CO5 | Describe the basic principle and working of Hydro and tidal Power systems. | Comprehension |
| CO6 | Demonstrate the basic principle and working of biomass, geothermal and fuel cell systems. | Application |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

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

**IV Year –I Semester**

## POWER SYSTEMS OPERATION AND CONTROL (16EE7T22)

**Preamble:**

This subject deals with Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

**Course Objectives:**

The course enables the students to

- Understand optimal dispatch of generation with and without losses.
- Study the optimal scheduling of hydro thermal systems.
- Solve the unit commitment problem using priority ordering and dynamic programming approach.
- Model power-frequency dynamics for studying the load frequency control for single area system with and without controllers
- Study the load frequency control for two area system with and without controllers
- Understand the reactive power control and compensation of transmission lines.

**UNIT–I : Economic Operation of Power Systems**

Optimal operation of Generators in Thermal power stations, – Heat rate curve – Cost Curve –Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

**UNIT–II : Hydrothermal Scheduling**

Optimal scheduling of Hydrothermal System**:** Hydroelectric power plant models – Scheduling problems – Short term hydrothermal scheduling problem.

**UNIT–III : Unit Commitment**

Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

**UNIT–IV : Load Frequency Control-I**

Modeling of steam turbine – Generator – Mathematical modeling of speed governing system – Transfer function – Modeling of Hydro turbine –Necessity of keeping frequency constant – Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

Proportional plus Integral control of single area and its block diagram representation – Steady state response.

**UNIT–V : Load Frequency Control-II**

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

Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

**UNIT–VI : Reactive Power Control**

Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – Uncompensated and compensated transmission lines**:** Shunt and series compensation – Need for FACTS controllers.

**Text Books:**

1. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–hill Publishing Company Ltd., Second edition.
2. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.
3. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.

**References:**

1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma.,Thompson, 3rd Edition.
2. Power System Analysis by HadiSaadat – TMH Edition.
3. Power System stability & control, Prabha Kundur, TMH
4. Power systems operation and control - by Dr. G. Chandrasekhar Reddy, Right publications.
5. Power Generation, Operation and Control by AS Wood, B F Wollenberg, Willey India
6. http://nptel.ac.in/downloads/108101040/
7. https://www.youtube.com/watch?v=iSVfsZ3P0cY
8. http://home.engineering.iastate.edu/~jdm/ee553/HydroThermal.pdf
9. http://nptel.ac.in/courses/108101040/download/lec-4.pdf
10. http://nptel.ac.in/courses/108101040/download/lec-15.pdf
11. http://nptel.ac.in/courses/108101040/download/Lec-17.pdf

**Course Outcomes:**

At the end of the Course, the student should be able to

| CO# | Statement | Cognitive Level |
|---|---|---|
| **CO1** | Assess the optimum allocation of generation among Generators for economic operation of the power system | Comprehension |
| **CO2** | Estimate the optimal scheduling of hydro thermal systems using various methods | Analysis |
| **CO3** | Identify the optimal scheduling of optimal unit commitment problem | Comprehension |
| **CO4** | Analyze the effect of PI controller for single area load frequency control | Analysis |
| **CO5** | Select the best parameter values to obtain optimum static and dynamic response for two area load frequency control | Synthesis |
| **CO6** | Identify suitable compensating equipment for reactive power control and Series and/or Shunt compensation of transmission lines. | Comprehension |

**PRAGATI ENGINEERING COLLEGE**
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**Department of Electrical and Electronics Engineering**

**IV Year –I Semester**

## POWER SYSTEM PROTECTION (16EE7T23)

**Preamble:**
To introduce different types of protection equipments and schemes for the protection of power system equipment.

**Course Objectives:**
This course enables the students to

- Study the different types of protection equipments in the power system.
- Understand the operation of circuit breakers and relays and their applications.
- Get Knowledge on the protection for generator and transformer in the power system.
- Understand the concept of static and digital relays for more accuracy and speed.
- Understand the concept of protection for Feeder and Bus bar in the power system
- Understand concept of protection against over voltage and grounding.

**UNIT-I: Fuses and Circuit Breakers:**
Basics of protection and its significance.
Fuses: Introduction, types of fuses, ratings and specifications, HRC fuses and applications.
Circuit Breakers: Miniature Circuit Breaker (MCB)– Elementary principles of arc interruption– Restrike Voltage and Recovery voltages– Restrike phenomenon– Average and Max. RRRV– Current chopping and Resistance switching– Introduction to oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– CB ratings and specifications– Auto reclosures.

**UNIT-II: Electromagnetic Protection:**
Relay connection– Balanced beam type attracted armature relay– induction disc and induction cup relays– Torque equation- Relays classification– Instantaneous– DMT and IDMT types– Applications of relays: Over current/under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and their comparison.

**UNIT-III: Generator and Transformer Protection:**
Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection.
Protection of transformers: Percentage differential protection– Design of CT's ratio– Buchholz relay protection.

**UNIT-IV: Feeder and Bus bar Protection:**
Protection of lines: Over current– Carrier current and three zone distance relay using impedance relays– Translay relay–Protection of bus bars– Differential protection

**UNIT-V: Static and Digital Relays:**
Static relays: Static relay components–Static over current relay– Static distance relay.
Digital relays: Micro processor based digital relays.

**UNIT-VI: Protection against over voltage and grounding:**
Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc–Oxide lighting arresters– Insulation coordination– Basic Insulation Level (BIL) – impulse ratio– Standard impulse test wave– volt time characteristics– Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding: Solid–resistance– Reactance–Arcing grounds and grounding Practices.

**Text Books:**

1. Power System Protection and Switchgear by Badari Ram, D.N Viswakarma, TMH Publications.
2. Power system protection- Static Relays with microprocessor applications by T. S. Madhava Rao, TMH
3. Switch Gear Protection and Power Systems, S. Rao, Khanna Publications.

**References :**

1. Electrical Power System Protection by C. Christopoulos and A. Wright, Springer publications.
2. Protection and Switch Gear by Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chothani, Oxford University Press, 2011.
3. Power System Protection and Switch Gear by Bhuvanesh A Oza, Nirmal Kumar C. Nair, Rashesh P. Mehta and Vijay H. Makwana, TMH publications.
4. Fundamentals of Power System Protection by Paithankarand S.R. Bhide,PHI,2003.
5. Art & Science of Protective Relaying–by C R Mason, Wiley Eastern Ltd.
6. Switch Gear and Protection by Haroon Asfaq (ISBN: 978-93-80016-07-8)
7. http://definedelectric.com/basic-definitions-fuse/
8. https://www.electrical4u.com/protection-system-in-power-system/
9. http://nptel.ac.in/downloads/108101039/
10. https://www.researchgate.net/publication/3219336_Microprocessor-_Based_Overcurrent_Relays

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Identify the basic protection equipment types in power systems. | Comprehension |
| CO2 | Review the working operation and construction of different types of circuit breakers and relays. | Knowledge |
| CO3 | Propose the different types of protection schemes for generator and transformer in the power systems. | Synthesis |
| CO4 | Relate the different types of protection schemes for feeders and bus bars in the power systems. | Application |
| CO5 | Compare the static, digital and electromagnetic relays for protection purpose. | Evaluate |
| CO6 | Examine the various scenarios for protection against over voltage and grounding. | Application |

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**IV Year –I Semester**

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

## ELECTRICAL MACHINE MODELING AND ANALYSIS (16EE7D01)

**(Elective-I)**

**Preamble:**
To develop the strategies for controlling the electrical motor drives it is crucial to have complete knowledge on modeling of electrical machines.

**Course Objectives:**
This course enables the students to

- Apply the modeling of dc and ac machines using Kron's primitive machine.
- Apply mathematical modeling concept to DC Machine.
- Understand the concept of phase transformation and to apply mathematical modelling of single phase induction machines.
- Analyze the performance of three phase Induction Machine.
- Evaluates the performance characteristics of machine in d-q modeling.
- Analyse the controlling strategies of different machines.

**UNIT – I: Basic concepts of Modeling**
Basic Two-pole Machine representation - Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

**UNIT – II: DC Machine Modeling**
Mathematical model of separately excited D.C motor – Steady State analysis-Transient analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.

**UNIT- III: Reference frame theory & Modeling of single phase Induction Machines**
Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence-Mathematical modeling of single phase induction machines.

**UNIT – IV: Modeling of three phase Induction Machine**
Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables.

**UNIT –V: Modeling of Synchronous Machine**

Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame, electromagnetic torque-current in terms of flux linkages-three phase synchronous machine model.

**UNIT –VI: Modeling of Special Machines**

Modeling of PM Synchronous motor, modeling of BLDC motor, modeling of Switched Reluctance motor.

**Text Books:**

1. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
2. Analysis of Electrical Machinery and Drive systems – P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff – Second Edition-IEEE Press.

**References:**

1. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications- 1st edition -2002.
2. Dynamic simulation of Electric machinery using Matlab / Simulink –CheeMunOng-PHI.
3. Modern Power Electronics and AC Drives-B.K. Bose – PHI
4. Modeling and High Performance Control of Electric Machines by John Chiasson, John Wiley & Sons, 2005.
5. https://www.scribd.com/doc/96309628/The-Primitive-Machines
6. onlinelibrary.wiley.com/doi/10.1002/0471722359.ch6/summary
7. shodhganga.inflibnet.ac.in/bitstream/10603/8434/11/11_chapter%203.pd
8. www.transoneleng.org/2013/20134e.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Describe the generalized machine theory for all electrical machines. | Evaluate |
| CO2 | Develop the mathematical modeling of dc machine. | Synthesis |
| CO3 | Apply the linear transformation and phase transformation on electrical machines | Application |
| CO4 | Apply mathematical modeling to Induction machines models. | Application |
| CO5 | Design control strategies based on dynamic modeling of 3-phase synchronous machine. | Synthesis |
| CO6 | Analyse BLDC Machine, switched reluctance machine based on mathematical modeling. | Analysis |

# PRAGATI ENGINEERING COLLEGE
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**Department of Electrical and Electronics Engineering**

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

**IV Year –I Semester**

## ADVANCED CONTROL SYSTEMS (16EE7D02)

**(Elective-I)**

**Preamble:**
This subject aims to study state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

**Course Objectives:**
This course enables the students to
- Review of the state space representation of a control system
- Study the concept of controllability and observability.
- Analysis of a nonlinear system using Describing function approach and Phase plane analysis.
- Study the Lypanov's method of stability analysis of a system.
- Understand the concept of calculus of variation.
- Formulation of linear quadratic optimal regulator (LQR) problem by parameter adjustment and solving riccatti equation.

**UNIT-I : State space analysis:**
State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Jordan Canonical Form.

**UNIT-II : Controllability & Observability:**
Tests for controllability and observability for continuous time systems –Time varying case – Time invariant case –Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability.

**UNIT-III : Describing function analysis**
Introduction to nonlinear systems, Types of nonlinearities, describing functions, Introduction to phase–plane analysis.

**UNIT-IV :Stability analysis**
Stability in the sense of Lyapunov – Lyapunov's stability and Lypanov's instability theorems – Direct method of Lypanov for the linear and nonlinear continuous time autonomous systems.

**UNIT-V : Calculus of variations**
Minimization of functional of single function – Constrained minimization –Minimum principle – Control variable inequality constraints – Control andstate variable inequality constraints – Euler lagrangine equation.

**UNIT-VI : Optimal control**

Linear quadratic optimal regulator (LQR) problem formulation – Optimalregulator design by parameter adjustment (Lyapunov method) – Optimal regulator design by continuous time algebraic riccatti equation (CARE) - Optimal controller design using LQG framework.

**Text Books:**

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, NewAge International (P) Ltd.
3. Modern Control Engineering by K. Ogata, PHI, 5th Edition.

**References:**

1. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
2. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
3. https://en.wikipedia.org/wiki/Controllability
4. https://en.wikipedia.org/wiki/Observability
5. https://www.electrical4u.com/state-space-analysis-of-control-system/
6. https://www.electrical4u.com/different-types-non-linearities-in-control-system/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Analyze the state-space models of linear control systems. | Analysis |
| CO2 | Interpret the behavior of the controllability and observability of control systems. | Application |
| CO3 | Apply the phase plane & describing functions for non-linear control systems. | Application |
| CO4 | Solve the stability analysis using lypnov method for linear and non linear systems. | Application |
| CO5 | Minimize of functional using calculus of variations. | Evaluate |
| CO6 | Determine the riccatti equation and LQR for optimal control of a system. | Evaluate |

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| **IV Year –I Semester** | **3** | **1** | **0** | **3** |

## INDUSTRIAL AUTOMATION AND CONTROL (16EE7D03)

**(Elective-I)**

**Preamble:**
This subject aims to study structure & components Industrial Automation systems. It also deals with architectural levels of Industrial controls.

**Course Objectives:**
This course enables the students to

- Understand the significance of PLC in industrial applications.
- Study the basic instructions in PLC.
- Study the Data manipulation, math instructions and registers.
- Know the applications of PLC.
- Understand the basics of SCADA.
- Know the protocols involved in SCADA for industrial applications.

**UNIT-I: Introduction to PLC**
Role of automation in Industries, benefits of automation, Necessity of PLC, Definition, PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, Solid state memory , advantages and disadvantages

**UNIT-II: PLC Instructions**
Programming equipment, Various techniques of programming, proper construction of ladder diagram, basic components and their symbols in ladder diagram, Boolean logic and relay logic. Timer and counter-types along with timing diagrams, Timer instructions and Counter instructions- Counter Applications, Combining counter and timer functions.

**UNIT-III: Other Instructions**
Data manipulation – Data transfer operation – Data compare instruction – Data manipulation programs – Numerical data I/O interfaces – Math instructions- Sequential instructions – Sequence programs – Shift registers – Word shift registers.

**UNIT-IV: Applications of PLC**
PLC interface to various circuits : Measurement of temperature, Tank level control, ON OFF temperature control, elevator, Alarm Monitor, car parking Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive. Ladder diagram for process control – PID controller.

**UNIT-V**: **SCADA Systems:**
Introduction to Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements. Features, advantages, disadvantages and applications of SCADA.

**UNIT-VI**: **SCADA Protocols**

Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).

**Text Books:**

1. Programmable logic controllers by Frank D.Petruzella- McGraw Hill – 3rd Edition.
2. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.
3. Ronald L. Krutz, "Securing SCADA System", Wiley Publishing

**References:**

1. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
2. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.
3. Programmable Logic Controllers –W.Bolton-Elsevier publisher
4. Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition.
5. Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols", ELSEVIER
6. Krishna Kant, "Computer Based Industrial Control", PHI.
7. M. Chidambaram, "Computer Control of Process", Narosha Publishing.
8. P. K. Srivstava, "Programmable Logic Controllers with Applications", BPB Publications.
9. http://electrical-engineering-portal.com/basic-steps-in-plc-programming
10. http://www.nptel.ac.in/courses/108106022/8
11. http://nptel.ac.in/courses/112102011/
12. https://library.e.abb.com/public/fed26a71538479c3c12570d50034fbe4/Rapport.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Interpret the concept of PLC in industrial applications. | Application |
| CO2 | Distinguish the working of PLC with the help of a Ladder diagram. | Analysis |
| CO3 | Setup PLC registers for effective utilization in different applications. | Analysis |
| CO4 | Arrange the programs with ladder diagrams for appropriate applications of PLC | Synthesis |
| CO5 | Distinguish the architecture of SCADA and importance of SCADA in critical infrastructure | Analysis |
| CO6 | Initiate the debug and test the programs developed for digital and analog operations. | Evaluate |

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**IV Year –I Semester**

## INSTRUMENTATION (16EE7D04)
**(Elective-I)**

**Preamble:**
To enrich the students to acquire knowledge about various types of data/ information transmission methods and different types of display devices. To provide knowledge on various types of transducers, Wave analyzers their construction and functioning.

**Course Objectives:**
This course enables the students to

- Study about different types of signal and data processing techniques.
- Understand the classification of transducers.
- Obtain knowledge in evaluation of strain, torque, displacement, velocity, angular velocity, temperature, pressure and vaccum using transducer.
- Understand the concept of measuring frequency, phase with oscilloscopes.
- Study about wave analyzer and their practical applications and usage.
- Obtain knowledge in sensors and their usage.

**UNIT-I: Signals and their representation**
Measuring Systems, Performance Characteristics, – Static characteristics – Dynamic Characteristics – Errors in Measurement – Gross Errors – Systematic Errors – Statistical analysis of random errors – Signal and their representation – Standard test, periodic, aperiodic, modulated signal – Sampled data pulse modulation and pulse code modulation.

**UNIT-II: Transducers**
Definition of transducers – Classification of transducers – Advantages of Electrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor, LVDT and capacitor transducers – LVDT Applications – Strain gauge and its principle of operation – Guage factor – Thermistors – Thermocouples – Synchros – Piezoelectric transducers – Photo diodes.

**UNIT-III : Measurement of Non–Electrical Quantities**
Measurement of strain – Gauge Sensitivity – Displacement – Velocity – Angular Velocity – Acceleration – Force – Torque – Measurement of Temperature, Pressure, Vacuum, Flow rate, Liquid level.

**UNIT-IV : Oscilloscopes**
Cathode ray oscilloscope – Time base generator – Horizontal and vertical amplifiers – Measurement of phase and frequency – Lissajous patterns –Digital Storage Oscilloscope- Sampling – Analog and digital type data loggers.

**UNIT-V: Signal Analyzers**

Wave Analyzers – Frequency selective analyzers – Heterodyne – Application of Wave analyzers – Harmonic Analyzers – Total Harmonic distortion – Spectrum analyzers – Basic spectrum analyzers – Spectral displays – Vector impedance meter – Q meter- Peak reading
and RMS voltmeters.

**UNIT-VI: Sensors**

Sensors Hall effect sensors, Eddy current sensors, Fiber-optic sensors –Voltage Sensor, Semiconductor sensors, Film sensors– Nano sensors, laser - acoustic - magnetic, fiber optic and tactile sensors.

**Text Books:**

1. Electronic Instrumentation–by H. S. Kalsi Tata MC Graw–Hill Edition, 1995
2. Patranabis. D, "Sensors and Transducers", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2004.

**References:**

1. J. B. Gupta , "Electrical & Electronic Measurements & Instrumentation", Kataria. 2014
2. A. K. Sawhney , "Electrical & Electronics Measurements & Instrumentation", Danpat Rai & Sons. 2004
3. DVS Murthy , "Transducers & Instrumentation", PHI. 2013
4. C. S. Rangan, G. R. Sarma and Mani , "Instrumentation: Devices & systems", TMH. 2002
5. A. D. Helfrick & W. D. Cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI. 1992
6. D. O. Doeblin, "Measurement Systems, Applications & Design", TMH. 2000
7. C. Johnson , "Process Control Instrumentation Technology", PHI.1982
8. A.S. Morris , "Principles of Measurement & Instrumentation", PHI. 2003
9. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and-measurement-spring-2006/index.htm
10. http://nptel.ac.in/courses/108105064/24
11. https://www.electrical4u.com/voltage-sensor/

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Describe the characteristics of measuring system and analyze the signal processing techniques | Comprehension |
| CO2 | Identify the various transducers used for various applications. | Comprehension |
| CO3 | Illustrate the ways to measure parameters such as strain, velocity, temperature, pressure etc | Application |
| CO4 | Demonstrate the construction of C.R.O, data acquisition, display and storage | Application |
| CO5 | Discuss the operation of wave analyzers, harmonic analyzers, spectrum analyzers | Comprehension |
| CO6 | Describe operation of different sensors and their usage. | Comprehension |

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**IV Year –I Semester**

## ELECTRIC POWER QUALITY (16EE7D05)
**(Elective-II)**

**Preamble:**
Power quality is a major problem for utilities and customers. Customers using sensitive critical loads need quality power for proper operation of the electrical equipment. It is important for the student to learn the power quality issues and improvement measures provided by the utility companies. This course covers the topics on voltage and current imperfections, harmonics, voltage regulation, power factor improvement, distributed generation, power quality monitoring and measurement equipment.

**Course Objectives:**
This course enables the students to

- Learn different types of power quality phenomena.
- Identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- Describe power quality terms and study power quality standards.
- Learn the principle of voltage regulation and power factor improvement methods.
- Explain the relationship between distributed generation and power quality.
- Understand the power quality monitoring concepts and the usage of measuring instruments.

**UNIT–I: Introduction**
Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

**UNIT–II: Voltage imperfections in power systems**
Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

**UNIT–III: Voltage Regulation and power factor improvement:**
Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

**UNIT– IV : Harmonic distortion and solutions**
Voltage distortion, Current distortion – Harmonics vs Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering.

**UNIT–V: Distributed Generation and Power Quality**
Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

**UNIT–VI : Monitoring and Instrumentation**
Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

**Textbooks**:
1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Electric power quality problems –M. H. J. Bollen IEEE series-Wiley India publications, 2011.

**References**:
1. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen MHJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
5. Power Quality C. Shankaran, CRC Press, 2001
6. Harmonics and Power Systems –Franciso C.DE LA Rosa – CRC Press (Taylor & Francis)
7. Power Quality in Power systems and Electrical Machines–Ewald F.fuchs, Mohammad A.S. Masoum–Elsevier.
8. http://nptel.ac.in/courses/108106025/
9. xlcatlin.com/-/media/gaps/5713___0.pdf

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Raise the different problems related to power quality. | Characterization |
| CO2 | Explore the power quality terms as per IEEE and IEC standards. | Responding |
| CO3 | Analyze over voltage protection and voltage regulation with improvement devices. | Analysis |
| CO4 | Propose different solutions for harmonic distortion with effect on power factor. | Synthesis |
| CO5 | Demonstrate the distribution generator with power quality issues. | Application |
| CO6 | Examine the different instruments used to power quality measurements as per standards | Analysis |

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**IV Year –I Semester**

## SPECIAL ELECTRICAL MACHINES (16EE7D06)

**(Elective-II)**

**Preamble:**
Exposure for the students to various special machines used in the industries. This course covers topics related to principles, performance and applications of these special machines including switched reluctance motors, stepper motors, permanent magnet dc motors and linear motors.

**Course Objectives:**
This course enables the students to

- Understands the characteristics of permanent magnet dc motor and its applications.
- Study the performance and control of stepper motors, and their applications.
- Understand about the operation and control of switched reluctance motor.
- Analyze operation and performance of BLDC motor
- Distinguishes between square wave and sine wave permanent magnet motors.
- Understand the operation Linear Induction Motors.

**UNIT – I : Permanent magnet materials and PMDC motors**
Introduction-classification of permanent magnet materials used in electrical machines-minor hysteresis loop and recoil line-Stator frames of conventional dc machines-Development of electronically commutated dc motor from conventional dc motor-Permanent-magnet materials and characteristics- B-H loop and demagnetization characteristics - Temperature effects: reversible and irreversible losses-high temperature effects-reversible losses-Irreversible losses recoverable by magnetization-Mechanical properties, handling and magnetization – Applications of PMDC motors.

**UNIT-II : Stepper Motors**
Classification of stepper motors – Hybrid and Variable Reluctance Motor (VRM) -Construction and principle of hybrid type synchronous stepper motor – Different configuration for switching the phase windings control circuits for stepper motors – Open loop and closed loop control of 2-phase hybrid stepping motor. Construction and principle of operation of Variable Reluctance Motor (VRM) – Single stack and multiple stack – Open loop control of 3- phase VR Stepper Motor- Applications.

**UNIT – III : Switched Reluctance Motors**
Construction – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs – Torque producing principle and torque expression –Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

**UNIT – IV : Square Wave Permanent Magnet Brushless DC Motor**
Types of constructions – Surface mounted and interior type permanent magnet – Principle of operation of BLDC motor. Torque and EMF equations – Torque speed characteristics – Performance and efficiency- Square wave brushless motors with 120ºand 180º magnetic areas commutation.

**UNIT –V : Sine wave Permanent Magnet Brushless Motor**
Torque and EMF equations – Phasor Diagram – Circle diagram – Torque/speed characteristics – Comparison between square wave and sine wave permanent magnet motors - Applications.

**UNIT – VI : Linear Induction Motors (LIM)**
Construction– principle of operation–Double sided LIM from rotating type Induction Motor –Schematic of LIM drive for traction – Development of one sided LIM with back iron equivalent circuit of LIM.

**Text Books:**
1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K. Venkata Ratnam, University press, 2009, New Delhi.

**References:**
1. Special Electrical Machines by E.G. Janardanan, PHI Learning Pvt. Ltd, 2014.
2. Special Electrical Machines by Simmi P. Burman, S. K. Kataria and Sons, 2013 Edition.
3. https://www.electrical4u.com/brushless-dc-motors/
4. nptel.ac.in/courses/108103009/23
5. http://www.electricaltechnology.org/2016/12/stepper-motor-construction-types-and-modes-of-operation.html
6. https://en.wikipedia.org/wiki/Switched_reluctance_motor

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Analyze the performance of PMDC motors. | Analysis |
| CO2 | Exhibit the different stepper motors and their applications depending on their characteristics. | Comprehension |
| CO3 | Design the switched reluctance motor configuration and gives their applications. | Comprehension |
| CO4 | Measure the performance operation of BLDC motor. | Synthesis |
| CO5 | Distinguish square wave from sine wave permanent magnet motors. | Knowledge |
| CO6 | Demonstrate the linear induction motor depending on their construction and operation. | Application |

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**Sub. Code:** 16ME7D07

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# OPTIMIZATION TECHNIQUES
## (for EEE)
## (Elective – II)

***Course Objectives:***

*Students will learn:*

1. *Constraint functions in terms of design variables and its optimization.*
2. *To state single variable and multi variable optimization problems, without and with constraints.*
3. *To impart linear programming technique to an optimization problem.*
4. *To study and explain nonlinear programming techniques.*
5. *Evolutionary programming techniques.*
6. *Principles of Swarm Optimization methods.*

**UNIT – I:**

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**UNIT – II:**

Classical Optimization Techniques Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – III:**

Linear Programming Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

**UNIT – IV:**

Nonlinear Programming: Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method. Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.Introduction to convex Programming Problem.

**UNIT – V:**

Introduction to Evolutionary Methods: Evolutionary programming methods - Introduction to Genetic Algorithms (GA)– Control parameters –Number of generation, population size, selection, reproduction, crossover and mutation – Operator selection criteria – Simple mapping of objective function to fitness function – constraints – Genetic algorithm steps – Stopping criteria –Simple examples.

**UNIT – VI:**

Introduction to Swarm Intelligence Systems: Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

**TEXT BOOKS**

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N.P.Padhy&S.P.Simson, Oxford University Press – 2015

**REFERENCE BOOKS:**

1. "Optimization methods in operations Research and Systems Analysis" by K.V.Mital and C.Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by David E.Goldberg,ISBN:978-81-7758-829-3, Pearsonby Dorling Kindersley (India) Pvt. Ltd.
3. "Operations Research: An Introduction" by H.A.Taha, PHI pvt. Ltd., 6th edition.
4. Linear Programming by G.Hadley.

***Course Outcomes:***

*The student will be able to:*

1. *Evaluate the optimization problem in consideration with constraints.*
2. *Apply classical optimization techniques to minimize or maximize a multi-variable objective function.*
3. *Evaluate a mathematical model and apply linear programming technique for optimal solutions.*
4. *Evaluate nonlinear programming for different cases.*
5. *Apply genetic algorithms for simple electrical problems.*
6. *Solve practical problems using Swarm Optimization methods.*

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| **IV Year –I Semester** | **0** | **0** | **3** | **2** |

## POWER SYSTEMS AND SIMULATION LAB (16EE7L10)

**Course objectives:**
**This course enables the students to**

- Impart the practical knowledge of functioning of various power system components and determination of various parameters and simulation LFC and Economic dispatch.
- Simulate Boost converter, Buck converter.
- Simulate lossy transmission line.
- Perform analysis of single machine connected to infinite bus (SMIB).

**ANY FIVE EXPERIMENTS ARE TO BE CONDUCTED FROM EACH PART**

**PART – A: Hardware Based**

1. Sequence impedances of 3 phase Transformer.
2. Sequence impedances of 3 phase Alternator by Fault Analysis.
3. Sequence impedances of 3 phase Alternator by Direct method.
4. ABCD parameters of Transmission network.
5. Dielectric strength of Transformer oil.
6. Calibration of Tong Tester

**PART – B: Simulation Based (using MATLAB)**

1. Transient analysis of single machine connected to infinite bus (SMIB).
2. Modeling of transformer and simulation of lossy transmission line.
3. Load frequency control with and without control
4. Economic load dispatch with & without losses.
5. Load flow studies using Gauss-seidel method
6. Load flow studies using N-R method.

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Examine the sequence parameters of 3 phase transformers and alternators by direct and indirect methods. | Evaluate |
| CO2 | Analyze the response of various power system components and determination of various parameters and simulation LFC and Economic dispatch. | Analysis |
| CO3 | Understand the performance Boost converter, Buck converter | Knowledge |

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**IV YEAR – I SEMESTER**

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## MICROPROCESSORS AND MICROCONTROLLERS LAB (16EC7L07)

## LIST OF EXPERIMENTS

### PART- A:
**8086 Assembly Language Programming using Assembler Directives**

1. Sorting
2. Multibyte addition/subtraction
3. Sum of squares/cubes of a given n-numbers
4. Addition of n-BCD numbers
5. Factorial of given n-numbers
6. Multiplication and Division operations
7. Stack operations
8. BCD to Seven segment display codes

### PART- B:
**8086 Interfacing**

1. Hardware/Software Interrupt Application
2. A/D Interface through Intel 8255
3. D/A Interface through Intel 8255
4. Keyboard and Display Interface through Intel 8279
5. Generation of waveforms using Intel 8253/8254

### PART- C:
**8051 Assembly Language Programs**

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Addition of even numbers from a given array
3. Ascending / Descending order
4. Average of n-numbers

### PART-D: (Minimum of 3 Experiments has to be performed)
**8051 Interfacing**

1. Switches and LEDs
2. 7-Segment display (multiplexed)
3. Stepper Motor Interface
4. Traffic Light Controller

**Equipment Required:**

a) Regulated Power supplies
b) Analog/Digital Storage Oscilloscopes
c) 8086 Microprocessor kits
d) 8051 microcontroller kits
e) ADC module
f) DAC module
g) Stepper motor module
h) Keyboard module
i) LED, 7-Segemt Units
j) Digital Multimeters
k) ROM/RAM Interface module
l) Bread Board etc.

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**IV Year –II Semester**

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## DIGITAL CONTROL SYSTEMS (16EE8T24)

**Preamble:**
In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading nonlinear control systems. In this context, this course focuses on the analysis and design of digital control systems.

**Course Objectives:**
This course enables the students to

- Understand the concepts of digital control systems and assemble various components associated with it.
- Study the theory of z–transformations and application for the mathematical analysis of digital control systems.
- Represent the discrete–time systems in state–space model and evaluation of state transition matrix.
- Examine the stability of the system using different tests.
- Study the conventional method of analyzing digital control systems in the w–plane.
- Study the design of state feedback control by "the pole placement method."

**UNIT-I : Introduction and signal processing**
Introduction to analog and digital control systems – Advantages of digital systems – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

**UNIT-II : Z–transformations**
Z–Transforms – Theorems – Inverse z–transforms – Formulation of difference equations – Block diagram representation – Pulse transfer functions, open loop and closed loop responses.

**UNIT-III : State space analysis and the concepts of Controllability and observability**
State Space Representation of discrete time systems – State transition matrix and methods of evaluation – Discretization of continuous – Time state equations –Concepts of controllability and observability – Tests.

**UNIT-IV : Stability analysis**
Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability criterion – Modified routh's stability criterion and jury's stability test.

**UNIT-V : Design of discrete–time control systems by conventional methods**
Transient and steady state specifications – Design using frequency response in the ω–plane for lag and lead compensators – Root locus technique in the z– plane.

**UNIT-VI : State feedback controllers:**
Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

**Text Books:**

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI,2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition.

**References:**

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. M. Gopal, "Modern Control Systems Theory", Wiley Eastern,1984
3. M. Gopal, "Digital control engineering", New Age International Publications,2003
4. https://www.electrical4u.com/digital-data-control-system/
5. https://www.electrical4u.com/first-order-control-system/
6. https://www.electrical4u.com/initial-value-theorem-of--laplace-transform/
7. https://www.electrical4u.com/laplace-transformation/
8. http://nptel.ac.in/courses/108102044/28

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Apply the concept of sample and hold operation to digital systems. | Application |
| CO2 | Relate the Z-transforms to Digital systems. | Analysis |
| CO3 | Test the performance of digital control systems with the concept of state space. | Evaluate |
| CO4 | Examine the stability of digital control systems. | Evaluate |
| CO5 | Design controllers to meet the desired performance by conventional methods. | Synthesis |
| CO6 | Develop the controller by pole-placement technique for desired system behavior. | Synthesis |

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**IV Year –II Semester**

| L | T | P | C |
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## HVDC TRANSMISSION (16EE8T25)

**Preamble :** HVDC TRANSMISSION is the foremost pre-requisite course in Electrical Engineering. In the transmission of High Voltage, D.C Power plays a vital key role. This course also introduces the concepts of Power Electronic devices and their applications which will be utilized in the regulation of the power transmission lines and electrical machines.

**Course Objectives:**

This course enables the students to

- Understand the basic concepts of HVDC Transmission and to know about the HVDC projects in INDIA.
- Study the properties of converter circuits and to know about their configuration.
- Learn the HVDC converter system control and their characteristics.
- Study the sources of reactive power and their control strategies and to know about the power flow in D.C & A.C circuits.
- Understand the different converter faults and their protection and to know about the MTDC Systems and the existence of Harmonics.
- Study the various types of filter circuits.

**UNIT – I : Basic Concepts of DC Transmission**

Economics & Terminal equipment of HVDC transmission systems**:** Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC&DC transmission – Application of DC Transmission System – Planning - Recent trends in DC transmission.

**UNIT – II: Analysis of HVDC Converters**

Choice of Converter configuration – Analysis of Graetz – Characteristics of 6-Pulse & 12-Pulse converters –3 phase converters – Y-Y & Y- Δ configurations - performance.

**UNIT – III: Converter & HVDC System Control**

Principle of DC Link Control – Converters Control Characteristics – Firing angle control –Current and extinction angle control – Effect of source inductance on the system – Starting and stopping of DC link - Power Control.

**UNIT – IV: Reactive Power Control in HVDC**

Reactive Power Requirements in steady state – Conventional and alternate control strategies -Sources of reactive power – AC Filters– Shunt capacitors – Synchronous condensers- Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow –solution of AC-DC Power flow-Simultaneous method-Sequential method.

**UNIT – V: Converter Faults & Protection**

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

**Harmonics**

Generation of Harmonics – Characteristic harmonics – Non–Characteristic harmonics – Calculation of Harmonic components -Adverse effects of harmonics– Calculation of voltage & current harmonics – Effect of Pulse number on harmonics.

**UNIT – VI: Filters**

Types of AC filters, Design of Single tuned filters –Design of High pass filters.

**Text books:**

1. K. R. Padiyar, "HVDC Power Transmission Systems Technology and System Interactions", New Age International (p) Limited, New Delhi, 2003.
2. HVDC Transmission by S. Kamakshaiah and V. Kamaraju-Tata McGraw–Hill

**References:**

1. Edward Wilson Kimbark, "Direct current Transmission", Wiley Interscience, Vol. I, New York, 1971.
2. EHVAC and HVDC Transmission Engineering and Practice – S. Rao, Khanna Publishers.
3. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications
4. HVDC Transmission – J. Arrillaga.
5. https://onlinecourses.nptel.ac.in/noc16_ph03/preview
6. http://nptel.ac.in/courses/108104013/
7. http://www.learnerstv.com/video/Free-video-Lecture-7548-Engineering.htm

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Recall the transmission of HVDC power with regard to terminal equipments, type of HVDC connectivity and planning of HVDC system | Knowledge |
| CO2 | Develop the knowledge with regard to choice of pulse conversion, control characteristic, firing angle control and effect of source impedance. | Synthesis |
| CO3 | Revise the converter control characteristics from that the flexibility of power control in HVDC systems | Characterization |
| CO4 | Observation reactive power requirements of conventional control, filters and reactive power compensation in AC side of HVDC system. | Evaluate |
| CO5 | Calculate the voltage and current harmonics, and to get knowledge in multi terminal HVDC Systems protection schemes. | Evaluate |
| CO6 | Design of filters for six and twelve pulse conversion. | Synthesis |

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|---|---|---|---|---|
| **IV Year – II Semester** | **3** | **1** | **0** | **3** |

## ELECTRICAL DISTRIBUTION SYSTEMS (16EE8T26)

**Preamble:**
This subject deals with the general concept of distribution system and planning, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement.

**Course Objectives:**
This course enables the students to
- Learn different factors of Distribution system.
- Study and design the substations and distribution systems.
- Determination of voltage drop and power loss.
- Study the distribution system protection and its coordination.
- Understand the effect of compensation on P.F improvement.
- Study the effect of voltage control on distribution system.

**UNIT-I: General Concepts**
Introduction to Distribution systems–Load modeling and characteristics - Coincidence factor – Contribution factor loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

**UNIT-II: Substations**
Location of substations: Rating of distribution substation – Service area with 'n' primary feeders – Benefits and methods of optimal location of substations.
**Distribution Feeders**
Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

**UNIT-III: System Analysis**
Voltage drop and power–loss calculations: Derivation for voltage drop and power loss in lines- Uniformly distributed loads and non-uniformly distributed loads – Three phase balanced primary lines.

**UNIT-IV: Protection**
Objectives of distribution system protection – Types of common faults and procedure for fault calculations – Protective devices: Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers. Coordination of protective devices: General coordination procedure – Various types of co-ordinated operation of protective devices- Residual current circuit breaker (RCCB)

**UNIT-V: Compensation for Power Factor Improvement**

Capacitive compensation for power–factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location

**UNIT-VI: Voltage Control**

Voltage Control: Equipment for voltage control – Effect of series capacitors– Effect of AVB/AVR –Line drop compensation

**Text Books:**

1. "Electric Power Distribution system, Engineering"–by Turan Gonen, McGraw–hill Book Company.
2. Electric Power Distribution –by A.S. Pabla, Tata McGraw hill Publishing company, 4$^{th}$edition, 1997.

**References:**

1. Dr M K Khedkar and Dr G M Dhole, "A Textbook of Electric Power Distribution Automation", University Science Press (Laxmi Publications Pvt. Ltd.), 2011
2. Electrical Distribution Systems by Dale R. Patrick and Stephen W. Fardo, CRC press
3. Electrical Power Distribution Systems by V. Kamaraju, Right Publishers.
4. http://nptel.ac.in/courses/108108034/4
5. https://www.slideshare.net/surajprasad12/distribution-systems-44252619

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Analyze the characteristics and components of electric power distribution systems and its planning. | Analysis |
| CO2 | Propose suitable layout and components for a sub-station | Synthesis |
| CO3 | Evaluate the impact of economical factors on distribution systems | Evaluate |
| CO4 | Exhibit the protective devices used in distribution system and their coordination. | Responding |
| CO5 | Demonstrate reactive power control and Power factor improvements of the system. | Application |
| CO6 | Propose the equipment used for voltage control in a distribution system. | Synthesis |

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|---|---|---|---|---|
| **IV Year –II Semester** | **3** | **1** | **0** | **3** |

## HIGH VOLTAGE ENGINEERING (16EE8D07)

**(Elective-III)**

**Preamble:**
High Voltage Engineering is the foremost pre-requisite course for most of the subjects in Electrical Engineering. To meet the demand of the electricity, this subject plays a vital key role in the power engineering. This course introduces the development of the theory for generation and measurement of High Voltage.

**Course Objectives:**
This course enables the students to

- Study the electric field distribution and computation in different configuration of electrode systems.
- Understand the HV breakdown phenomena in gases, liquids and solids dielectric materials.
- Understand the operating principles of HVDC, AC & Impulse voltages and currents.
- Study the various techniques in measurement of HVDC, AC & Impulse voltages and currents.
- Learn the insulating characteristics of dielectric materials.
- Study the various techniques of HV equipments for testing.

**UNIT – I Introduction to High Voltage Technology:**
Electric Field Stress – Uniform and non–uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation.

**UNIT – II Break down phenomenon in gaseous, liquid and solid insulation:**
Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases – Paschen's law – Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of solid dielectrics in practice – Breakdown in composite dielectrics used in practice.

**UNIT – III Generation of High voltages and High currents:**
Generation of DC and AC high voltages–impulse voltages –impulse currents –switching voltages.

**UNIT – IV Measurement of high voltages and High currents:**
Measurement of high DC, AC and Impulse voltages –Measurement of high currents- DC, AC and Impulse.

**UNIT – V Non–destructive testing of material and electrical apparatus:**
Measurement of DC resistivity – Measurement of dielectric constant and loss factor – Partial discharge measurements.

**UNIT – VI High voltage testing of electrical apparatus:**
Testing of insulators and bushings – Testing of isolators and circuit breakers – Testing of cables – Testing of transformers – Testing of surge arresters- Radio Interference measurements.

**Text Books:**

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition.
2. High Voltage Engineering : Fundamentals by E.Kuffel, W.S. Zaengl, J. Kuffel by Elsevier, 2nd Edition.

**References:**

1. High Voltage Engineering by C.L.Wadhwa, New Age Internationals(P) Limited, 1997.
2. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New. Age International (P) Limited, 1995.
3. High Voltage Engineering and Technology by Ryan, IET Publishers.
4. http://nptel.ac.in/courses/108104048/ui/TOC.htm
5. http://www.mv.helsinki.fi/tpaulin/Text/hveng.pdf

**Course Outcomes:**

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

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Measure the performance of high voltages with regard to different configurations of electrode systems. | Synthesis |
| CO2 | Describe the theory of breakdown and withstand phenomena of all types of dielectric materials. | Comprehend |
| CO3 | Differentiate the operating principles of HVDC, AC & Impulse voltages and currents. | Analysis |
| CO4 | Recognize the various techniques in measurement of HVDC, AC & Impulse voltages and currents | Comprehend |
| CO5 | Propose dielectric property of material used for HV equipment. | Synthesis |
| CO6 | Illustrate the techniques of testing various equipment's used in HV engineering | Application |

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| **IV Year –II Semester** | **3** | **1** | **0** | **3** |

## FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS (16EE8D08)
**(Elective-III)**

**Preamble:**
Flexible Alternating Current Transmission System controllers have become a part of modern power system. It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. As the heart of many power electronic controllers is a voltage source converter (VSC), the student should be acquainted with the operation and control of VSC. Two modern power electronic controllers are also introduced.

**Course Objectives:**
This course enables the students
- Learn the basics of power flow control in transmission lines using FACTS controllers
- Explain operation and control of voltage source converter.
- Understand compensation methods to improve stability and reduce power oscillations of a power system.
- Learn the method of shunt compensation using static VAR compensators.
- Learn the methods of compensation using series compensators
- Explain operation of Unified Power Flow Controller (UPFC)

**Unit–I : Introduction to FACTS**
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 – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

**Unit–II : Voltage source and Current source converters**
Concept of voltage source converter(VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

**Unit–III : Shunt Compensators–1**
Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

**Unit–IV : Shunt Compensators–2**
Thyristor Switched Capacitor (TSC), Thyristor controlled reactor (TCR), TSC–TCR, FC-TCR, SVC, STATCOM- Regulation slope, transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control and summary of compensation control.

**Unit V : Series Compensators**

Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

**Unit–VI : Combined Controllers**

Schematic and basic operating principles of Unified Power Flow Controller (UPFC) – Application on transmission lines.

**Text Books:**

1. "Understanding FACTS" N. G. Hingorani and L. Guygi, IEEE Press.Indian Edition is available:— Standard Publications, 2001.
2. FACTS Controllers in Power Transmission & Distribution by K. R. Padiyar, New Age International (P) Ltd., 2007.

**References:**

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv k.Varma, Wiley
3. http://www.eetindia.co.in/VIDEO_DETAILS_700001240.HTM
4. http://nptel.iitm.ac.in

**Course Outcomes:**

At the end of the Course, the student should be able to

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Illustrate the requirements, characteristics and benefits of FACTS controllers | Comprehension |
| CO2 | Identify the process of converting electrical energy from AC to DC or vice versa using various types of voltage sourced converters | Comprehension |
| CO3 | Select the optimum location for shunt compensator to prevent voltage instability, improving power oscillation damping and transient stability enhancement | Application |
| CO4 | Analyze the performance of variable impedance type and switched converter type VAR compensators for transient stability enhancement and improving power oscillation damping | Analysis |
| CO5 | Express the functional operation and control schemes of Series Compensators such as GSC, TSSC and TCSC | Comprehension |
| CO6 | Use UPFC for independent and simultaneous control of Real and Reactive powers in a transmission line | Application |

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**IV Year –II Semester**

## POWER SYSTEM DEREGULATION (16EE8D09)
**(Elective-III)**

**Preamble:**

This course introduces the concepts and issues of power system reforms and aims at computation of Available Transfer Capability (ATC), Congestion Management, Electricity Pricing, Ancillary services Management and Power system operation in competitive Environment.

**Course Objectives:**

This course enables the students to

- Understand the fundamentals of power system deregulation and restructuring.
- Study available transfer capability.
- Get Knowledge on congestion management
- Study various electricity pricing methods.
- Understand the operation of power system in deregulated environment.
- Study the importance of Ancillary services management.

**UNIT-I : Over View of Key Issues in Electric Utilities**

Introduction –Restructuring models–Independent system operator(ISO)– Power Exchange –Market operations–Market Power–Standard cost– Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intrazonal Congestion. Difference between integrated power system and restructured power system

**UNIT-II : Oasis: Open Access Same–Time Information System**

Structure of OASIS –Processing of Information–Transfer capability on OASIS–Definitions Transfer Capability Issues–ATC–TTC–TRM– CBM calculations– Methodologies to calculate ATC.

**UNIT-III: Congestion Management**

Introduction to congestion management–Methods to relieve congestion- Bid, Zonal and Node Congestion Principles

**UNIT-IV :Electricity Pricing**

Introduction–Electricity price volatility electricity price indexes– Challenges to electricity pricing– Construction of forward price curves– Short–time price forecasting.

**UNIT-V : Power System Operation in Competitive Environment**

Introduction –Operational planning activities of ISO–The ISO in pool markets–The ISO in bilateral markets–Operational planning activities of a GENCO.

**UNIT-VI : Ancillary Services Management**

Introduction – Reactive power as an ancillary service – A review – Synchronous generators as ancillary service providers.

**Text Books:**

1. Kankar Bhattacharya, Math H.J. Boller, Jaap E.Daalder, 'Operation of Restructured Power System' Kluver Academic Publisher – 2001.
2. Mohammad Shahidehpour, and Muwaffaqalomoush, – "Restructured electrical Power systems" Marcel Dekker, Inc. 2001

**References:**

1. Loi Lei Lai; "Power system Restructuring and Deregulation", John Wiley & Sons Ltd., England.
2. Electrical Power Distribution Case studies from Distribution reform, upgrades and Management (DRUM) Program, by USAID/India, TMH
3. http://nptel.ac.in/courses/108101005/2
4. http://www.nptel.ac.in/courses/108101040/Module%207/L02Power%20System%20Restructuring%20Models.pdf

**Course Outcomes:**

At the end of the Course, the student should be able to

| CO# | Statement | Cognitive Level |
|---|---|---|
| CO1 | Evaluate the power system deregulation and restructuring. | Evaluate |
| CO2 | Examine the different methods of transfer capability. | Evaluate |
| CO3 | Express the transmission congestion management. | Comprehend |
| CO4 | Calculate the electricity pricing in deregulated environment. | Analysis |
| CO5 | Display the power system operation in deregulated environment. | Responding |
| CO6 | Identify the importance of ancillary services | Comprehend |