Jharkhand University of Technology

Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Electrical Engineering

&

Electrical and Electronics Engineering

Electrical Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	EE301	Electrical Machine-I	3	1	0	3
02	EE302	Network Theory	3	1	0	3
03	EE303	Electromagnetic Field Theory	3	1	0	3
04	EC301	Basic Electronics	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	EE301P	Electrical Machine-I Lab	0	0	3	1
02	EE302P	Network Theory Lab	0	0	3	1
03	EC301P	Basic Electronics Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

Electrical and Electronics Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	EE301	Electrical Machine-I	3	1	0	3
02	EE302	Network Theory	3	1	0	3
03	EE303	Electromagnetic Field Theory	3	1	0	3
04	EC301	Basic Electronics	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	EC301P	Basic Electronics Lab	0	0	3	1
02	EE301P	Electrical Machine-I Lab	0	0	3	1
03	EE302P	Network Theory Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

PROPOSED SYLLABUS FOR ALL BRANCHES EXCEPT CSE & IT

2nd year, III Semester, UG course Engg. & Tech Jharkhand University of Technology

BSC301 MATHEMATICS III

Module -1

Laplace Transformation: Laplace Transformation and its properties, Periodic function, Unit step function and impulse function .Inverse Laplace Transformation, Convolution Theorem, Applications of Laplace transforms in solving certain initial value problems & simultaneous differential equations**.** **(8L/1.5Q)**

Module-2

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton - Gregory forward and backward formula, Lagrange's formula, Inverse Interpolation by Lagrange's formula. Numerical Differentiation and Numerical Integration, Newton Cotes Quadrature formula, Trapezoidal rule. Simpson's 1/3" rule, Simpson's 3/8" rule. **(10L/1.5Q)**

Module -3

Z-Transform & Inverse Z-Transform- Properties - Initial and Final value theorems, Convolution theorem- Difference equations. Solution of difference equations using Z-Transformation. **(6L/1.5Q)**

Module -IV

Fourier Series & Fourier Transform: Expansion of - Algebraic, Exponential &Trigonometric functions in Fourier series, Change of interval, Even and odd function, half range sine and cosine series, Complex form of Fourier series.

Fourier Transformation and inverse Fourier Transformation, Fourier sine & cosine transforms. Convolution theorem for Fourier transforms with simple illustrations. **(8L/1.5Q)**

Module V

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations of first order, Lagrange's linear equation, Non-linear equations of first order, Charpit's method Solution of one dimensional Wave equation & Heat equation by the method of separation of variables and its applications. **(8L/1Q)**

Note-Question no.1 will be compulsory, objective type with 7 sub-parts comprising of the whole syllabus.

Text Books

1. Irwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,

2. Ramana R. V ., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.

3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition,

Reference Books

1. R. J. Beerends .H. G. Ter Morsche, J. C. Van Den Berg. L. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.

2. Sastry S.S. Introductory Methods of Numerical Analysis, PHI

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

BASIC ELECTRONICS

(ECE, EEE, EE,CSE, IT)
Course code -EC 301

L	T	P	CR.
3	1	0	3

Module I: Basic Electronic Components

Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II: Semiconductors

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, Charge Densities in Semiconductors, Mass Action Law, Current Components in Semiconductors, Drift and Diffusion Current, The Continuity Equation, Injected Minority Charge Carrier, Hall Effect, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector.

Module III: Transistors

Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module IV: Power electronic devices &Communication engineering

Construction, characteristics and working of SCR, DIAC, TRIAC and UJT. Introduction, Characteristics and applications of Operational Amplifier (Ic741). Modulation and its types.

Module V: Digital Logic and basic circuit Design

Number systems and conversion (DECIMAL, OCTAL, HEXADECIMAL,BINARY, BCD etc.),binary addition and subtraction, Logic Gates and their truth-table ,Boolean algebra .Design

of Single Stage Amplifier, LED Driver Circuit, Infrared Transmitter Receiver Circuit, LDR Driver Circuit, Relay Driver Circuit, Square Wave and Fix Frequency Generator using 555 IC.

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.

2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.

3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.

Reference Books

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.

2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.

4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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ELECTRICAL MACHINE-I

(EE, EEE)

Course Code – EE 301

L T P CR

3 1 0 3

Course Outcomes:

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

CO's	CO Description
CO1	**Understand** the construction and principle of operation of DC machines, Induction motor, single phase and three phase transformers.
CO2	**Analyze** the effects of armature reaction and process of commutation.
CO3	**Identify, formulate** and solve DC machine, transformer and Induction motor related problems.
CO4	**Analyze** speed-torque characteristics and speed control of three phase Induction motor.

DETAILED SYLLABUS

UNIT – I: Principles of Electro-mechanical Energy Conversion (5 Lectures)

Introduction, Flow of energy in electromechanical devices, Energy in magnetic systems (defining energy and co-energy), Singly excited systems, Determination of mechanical force, Mechanical energy, Torque equation, Doubly excited systems, Energy stored in magnetic field, Electromagnetic torque, Generated emf in machines, Torque in machines with cylindrical air gap.

UNIT – II: D.C Machines (12 Lectures)

Construction of D.C Machines, Armature winding, EMF and torque equations, Armature reaction, Commutation, Interpoles and compensating windings, Performance characteristics of D.C Generators and D.C Motors, Starting of D.C Motors, 3- point and 4- point starters, Speed control of D.C Motors, Field control, Armature control and Voltage control(Ward- Leonard method), Efficiency and testing of D.C Machines(Hopkinson's and Swinburn's Test)

UNIT- III: Single phase Transformers (8 Lectures)

Construction, Principle of operation, EMF equation, Phasor diagram , Equivalent circuit, Determination of equivalent circuit parameters, Losses, Calculation of efficiency and regulation, Polarity test, O.C and S.C test, Sumpner's test, Parallel operation of transformers and load sharing, Principle of single phase auto – Transformer, Saving of copper compared to two winding transformer and its application, Cooling methods of transformer.

UNIT – IV: Three Phase Transformers (7 Lectures)

Construction , Three phase transformer, Phasor groups and their connections, Open delta connection, Three phase to 2 phase, 6 phase and 12 phase connections and their applications, Principle of three phase auto- Transformer, Parallel operation of single phase and three phase

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transformers and load sharing, Excitation phenomenon and harmonics in transformers, Three winding transformers.

UNIT – V: Three Phase Induction Machine **(10 Lectures)**

Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, Equivalent circuit, Torque and Power equations, Torque- slip characteristics, No- Load and blocked rotor tests, Efficiency , Starting, Braking and speed control, Deep bar and double cage rotors, Cogging and Crawling, Induction Generators and its applications.

Text Books

[1]. I.J Nagrath and D.P Kothari, " Electrical Machines" , Tata Mcgraw hill
[2]. Husian Ashfaq, " Electrical Machines", Dhanpat Rai and Sons
[3]. P.S Bimbhra, " Electrical Machinery" , Khanna Publisher
[4]. E Fitggerald, C. Kingsley Jr and Umans, " Electrical Machinery" , McGraw Hill, International student addition.

Reference Books

[1]. Irving L. Kosow, "Electrical Machine and transformers" , Prentice Hall of India
[2]. M.G Say," The performance and design of A.C machine", Pit man and sons

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NETWORK THEORY

(EE, EEE, ECE)

Course Code – EE302

L T P CR

3 1 0 3

Course Outcomes:

COs	At the end of this course, students will be able to
CO1	**Evaluate** and **Analyse** the transient and resonant behavior of linear time invariant circuits.
CO2	**Analyse** circuits using graph theory.
CO3	**Evaulate** two port parameters and **obtain** transfer function.
CO4	**Design** passive filters and synthesize the R-L, R-C & L-C networks.

Module I: **(8 Lectures)**

Introduction to LTI elements. Impulse, Step, Ramp and Sinusoidal Inputs, Behaviour of R, L & C at t=0+ and t=∞, Concept of t=0- , 0 & 0+, Analysis of zero input response, zero state response and complete response of transient behavior of R-L, R-C and R-L-C Circuits using integro-differential equation and Laplace Transform.

Module II: **(5 Lectures)**

Resonance: Series resonance circuit, Effect of Q on bandwidth and selectivity. Relation between bandwidth and Q, Resonance curve with the variation of L and C, Parallel resonant circuit.

Mutual coupled circuits, Dot Convention in coupled circuits, Equivalent inductance, Analysis of Mutual coupled circuits, Ideal Transformer.

Module III: **(5 Lectures)**

Graph Theory: Introduction to graph, sub-graph, degenerate sub-graph, incidence matrix, reduced incidance matrix, Tie-set and cut set matrix, Analysis of the circuit using fundamental tie set matrix and fundamental cut set matrix.

Module IV: **(6 Lectures)**

Definition of Network Function, Driving point impedance, Driving point admittance, Transfer impedance and admittance, Voltage and current transfer ratio, Concept of poles and zeros, OCNF and SCNF, To obtain response from pole zero plot analytically and graphically. Response of the circuit transfer function with impulse, step and sinusoidal inputs.

Module V: **(6 Lectures)**

Two Port Networks: Impedance parameters, admittance parameters, transmission parameters and hybrid parameters, Interconnections of two port networks: Series, Parallel, Cascade, Series-parallel, Parallel-series, Lattice network, Ladder network, Equivalent T and π network.

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Module VI: **(6 Lectures)**

Hurwitz polynomial, its properties and Test, Positive real functions, its properties and test, Driving point immittances of L-C Network, Synthesis of L-C Network using Foster-I and Foster-II forms, Cauer-I and Cauer-II forms, Driving point impedance and admittance of R-L and R-C Network, Synthesis using Foster-I, Foster-II, Cauer-I & Cauer-II forms.

Module VII: **(6 Lectures)**

Introduction and Classifications of filters and its uses, Design of prototype Constant k and m-derived low pass filter, high pass filter, band pass filter and band stop filter.

Text Book:

[1]. Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hil,5th Editionl.

[2]. Circuits & Networks: Analysis, Design and Synthesis- Sukhija & Nagsarkar- Oxford

Reference Book(s):

[1]. Network Analysis – M E Van Valkenburg – Pearson Education, 3rd Edition.

[2]. Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.

[3]. Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.

[4]. Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.

[5]. Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, MahmoodMaqvi.

[6]. Electric Circuits – David A.Bell – Oxford, 7th Edition, 2015.

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ELECTROMAGNETIC FIELD THEORY

(ECE, EEE, EE)
Course code -EE 303

L	T	P	CR.
3	1	0	3

Module I: Coordinate Systems and Transformation:
Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.

Module II: Electrostatic fields:
Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law- Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.

Module III: Magneto Statics:
Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.

Module IV: Magnetic Forces:

Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.

Module V: Waves and Applications:
Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines, and Smith Chart.

Text Book:
1. MNO Sadiku, "Elements of Electromagnetic', Oxford University Press.

Reference Books:
1. WH Hayt and JA Buck, "Engineering Electromagnetic", McGraw- Hill Education.
2. Antenna and wave propagation by k.d parsad satya prakashan.

ENVIRONMENTAL SCIENCE

Course code – BSC 302
L T P CR.
2 0 0 0
(COMMON FOR ALL BRANCH)

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **(4 Hrs)**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods. **(5 Hrs)**

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

BASIC ELECTRONICS LAB

(ECE, EEE, EE) Course
code -ECE 301P

List of Experiments (Minimum 10)

1. Identification and testing of Resistors, Inductors, Capacitors, PN-Diode. Zener Diode, LED, LCD, LDR, BJT, Photo Diode, Photo Transistor,

2. Measurement of voltage and current using multimeter ,Measure the frequency and Amplitude of a signal with the help of CRO and function generator.

3. Study of p-n junction diode AND Zener Diode I-V characteristics

4. Assemble the single phase half wave and full wave bridge rectifier & the analyze effect of capacitor as a filter(only study of waveforms).

5. Study of Zener diode as voltage regulator.

6. Measurement & study of input characteristics of a BJT in CB configuration.

7. Measurement and study of characteristics of JFET and MOSFET

8. To design and simulate IR Transmitter and Receiver Circuit.

9. To design and simulate Motor Driver using Relay.

10. To design and simulate Light detector using LDR.

11. To design and simulate Constant frequency square wave generator using.

12. To design and simulate 5 volt DC power supply from 230 AC.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELECTRICAL MACHINE LAB-I

List of Experiments (Minimum 10)

1. To obtain the speed characteristics of a D.C shunt motor as a function of armature voltage, field current, and externalresistance in the armature circuit.
2. To find the critical resistance (R_c) and critical speed (N_c) and O.C.C. of a dc shunt generator.
3. To conduct a load test on a dc shunt generator and obtain its internal and external characteristics.

4. To conduct load test on a dc series generator and to obtain its internal and external characteristics.
5. To perform Hopkinson's test on two similar DC shunt machines and obtain their efficiencies at various loads.
6. To separate the mechanical and iron losses (Retardation Test) of the given dc shunt machine.
7. To pre-determine the efficiency of a D.C shunt machine considering it as a motor by performing Swinburne's test on it.
8. To study about different types of DC motor starters.
9. To study power-sharing between two single-phase transformers operated in parallel.
10. To determine transformer winding polarity and explore the impact of connecting windings in series aiding and series opposing configurations.
11. To perform the short circuit and open circuit test of single-phase transformer and draw the equivalent circuit.

12.To determine Regulation and Efficiency of a single-phase transformer using direct loading test.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

NETWORK THEORY LAB

(ECE, EEE, EE)
Course code -EE 302P

List of Experiments (Minimum 10)

1. Transient response of RC circuit.
2. Transient response of RL circuit.
3. To find the resonance frequency, Band width of RLC series circuit.
4. To study and verify effect of R on frequency response of parallel resonance circuit.
5. To calculate and verify "Z" parameters of a two port network.
6. To calculate and verify "Y" parameters of a two port network.
7. To determine equivalent parameter of parallel connections of two port network.

8. To plot the frequency response of low pass filter and determine half-power frequency.

9. To plot the frequency response of high pass filters and determines the half-power frequency.

10. To plot the frequency response of band-pass filters and determines the band-width.

11. To calculate and verify "ABCD" parameters of a two port network.

12. To synthesize a network of a given network function and verify its response.

13. Introduction of P-Spice or other simulation software

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

- Introduction
- Listening/Speaking

- Telephonic Skills Required
- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Jharkhand University of Technology

Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Electrical Engineering

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Electrical and Electronics Engineering

Electrical Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credit
01	EE401	Power System – I	3	1	0	3
02	EE402	Measurement & Instrumentation	3	1	0	3
03	EC401	Analog Electronics And Circuits	3	1	0	3
04	EC403	Digital Electronics And Logic Design	3	1	0	3
05	CS301	Data Structure And Algorithm	3	1	0	3
06	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0
01	EE401P	Power System- I Lab	0	0	3	1
02	EE402P	Measurement & Instrumentation Lab	0	0	3	1
03	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

Electrical & Electronics Engineering

4th semester course structure

Sl. No.	Course code	Subject	L	T	P	Credit
01	EE401	Power System – I	3	1	0	3
02	EE402	Measurement & Instrumentation	3	1	0	3
03	EC401	Analog Electronics And Circuits	3	1	0	3
04	EC403	Digital Electronics And Logic Design	3	1	0	3
05	CS301	Data Structure And Algorithm	3	1	0	3
06	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0
01	EE401P	Power System- I Lab	0	0	3	1
02	EE402P	Measurement & Instrumentation Lab	0	0	3	1
03	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

POWER SYSTEM-I

Course Code – EE 401

Course Outcomes:

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

CO's	CO Description
CO1	**Understand** the operation of conventional generating stations as well as renewable sources of electrical power.
CO2	**Determine** the electrical circuit parameters of overhead transmission lines.
CO3	**Analyze** the mechanical design of insulators and cables of power system.
CO4	**Solve** power distribution system problems.
CO5	**Illustrate** different types of tariff and **Analyze** power factor improvement methods.

DETAILED SYLLABUS

Module I: Power System Basics **(06 Lectures)**

Structure of power systems, Single line diagram. Introduction to Per Unit System.

Basic concepts of electrical power generation by conventional resources (Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant) and renewable resources (Ocean Energy, Tidal Energy, Wave Energy, Wind Energy, Fuel Cells, and Solar Energy).

Module-II:

Electrical Design of Overhead Line **(06 Lectures)**

Constants of a Transmission Line, Resistance of a Transmission Line, Skin Effect, Proximity effect.

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Bundled conductors.

Performance of Transmission Line **(06 Lectures)**

Representation of lines: Short, Medium and Long length transmission line, Equivalent π and T circuits, Regulation and Efficiency, Evaluation of ABCD parameters. Ferranti effect, Surge impedance loading.

Module-III

Mechanical Design of Transmission Line **(08 Lectures)**

Types of insulators, methods of equalizing the potential, string efficiency. Phenomenon of corona, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona.

Catenary curve, calculation of sag and tension, effects of wind and ice loads, sag template, vibration dampers.

Module-IV

Underground cables **(04 Lectures)**

Types of cables and their construction, charging current, dielectric stress, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables, grading of cables.

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Distribution Systems **(04 Lectures)**

Classification of Distribution Systems, D.C Distribution, Overhead Versus Underground System, Methods of solving D.C and A.C distribution problems.

Module V **(05 Lectures)**

Economics of Power system

Cost of electrical system, Economics of size of the conductor, Kelvin's law, variable load on power station, load curve, load duration curve, load characteristics, Tariff, Types of tariff.

Power Factor Improvement **(03 Lectures)**

Causes and disadvantages of Low Power Factor, Power Factor Improvement Equipments, Calculations of Power Factor Correction, most economical power factor.

Suggested Readings:

[1]. W.D. Stevenson "Elements of Power System Analysis". McGraw Hill.
[2]. C.L. Wadhwa "Electrical Power System", New age international Ltd. Third Edition.
[3]. B.R. Gupta, "Power System Analysis and Design", Third Edition, S.Chand& Co.
[4]. M.V. Deshpande,"Electrical Power System Design", TataMcGraw Hill.
[5]. S.Sivanagaraju&S.Satyanarayana,"Electric Power Transmission and Distribution", Pearson Education.
[6]. Kothari &Nagrath,"Power System Engineering", Tata McGraw Hill Education.

Reference Books:

[1]. Soni Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & Sons.
[2]. S.N. Singh, "Electric Power Generation, Transmission & Distribution", PHI Learning.

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MEASUREMENT AND INSTRUMENTATION

Course Code- EE402

Module I: Measuring System Fundamentals:

Absolute standards (International, Primary, Secondary, and Working standards),True Value, Errors(Gross, Systematic and Random); Static Characteristic of instruments(Accuracy, Precision, Sensitivity, Resolution and threshold).Classification of Instruments (based upon mode of measurement- Indicating , Recording and Integrating Instruments), Generalized Instrument (block diagram and description of various blocks), the three forces in an electromechanical indicating instrument (deflecting controlling and damping forces and the interplay between them), Comparison between gravity and spring(Qualitative Study) . Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk

Module II: Analog Ammeters , Voltmeters and Watt meters :

PMMC and MI Instruments, Construction, Torque Equation, Range Extension, Effect of temperature, Classification, Errors, Advantages and Disadvantages. Analog Wattmeters Power Factor Meters and Energy Meter Power and Power Factor, Electrodynamometer type wattmeter, power factor meter, Construction, theory, Shape of scale, torque equation, Advantages and disadvantages, active and reactive power measurement in single phase, Measurement in three phase. Single phase induction type energy meters, construction, theory, Operation, lag adjustments, Max Demand meters/indicators, Measurement of VAH and VARh.

Module III: DC and AC Bridges:

Measurement of resistance, Wheatstone Bridge, Kelvin's Bridge, Kelvin's Double Bridge, Measurement of inductance, Capacitance, Maxwell's Bridge, Desauty Bridge, Anderson Bridge, Schering Bridge, Wien Bridge, Applications and Limitations.

Module IV: Instrument Transformers and Transducers

Current Transformer and Potential Transformer - construction, theory, phasor diagram, errors, testing and applications. Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.

Module V: Electronic Instruments:

Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and C.Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.Digital Storage Oscilloscope.

Text Books:

1. W.D. Coopers and Helfrick, Modern Electronic instrumentation and Measurements Techniques, Prentice Hall of India Pvt. Ltd,
2. E.W. Gowlding and F.C.Widdis, Electrical Measurements and Measuring Instruments 5/e, Wheeler Publications.
3. U. A. Bakshi, A. V. Bakshi: Electrical Measurements and Instrumentation, Technical Publications.

Reference Books

1. A. K. Sawhney: A course in Electrical Measurements Electronic Measurements Instrumentation, Edition 11, Dhanpat Rai and Sons,
2. J. B. Gupta: A course in Electrical and Electronic Measurements and Instrumentation, 13/E, Kataria and Sons.

ANALOG ELECTRONICS AND CIRCUITS

Course Code- EC401

Module I: Diode & Transistor Circuits:

P-N junction diode, I-V characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. Amplifier models, Voltage amplifier, current amplifier, transconductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers, high-frequency equivalent circuits.

Module II: Oscillators, DAC & ADC:

Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Digital-to-analog converters (DAC) Weighted resistor, R-2R ladder, resistor string etc., Analog to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Module III: MOSFET circuits:

MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module IV: Differential, multi-stage and operational amplifiers:

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module V: Linear & Nonlinear applications of op-amp:

Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, Differential amplifier, Instrumentation amplifier, Integrator, Active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, Voltage regulator, Oscillators (Wein bridge and phase shift).Analog to Digital Conversion. Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Monoshot.

Text Books :

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

Reference Books:

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001
3. Op-Amps and Linear Integrated Circuits by A. Gayakwad, Pearson Publication

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DIGITAL ELECTRONICS AND LOGIC DESIGN

Course code -EC 302

Module I: Binary Codes and Boolean algebra

Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non weighted codes, self complementary codes, BCD, Excess-3, Gray codes, Alphanumeric codes, ASCII Codes. *Boolean algebra*: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, DeMorgan's Theorem, Duality Theorems.

Module II : Boolean function minimization Techniques

Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. *Karnaugh map*: K-map(up to 5 variables), mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits, Quine Mc-cluskey method minimization technique, prime implicant table, Don't care condition.

Module III: Combinational Circuits Design

Adder & Subtractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De Multiplexers.

Module IV : Sequential Circuits Elements

Introduction to sequential circuit, Flip-flop & Timing Circuits: SR latch, Gated latch, Tri state logic, Edge triggered flip-plop: - D, JK, T Flip-flop, flip-flop asynchronous inputs ,characteristic table of Flip-flop, excitation table of Flip-flop, master slave JK flip flop, inter conversion of Flip-flop. Study of timing parameters of flip-flop. Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. *Counter*: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter,
Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. Introduction to FSM. Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator.

Module V: Logic Families and VLSI Design flow

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

Text Books **:**

1. Kharate "Digital Electronics" OXFORD Publication
2. A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
3. R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition
6. Bhaskar VHDL BASED DESIGN ,PEARSON EDUCATION

Reference Books:

1. Rajkamal 'Digital Systems Principals and Design' Pearson Education
2. A.P. Malvino, D.P. Leach 'Digital Principles & Applications' -VIth Edition-TMH publication.
3. M. Morris Mano 'Digital Design' (Third Edition). PHI Publications

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DATA STRUCTURES AND ALGORITHMS

Course code -CS 301

Module I

Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort,

Selection sort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search on sorted arrays.

Module II

Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list, Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and deletion operations, circular queue, Dequeue, priority queue. Linked Lists & their types.

(Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search and Update) with applications

Module III

Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree

Module IV

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths,, Floydd's Algorithm for All-Pairs Shortest Paths Problem

Module V

Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing

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

- Understand the concept of ADT
- Identify data structures suitable to solve problems
- Develop and analyze algorithms for stacks, queues
- Develop algorithms for binary trees and graphs
- Implement sorting and searching algorithms
- Implement symbol table using hashing techniques

Text Books:

1. Data Structures Using C – A.M. Tenenbaum (PHI)

2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)

3.Data Structures, Algorithms and Application in C, 2nd Edition, Sartaj Sahni

4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

REFERENCE BOOKS:

1. Data Structure and Program Design in C by C.L. Tondo.
2. Data Structures with C++, J. Hubbard, Schaum's Outlines, TMH.
3. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
4. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.
5. Classic Data Structures, D. Samanta, 2nd Edition, PHI.
6. Data Structure Using C by Pankaj Kumar Pandey.
7. Data Structure with C, Tata McGraw Hill Education Private Limited by Seymour Lipschutz.
8. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.
9. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, Mark Allen Weiss

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CYBER SECURITY

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

POWER SYSTEM-1 LAB

Course Code- EE401

List of Experiments (Minimum 10)

1. To draw operating characteristics of DMT/IDMT relay.
2. To draw operating characteristics of differential relay.
3. To study Bucholtz Relay.
4. Testing of Transformer oil.
5. To find ABCD Parameters of a model of transmission line.
6. To observe Ferranti effect in a model of transmission line.
7. To study the microcontroller based differential relay for the protection of transformer.
8. To study electromechanical type negative sequence relay.
9. To study electromechanical type over current relay.
10. To study electromechanical type directional over current relay.
11. To study electromechanical type earth fault relay.
12. To determine the string efficiency of suspension type insulators with and without guard ring.
13. To plot Annual / monthly / daily load demand of nearby area.
14. To draw single line diagram of distribution system of JUVNL of nearby area of college concerned.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

MEASUREMENT AND INSTRUMENTATION LAB

Course Code- EE402

List of Experiments (Minimum 10)

1. Calibration of AC voltmeter and AC ammeter.
2. Measurement of inductance using Maxwell's Bridge.
3. Measurement of capacitance using Schering Bridge.
4. Measurement of low resistance using Kelvin's Double Bridge.
5. Measurement of Power using CT and PT.
6. Measuring displacement using LVDT.
7. Measuring temperature using thermocouple.
8. Measuring pressure using piezoelectric pick up.
9. Measurement of speed of DC motor by photoelectric pick up.
10. Speed measurement using Hall Effect sensor.
11. Measurement of a batch of resistors and estimating statistical parameters. Measurement of L using a bridge technique as well as LCR meter.
12. Measurement of C using a bridge technique as well as LCR meter. Measurement of Low Resistance using Kelvin's double bridge.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

Course code EC 302P

List of Experiments (Minimum 10)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. Design all gates using VHDL.
9. Design a multiplexer using VHDL
10. Design a decoder using VHDL
11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder
12. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus. For VHDL Xilinx software may be used.

Jharkhand University of Technology

Jharkhand, Ranchi

Proposed Syllabus

For

B.Tech 5th & 6th Semester

Electrical and Electronics Engineering

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

a) Find employment in Core Electrical and Electronics Engineering and service sectors.

b) Get elevated to technical lead position and lead the organization competitively.

c) Enter into higher studies leading to post-graduate and research degrees.

d) Become consultant and provide solutions to the practical problems of core organization.

e) Become an entrepreneur and be part of electrical and electronics product and service industries.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Electrical and Electronics Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design an electrical system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments in electrical and electronics systems and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct them to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Electrical and Electronics Engineering program the student will have following Program specific outcomes.

1. Foundation of Electrical engineering: Ability to understand the principles and working of electrical components, circuits and systems, that are forming a part of power generation, transmission, distribution, energy saving. Students can assess the power management, auditing, crisis and saving aspects.
2. Foundations of power system development: Ability to understand the structure and development methodologies of electrical systems using knowledge on circuits, electronics for automation and control. Possess professional skills and knowledge of electrical system modelling and design of small and large systems. Familiarity and practical competence with a broad range of practice through experimentation on electrical circuits, electronic circuits and programming platforms.
3. Foundation of mathematical concepts: Ability to apply mathematical methodologies to solve computation task, model real world problem using appropriate engineering tools and suitable algorithm.
4. Applications of Computing and Research Ability: Ability to use knowledge in various domains to identify research gaps and hence to provide solution leading to new ideas and innovations.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

SEMESTER-5 (3rd YEAR)

Electrical & Electronics Engineering (B.Tech) Course Structure

Sl. No.	Category	Course Code	Course Title	Hours			Credit
				L	T	P	
Theory							
1	Professional Core Courses	EEC501	Power System-II	3	1	0	4
2	Professional Core Courses	EEC502	Control System	2	1	0	3
4	Professional Core Courses	EEC503	Electrical Machine-II	2	1	0	3
5	Professional Elective Course		Professional Elective Course -I	2	1	0	3
6	Open Elective Course		Open Elective Course-I	2	1	0	3
						Total(A)	**16**
Practical/Drawing/Design							
1	Professional Core Courses	EE501P	Power System -II Lab	0	0	2	1
2	Professional Core Courses	EE502P	Control System Lab	0	0	2	1
3	Professional Core Courses	EE503P	Electrical Machine-II lab	0	0	2	1
3	Professional Core Courses	EE504P	Electrical and Electronics workshop Lab	0	0	2	1
4	PPT presentation	EE505G	Seminar (PPT presentation)	0	0	2	2
						Total(B)	**6**
						Grand Total (A+B)	**22**
L-Lecture, T-Tutorial, P-Practical							

Professional Elective Course -I

Sl. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits	Preferred Semester
1	EEP504	Industrial Electrical Systems	02:01:0	3	V
2	EEP505	Non-Conventional Energy System	02:01:0	3	V
3	EEP506	Power Quality	02:01:0	3	V

Open Elective Course-I

Sl. No	Code No.	Subject	Hrs./ Week L: T: P	Credits
1	CSO501	Artificial Intelligence	02:01:00	3
2	CSO502	Internet-of-Things	02:01:00	3
3	ECO501	Communication and Networks	02:01:00	3

SEMESTER-6 (3rd YEAR)

Electrical & Electronics Engineering (B.Tech) Course Structure

Sl. No.	Category	Course Code	Course Title	Hours			Credit
				L	T	P	
Theory							
1	Professional Core Courses	EEC601	Power Electronics	3	1	0	4
2	Professional Core Courses	EEC602	Signals and Systems	2	1	0	3
4	Professional Core Courses	EEC603	Microprocessors and Microcontroller	2	1	0	3
3	Professional Elective Course		Professional Elective Course -II	2	1	0	3
5	Open Elective Course		Open Elective Course - II	2	1	0	3
						Total(A)	**16**
Practical/Drawing/Design							
1	Professional Core Courses	EE601P	Power Electronics Lab	0	0	2	1
2	Professional Core Courses	EE602P	Signals and Systems Lab	0	0	2	1
2	Professional Core Courses	EE603P	Microprocessors and Microcontroller Lab	0	0	2	1
2	Professional Core Courses	EE604P	Electrical Simulation Lab	0	0	2	1
3	Project Work	EE605I	Internship/Tour and Training/Industrial Training	0	0	2	2
						Total(B)	**6**
Grand Total (A+B)							**22**
L-Lecture, T-Tutorial, P-Practical							

Professional Elective Course -II

Sl. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits	Preferred Semester
1	EEP604	High Voltage Engineering	02:01:00	3	VI onwords
2	EEP605	Advanced Control Systems	02:01:00	3	VI onwords
3	EEP606	Digital Control Systems	02:01:00	3	VI onwords

Open Elective Course -II

Sl. No	Code No.	Subject	Hrs./ Week L: T: P	Credits
1	CSO601	Soft Computing Techniques	02:01:00	3
2	EEO607	Power Plant Engineering	02:01:00	3
3	CSO602	Image Processing	02:01:00	3

Detailed Syllabus

EEC501	POWER SYSTEMS-II	3L:1T:0P	4 Credits

Course Outcomes:

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

CO's	CO Description
CO1	**Illustrate** power system components using single line diagram and usage of per unit system.
CO2	**Calculate** symmetrical components and **Examine** different types of faults (both symmetrical and unsymmetrical).
CO3	**Formulate** nodal admittance (Y-bus) matrix, and **develop** load flow equations and **find** its solution.
CO4	**Illustrate** the concept of stability, power angle curve, and swing equation and **diagnose** steady-state and transient stability of the power system.
CO5	**Apply** different types of active, reactive and voltage control techniques.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	2	1	3	2							
CO3	3	2	1	3	2							2
CO4	3	3	1	2	2							2
CO5	3	3	1	2	2							2
Avg.	**3**	**2.4**	**1**	**2.5**	**2**							**2**

DETAILED SYLLABUS

Module I: Per Unit System and Faults (10 Lectures)

Per Unit meaning and its calculation. Need and advantages of per unit system, Selection of base quantities, per unit impedance for 1-φ and 3 – φ system. Change of base value. Faults causes and consequences. Classification of faults and statistics of occurrence.

Fortescue theorem, Method of symmetrical components (positive, negative and zero sequences). Symmetrical component transformation. Sequence networks for generators, lines and transformers. Sequence network for power system. Balanced and Unbalanced faults, computation of fault currents.

Module II: Load Flow Analysis (10 Lectures)

Review of the structure of power system and its components, Bus classification, formulation of Y_{bus} matrix, power flow equations. Gauss – Seidel method, algorithm, derivation of iterarative equation, modification for PV bus, Advantages and disadvantages, acceleration factor. Newton – Raphson method, algorithm, power mismatch vector, size of Jacobian matrix and its elements. Advantages and disadvantages.

Module III: Power system Stability (12 Lectures)

Concept of power system stability and it's classification. Dynamic equation of synchronous machine. Swing equation and power angle curve. Single machine infinite bus system. Large signal stability, Equal area criteria, derivation. Critical clearing angle and effect of clearing time on stability. Methods for improvement of transient stability. Introduction to Multi – machine transient stability.

Module IV: Economic Operation of Power Systems (6 Lectures)

Input-output characteristics of thermal and hydro plants, Optimum generator allocations without and with transmission losses, calculation of penalty factors, incremental transmission loss, transmission loss coefficients and their calculations.

Module V: Load Frequency Control: (7 Lectures)

Concept of load frequency control, load frequency control of single area system, effect of governor droop and load damping, block diagram representation of single area system, steady state frequency error, dynamic response.

Text Books

[1]. J Grainger and W.D. Stevenson, " Power System Analysis '' , McGraw Hill Education , 1994.
[2]. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons,2011.
[3]. D.P. Kothari and I.J. Nagrath, " Modern Power System Analysis '' ,McGraw Hill Education 2003
[4]. O.L. Elgerd, " Electric energy systems theory '' , McGraw Hill Education , 1995.

Reference Books

[1]. Soni Gupta & Bhatnagar , " A course in Electric Power '' , Dhanpat Rai & Sons.
[2]. A R Bergen and V Vittal , " Power system analysis '' , Pearson Education Inc, 1999.

EEC502	CONTROL SYSTEMS	2L:1T:0P	3 Credits

(This course is not offered to Electrical Engg. students)

Course Outcomes:

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

CO's	CO Description
CO1	**Analyse** electromechanical systems by mathematical modelling.
CO2	**Determine** Transient and Steady State behaviour of systems using standard test signals.
CO3	**Analyse** linear systems for steady state errors, absolute stability and relative stability using time domain and frequency domain techniques.
CO4	**Identify** and **design** a control system satisfying specified requirements.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
CO4	3	3	3	3	3		1	1				2
Avg.	3	3	2.33	3	3		1	1				2

DETAILED SYLLABUS

Module I: (8 Lectures)

Concepts of system, open loop and closed loop systems, Benefits of Feedback, Mathematical modelling and representation of physical systems, analogous systems.

Transfer functions for different types of systems, block diagrams; Signal flow graphs and Mason's gain formula.

Module II (12 Lectures)

Time domain performance criterion, transient response of first order, second order systems; Steady state errors: static and dynamic error constants, system types, steady state errors for unity and non-unity feedback systems, performance analysis for P, PI and PID controllers.

Concept of stability by Routh stability criterion, root-loci and root contours.

Module III (8 Lectures)

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

Module IV: (6 Lectures)

Compensation - lag, lead and lag-lead networks, design of compensation networks using time response and frequency response of the system.

Module V: (6 Lectures)

Concepts of state, state variables, state variable representation of system, dynamic equations, merits for higher order differential equations and solution. Concept of controllability and observability and techniques to test them.

Text/References:

[1]. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

[2]. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

[3]. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

[4]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

EEC503	ELECTRICAL MACHINES-II	2L:1T:0P	3 Credits

Course Outcomes:

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

CO's	CO Description
CO1	**Understand** the construction and principle of operation of synchronous machines.
CO2	**Analyse** the effects of excitation and mechanical input on the operation of synchronous Machine.
CO3	**Understand** the operation principles of Reluctance motor, shaded pole, Hysteresis motor, and Universal motor, PMBLDC, tachometer, synchro and identify the suitable applications.
CO4	**Analyse** single phase induction motors and **identify** the suitable methods of starting.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2		1					2
CO2	3	3	2	2	2		1					2
CO3	3	3	2	2	2		1					2
CO4	3	3	2	2	2		1					2
Avg.	**3**	**3**	**2**	**2**	**2**		**1**					**2**

DETAILED SYLLABUS

Module I: Fundamentals of A.C. Machines (8 Lectures)

Fundamental principles of A.C. machines: E.M.F equation of an elementary alternator, single & three phase, factors affecting the induced e.m.f, full pitch & fractional pitch windings, winding factors, armature reaction, concept of time phasor & space phasor.

Module-II: Synchronous Generator (14 Lectures)

Various types and construction, cylindrical rotor theory, phasor diagram, open circuit & short circuit characteristics, armature reaction, synchronous reactance, SCR, load characteristics, potier reactance, voltage regulation, E.M.F. method, MMF method, ZPF method, power angle characteristics.

Theory of salient pole machine: Blondel's two reaction theory, phasor diagram, direct axis and quadrature axis synchronous reactance, power angle characteristics, slip test, parallel operation: Synchronizing method, effect of wrong synchronization, load sharing between alternators in parallel, transient & sub-transient reactances.

Module-III: Synchronous motor (8 Lectures)

General physical consideration, torque & power relations in salient and non-salient pole motors, V-curves & inverted V-curves, effect of change of excitation, synchronous condenser, stating of synchronous motor, performance characteristics of synchronous motor, hunting.

Module-IV: Single phase Induction motors (7 Lectures)
Induction type, Double revolving field theory, equivalent circuit, characteristics & starting of single phase motor, shaded pole machine, synchronous type, hysteresis motor, reluctance motor.

Module V: Single phase special type of machines (3 Lectures)
Switched reluctance motor, PMBLDC motor, tachometer, two phase control motor, Synchro.

Text Books:

[1]. Electric Machines by I.J.Nagrath & D.P.Kothari,Tata Mc Graw Hill, 7th Edition.2005
[2]. Electrical machines by PS Bhimbra, Khanna Publishers.
[3]. Electric machinery by A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw Hill Companies, 5th edition.
[4]. Electric Machinery Fundamentals by Stephen Chapman Mc Graw Hill Company.

Reference Books:

[1]. Theory of Alternating Current Machinery- by Langsdorf, Tata McGraw-Hill Companies, 2nd edition.
[2]. Performance and Design of AC Machines by M G. Say, BPB Publishers.

EEP504	INDUSTRIAL ELECTRICAL SYSTEMS	2L:1T:0P	3 Credits

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

CO's	CO Description
CO1	**Understand** the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and single line drawings.
CO2	**Understand** various components of industrial electrical systems.
CO3	**Analyse and select** the proper size of various electrical system components.

COs-POs Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below-
1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3									1
CO2	3	3	3									1
CO3	3	3	3		2							1
Avg.	**3**	**3**	**3**		**2**							**1**

DETAILED SYLLABUS

Module I: Electrical System Components (10 Lectures)
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Module II: Residential and Commercial Electrical Systems (8 Lectures)
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Module III: Illumination Systems (6 Lectures)
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Module IV: Industrial Electrical Systems I (8 Lectures)
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Module V: Industrial Electrical Systems II (8 Lectures)
DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.
Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books:

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

EEP505	NON-CONVENTIONAL ENERGY SYSTEM	2L:1T:0P	3 Credits

Course Outcome:
After successful completion of the course students will be able to:

CO1	**Identify** different non-conventional energy system and **explain** the principle of thermo-electrical and thermionic conversions
CO2	**Analyse** the performance and limitations of the solar and wind energy conversion system
CO3	**Illustrate** the concept of geothermal energy.
CO4	**Outline** the basics of fuel cells.
CO5	**Understand** the principles behind the bio-mass, ocean thermal and wave energy conversions.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1	1		1					1
CO2	3	2	2	2	1		1					1
CO3	1	1		1	1		1					1
CO4	2	1	1	1	1		1					1
CO5	2	1	1	1	1		1					1
Avg.	**2.2**	**1.2**	**1.33**	**1.2**	**1**		**1**					**1**

DETAILED SYLLABUS

Module I: Introduction (6 Lectures)

Basics of energy, conventional energy sources, fossil fuels limitations, renewable energy sources, advantages and limitations, global energy scenario, energy scenario of India, new technologies (hydrogen energy, fuel cells, bio fuels).

Module II: Solar Energy (12 Lectures)

Theory of solar cells, solar cell materials, I-V characteristics of solar cell, PV module, PV array, MPPT, PV systems, Stand alone and grid connected PV systems, storage, PV based water pumping, solar radiation and its measurement, flat plate collectors and their materials, applications and performance, solar thermal power plants, limitations.

Module III: Wind Energy (8 Lectures)

Wind power and its sources, site selection, power in the wind, impact of tower height, classification of wind turbine and rotors, wind energy extraction, betz'z limit, wind characteristics, performance and limitations of wind energy conversion systems.

Module IV: Biomass and Geothermal energy (8 Lectures)

Availability of biomass and its conversion theory, types of biomass, gasification, biogas plant, biomass cogeneration, resources of geothermal energy, thermodynamics of geo-thermal energy conversion, geothermal power generation, environmental considerations.

Module V: Emerging technologies for power generation (6 Lectures)

Introduction to tidal energy, tidal characteristics, tidal power plant, tidal power development in India, introduction to wave energy, factors affecting wave energy, principles of wave energy plant, OTEC, applications of OTEC, principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, Emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.

Text/Reference Books:

[1]. Duffie and Beckmen, Solar Engineering of Thermal Processes, Wiley Publications, 1991.
[2]. S. P. Sukhatme, Solar Energy, TMH, India. 2008.
[3]. John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.
[4]. D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India, 2011.
[5]. Non Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd., 2006.

EEP506	POWER QUALITY	2L:1T:0P	3 Credits

Course Outcomes:

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

COs	CO Description
CO1	To understand the various power quality issues.
CO2	Evaluate the power quality indices used in industrial power system.
CO3	Understand various mitigation techniques for compensating devices to improve the power quality.
CO4	Simulate the compensating devices to improve the power quality

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
Avg.	**2**	**3**	**3**	**2.33**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**

DETAILED SYLLABUS

Module - I: Overview of Power Quality (10 Lectures)

Classification of power quality issues, characterization of electric power quality, power acceptability curves – power quality problems: poor load power factor, non linear and unbalanced loads, dc offset in loads, notching in load voltage, disturbance in supply voltage, flicker, transient phenomenon, voltage fluctuations, sags/swells, voltage unbalance, power quality indices, distortion index, C-message index, IT product, IEEE guides and recommended practices.

Module- II: Measurement and Analysis Methods (8 Lectures)

Voltage, current, power and energy measurements, power factor measurement and definitions, time domain methods, Instantaneous Reactive Power Theory, Synchronous Frame Theory, Synchronous Detection Method, instantaneous symmetrical components, Instantaneous real and reactive powers

Module- III: Harmonics & Voltage Fluctuations (8 Lectures)

Sources and effect of harmonics and inter harmonics, voltage fluctuations, flicker and impulses, flicker calculations, effect of voltage fluctuations and impulses, occurrence and causes of voltage unbalance, standardization, decomposition into symmetrical components.

Module IV: Power Quality Improvement-I (8 Lectures)

Utility- Customer interface, harmonic filter: passive, active and hybrid filter, compensation using shunt devices-DSTATCOM, voltage regulation using DSTATCOM, principle, working and construction, algorithms for control of DSTATCOM, some case study examples.

Module V: Power Quality Improvement-II (8 Lectures)

Series compensation, protecting sensitive loads using DVR, principle, working construction and control schemes for DVR, hybrid devices –UPQC, principle, working and construction, some case study examples.

Text /reference Books:

[1]. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh, Gerard Ledwich, Springer, 2009
[2]. Power Quality: VAR Compensation in Power Systems R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2008
[3]. Understanding Power Quality Problems: Voltage Sags and Interruptions, Math H.J. Bollen, Wiley India Pvt Ltd, 2011.
[4]. Power Quality: Mitigation Technologies in a Distributed Environment,A Moreno Munoz, Springer India Private Limited 2007.
[5]. Power System Quality Assessment J.Arrillaga, N.R.Watson, S.Chen, Wiley India Pvt Ltd, 2011.

CSO501	ARTIFICIAL INTELLIGENCE	2L:1T:0P	3 Credits

Course Outcomes:

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

COs	CO Description
CO1	To understand the various Programming, Commands and Syntax.
CO2	Understand initial Data Analysis, Relationship between attributes: Covariance, Correlation Coefficient
CO3	Understand Data Pre-processing and Preparation.
CO4	Understand Data Quality and Transformation

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
Avg.	**2**	**3**	**3**	**2.33**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**

Module I: (10 Lectures)

Data Science, AI & ML, Use Cases in Business and Scope, Scientific Method, Modeling Concepts, CRISP-DM Method.

Module II: (10 Lectures)

Programming, Commands and Syntax, Packages and Libraries, Introduction to Data Types, Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data. Control structures and Functions, Descriptive Statistics, Data exploration (histograms, bar chart, box plot, line graph, scatter plot), Qualitative and Quantitative Data, Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Anscombe's quartet Other Measures: Quartile and Percentile, Interquartile Range

Module III: (10 Lectures)

Initial Data Analysis, Relationship between attributes: Covariance, Correlation Coefficient, hi Square, Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs Probability, Probability (Joint, marginal and conditional probabilities), Probability distributions (Continuous and Discrete), Density Functions and Cumulative functions

Module IV: (10 Lectures)

Gather information from different sources. Internal systems and External systems. Web APIs, Open Data Sources, Data APIs, Web Scrapping, Relational Database access (queries) to process/access data Data Pre-processing and Preparation, Data Munging, Wrangling Ÿ Plyr packages, Cast/Melt

Module V: (10 Lectures)

Data Quality and Transformation, Data imputation, Data Transformation (minmax, log transform, z-score transform etc.). Binning, Classing and Standardization. Outlier/Noise& Anomalies Bag-of-words, Regular Expressions, Sentence Splitting and Tokenization, Punctuations and Stop words, Incorrect spellings, Properties of words and Word cloud, Lemmatization and Term-Document TxD computation, Sentiment Analysis (Case Study)

Text Books:

1. Hawkins, J. and Blakeslee, S. On Intelligence. Times Books, 2004.
2. Dean, T., Allen, J. & Aloimonos, Y., Artificial Intelligence theory and practice. New York: Benjamin Cummings (1995).
3. Ginsberg, M., Essentials of Artificial Intelligence. Palo Alto, CA: Morgan Kaufmann (1993).
4. Luger, G. F., & Stubblefield, W. A., Artificial Intelligence - Structures and Strategies for Complex Problem Solving. New York, NY: Addison Wesley, 5th edition (2005).
5. Poole, D., Mackworth, A., and Goebel, R. Computational Intelligence - A Logical Approach. New York: Oxford University Press. (1998).
6. Nilsson, N. J. Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann. (1998).

ITO502	INTERNET-OF-THINGS	2L:1T:0P	3 Credits

Course Outcomes:

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

COs	CO Description
CO1	To understand the various Defining and Characteristics of IoT.
CO2	Understand difference between IoT and M2M.
CO3	Understand Wireless medium access issues, MAC protocol.
CO4	Understand Home automation and Industry applications.
CO5	Developing applications through IoT tools

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
CO5	2	-	3	2	-	2	-	-	-	-	-	-
Avg.	**2**	**3**	**3**	**2.33**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**

Module I: (10 Lectures)

Introduction to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

IoT & M2M

Machine to Machine, Difference between IoT and M2M, Software define Network

Module II: (8 Lectures)

Network & Communication aspects

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Module III: (6 Lectures)

Challenges in IoT

Design challenges, Development challenges, Security challenges, Other challenges

Module IV: (8 Lectures)

Domain specific applications of IoT

Home automation, Industry applications, Surveillance applications, Other IoT applications

Module V: (8 Lectures)

Developing IoTs

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

Text/Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

ECO503	COMMUNICATION ENGINEERING	2L:1T:0P	3 Credits

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

CO's	CO Description
CO1	**Analyse** and compare different Analog modulation schemes for their efficiency and bandwidth.
CO2	**Analyse** the behaviour of a communication system in presence of noise.
CO3	**Investigate** pulsed modulation system and analyse their system performance.

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CO's-PO's Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	3	2								2
Avg.	**3**	**2.66**	**3**	**2**	**1**		**1**					**2**

Module – I:
Review of Fourier transform and Fourier series.

Amplitude modulation: (8 Lectures)

Frequency domain representation of signals, Need of Modulation, normal AM, modulation index, Generation and demodulation- envelop and synchronous detector, DSB-SC: Generation and demodulation, SSB: Generation and Demodulation, Concept of VSB modulation, Frequency Division multiplexing.

Module – II: Angle Modulation (7 Lectures)

Representation of FM and PM signals, Spectral characteristics of angle modulated signals, frequency deviation and modulation index, Narrowband FM, Generation of wideband FM-Armstrong method, Direct method, Demodulation of WBFM using PLL.

Module - III: Noise (6 Lectures)

Review of probability and random process, Type of Noise, Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module– IV: Pulse modulation: (9 Lectures)

Sampling Theorem, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) - their generation and detection, Time Division Multiplexing.

Digital communication:

Pulse code modulation (PCM), Differential pulse code modulation (DPCM), Delta modulation, Noise considerations in PCM, Digital Modulation – ASK, BPSK, BFSK.

Mod – V: Optical communication: (10 Lectures)

Types of optical fibers - step index and graded index, multimode and single mode; Attenuation and Dispersion in fibers; Optical transmitters – LEDs and Laser Diode; Optical Receivers- PIN and APDs, Fiber optic links.

Microwave communication:

Transmitter and Receiver antennas, Line of Sight Systems, Satellite Link-G/T Ratio of earth station, VSATS and GPSS, TDMA, FDMA, CDMA.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
7. Keiser Gerd, " Optical Fiber Communication", 2nd Edition, McGraw Hill, 1991.
8. Liao, "Microwave Devices and circuits", prentice Hall of India.

EE501P	POWER SYSTEMS-II Lab	0L:0T:2P	1 Credits

(Any 10)

1. To obtain the DC Transmission line characteristics in different load resistance.
2. To obtain the correct phase sequence of three phase system.
3. To improvement of power factor control mechanism using APFC-relay kit.
4. Determination of positive, negative and zero-sequence reactance of 3-phase transformer using sequence current excitation fault calculation.

5. To study three different transmission line models.
6. Study of different types of insulators.
7. To measurement of Earth Resistance using Earth Tester.
8. Study of different types of Earthing.
9. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay.
10. Polarity, Ratio and Magnetisation Characteristics Test of CT & PT.
11. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay.
12. Study on D C Load Flow.
13. Study of A C Load Flow Using Gauss – Seidel Method.
14. Study of A C Load Flow Using Newton Raphson Method.
15. Study on Economic Load Dispatch.
16. Study of Generator Protection by Simulation.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE502P	**CONTROL SYSTEM LAB**	**0L:0T:2P**	**1 Credits**

(Any 10)

1. To study and perform the synchro transmitter and receiver system as an indicating instrument.
2. To study the performance of stepper motor in
   (a) Wave drive mode
   (b) Full wave mode
   (c) Half wave mode
3. Demonstration of Pneumatic trainer kit.
4. Demonstration of Single and Double Acting Cylinder using Pneumatic Trainer Kit.
5. To study the "Proportional- Integral-Derivative (PID)" control for a temperature process controller using process control software.
6. To study the DC Servo Motor position control system.
7. To study the operation of a Proportional, Proportional-Integral (PI) Proportional-Derivative (PD) and Proportional- Integral-Derivative (PID) control systems.
8. To study the "Proportional-Integral-Derivative (PID)" control action for a using Matlab Simulink Software.
9. Study the effect of PI & PD controller on system performance.
10. VFD based Speed Control of Three Phase Induction Motor Using PLC.
11. Study of a DC Speed control system and determination of transfer function of a permanent magnet dc motor.
12. Study of a two-phase AC servomotor and its transfer function parameters.
13. Find the frequency response of a Lag and Lead compensator.
14. To observe the time response of a second order process with P, P+I, P+I+D control and apply PID control to a DC servomotor.
15. To study the characteristic of a relay and analyse the relay control system (Phase Plane).
16. Study of a DC position control system

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE503P	ELECTRICAL MACHINE-II LAB	0L:0T:2P	1 Credits

(Any 10)

1. To plot the 'V' and 'inverted ^' curves of Synchronous motor.
2. To conduct the direct load test on the given three phase induction motor to determine and plot its performance characteristics.
3. To determine the equivalent circuit parameters of a single phase induction motor by performing the no- load and blocked rotor tests.
4. To conduct the direct load test on the given single phase induction motor and to determine and plot its performance characteristics.
5. To Study The Synchronization Of Alternator With Infinite Bus By Bright Lamp Method.
6. To study about the various types of AC starters.
7. Brake Test on Slip Ring Induction Motor.
8. No-load and block rotor tests on squirrel cage induction motor.
9. Equivalent circuit of single phase induction motor.
10. Regulation of alternator by synchronous impedance method and MMF method.
11. Regulation of alternator by Zero Power Factor method.
12. Determination of X_d and X_q of a salient pole synchronous machine from slip test.
13. Determination of sub-transient reactance of Salient Pole Synchronous Machine.
14. Determination of sequence impedances of Salient Pole Synchronous Machine.
15. Rotor resistance starter for slip ring induction motor.
16. Parallel operation of Alternators.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE504P	ELECTRICAL AND ELECTRONICS WORKSHOP LAB	0L:0T:2P	1 Credits

(Any 10)

1. To understand & draw the symbols of various electronic devices and to identify resistors, capacitors using different codes.
2. Verification of truth tables of logic gates (NAND, NOR, EX-OR, AND, OR, NOT).
3. To study cathode ray oscilloscope and perform measurements.
4. To study digital multi-meter and perform testing of various components.
5. To study function generator & power supply and perform measurements.
6. To study soldering- de-soldering techniques.

7. To study wiring diagram of ceiling fan.
8. How fluorescent lights work.
9. To study about stair case wiring two way switch.
10. To study half – wave rectifier.
11. To study stair case wiring and circuit of SMPS.
12. To study house wiring i.e, BATTEN, CLEAT, CASING-CAPING AND CONDUIT WIRINGS.
13. To study moving iron, moving coil, electro-dynamic and induction type meter.
14. To study circuit and working of UPS
15. To study circuit and working of home inverter
16. To study fuses MCBS and importance of earthing.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EEC601	POWER ELECTRONICS	3L:1T:0P	4 Credits

Course Outcomes:

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

CO's	CO Description
CO1	To **understand** different power semiconductor devices and their switching characteristics.
CO2	To **understand** the operation, characteristics and performance parameters of AC to DC Converters.
CO3	To **study** the operation, switching techniques and basic topologies of DC-DC Converters
CO4	To learn the different modulation techniques of PWM inverters and to **understand** commutation techniques.
CO5	To **study** the operation of AC voltage controller and various configurations.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1		1					1
CO2	2	2	3	3	2		1					1
CO3	2	2	3	2	1	1	1					1
CO4	2	3	2	2	2	1	1					1
CO5	2	3	3	2	1	1	1					1
Avg.	**2.2**	**2.4**	**2.6**	**2.2**	**1.4**	**1**	**1**					**1**

DETAILED SYLLABUS

Module I: Power Semiconductor Devices (9 Lectures)

Diode, Thyristor, MOSFET, IGBT, GTO: constructional features, I-V Characteristics; Firing circuit for thyristor; protection of thyristor and gate drive circuit, Turn on techniques, Voltage and current commutation of a thyristor.

Module II: AC-DC Converters (9 Lectures)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge thyristor rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Module III: DC-DC Buck and Boost Converter (9 Lectures)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module IV: Single-Phase Voltage Source Inverter (9 Lectures)
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, sinusoidal pulse width modulation, modulation index and output voltage**.**

Module V: Three-Phase Voltage Source Inverter (9 Lectures)
Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, 120- degree conduction, 180-degree conduction, three-phase sinusoidal pulse width modulation

Text/References Books:

[1]. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
[2]. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design",
John Wiley & Sons, 2007.
[3]. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science
&Business Media, 2007.
[4]. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

EEC602	SIGNALS AND SYSTEMS	2L:1T:0P	3 Credits

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

CO's	CO Description
CO1	**Understand** the concepts of continuous time and discrete time systems.
CO2	**Analyze** systems in complex frequency domain.
CO3	**Understand** sampling theorem and its implications

.

CO's-PO's Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below-
1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	3	2								2
Avg.	**3**	**2.66**	**3**	**2**								**2**

DETAILED SYLLABUS

Module-I Introduction and Classification of signals (8 Lectures)

signals: Definition, Continuous time and discrete time signals, Elementary Continuous time signals and Disccrete time signals or sequences:, step, ramp, impulse, exponential, sine, , rectangular, triangular, signum, Sinc functions. Classification of signals as even and odd, periodic and aperiodic, deterministic and non-deterministic, energy and power. Operations on signals: time reversal, time shifting, Amplitude scaling, time scaling ,addition, multiplication, etc. and. Systems: Definition, Classification: Continuous time and discrete time systems ,linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable.

Module-II Continuous and discrete time LTI systems : (8 Lectures)

Impulse response and step response , Convolution, input- output behavior with aperiodic convergent inputs, cascade interconnections , characterizations of causality and stability of LTI systems, System representation through differential equations and difference equations . State- space representation of systems . state space analysis , multi input , multi output representation.State transition matrix and its role .

Module-III Fourier analysis of Continuous time & Discrete time signals and systems (8 Lectures)

Fourier series , Fourier transform and its properties, Parseval's Theorem , Frequency response of LTI systems, Discrete time Fourier transform and its properties, Frequency response of Discrete time LTI systems. Sampling theorem, Sampling of Continuous time signals, sampling by impulse functions, Signal reconstructions.

Module-IV Laplace Transform (8 Lectures)

Laplace transform and inverse Laplace transform , Properties of Laplace-transform, existence conditions , Region of convergence (ROC) and its properties, Application of Laplace transform for the analysis of Continuous time LTI system, significance of poles and zeros.

Module-V Z-Transforms: (8 Lectures)

z-transform and its inverse , Properties of z-transform, existence conditions , Region of convergence (ROC), Application of Z- transform for the analysis of Discrete time LTI systems, Significance of Poles and Zeros.. inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform.

Text/References Books :

[1].Haykin. S., Venn B. V. Signals and Systems
[2].Oppenheim A.V., Willsky A.S. &Nawab S.H., Signals and Systems, Tata McGraw Hill
[3].Taylor F.H, Principles of Signals and Systems, McGraw Hill
[4].Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill
[5].Haykin S., Communication Systems, John Wiley
[6].Lathi B.P., Modern Digital& Analog Communication Systems, Oxford University Press
[7].Papoulis A., Fourier Integral & Its Applications, McGraw Hill

EEC603	MICROPROCESSORS AND MICROCONTROLLER	2L:1T:0P	3 Credits

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

CO's	CO Description
CO1	**Understand** the concepts of addressing modes & instruction set of 8085 & 8051.
CO2	**Develop** skills in simple program writing in assembly languages.
CO3	**Understand** commonly used peripheral/ interfacing ICs.
CO4	**Understand** typical applications of micro-processors and micro-controllers.

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CO's-PO's Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	3	2								2
CO4	3	2	2	2	1		1					1
Avg.	**3**	**2.66**	**3**	**2**	**1**		**1**					**2**

Module I: Fundamentals of Microprocessors: (11 Lectures)
Fundamentals of 8 bit Microprocessor: Architecture, pin description, Timing diagram, Instruction set, ,Overview of 8085 Microprocessor, Data Transfer Scheme, Memory Basics of Memory and I/O Interfacing, Data Transfer Scheme (Serial & parallel data transfer scheme, Programmed & interrupt driven data transfer, Direct memory access, Programmable peripheral devices), Programmable interval timer, Analog input-output using AD & DA converter.

Module II: Fundamentals of Microcontrollers (5 Lectures)
8-bit Microcontroller architecture, Comparison of Microprocessor and Microcontrollers, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.

Module III:The 8051 Architecture (8 Lectures)
Architecture of 8051, Internal Block Diagram, CPU, ALU, address, data and control bus, Pin description, I/O configuration, interrupts; Interrupt structure and interrupt priorities, Port structure and operation, Accessing internal & external memories and different mode of operations, Memory organization, Timing diagrams and Execution Cycles, Data and Program Memory,

Module IV: Instruction Set and Programming (8 Lectures)
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing,

Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, Assemblers and compilers. Programming and debugging tools.

Module V: Memory and I/O Interfacing (12 Lectures)

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

External Communication Interface

Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. Module6: Applications (06 Hours) LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Text/References Books :

[1]. 0000 to 8085 – Introduction to Microprocessor for Scientists & Engineers by Ghosh & Sridhar, PHI publication (for Module I to Module – III)
[2]. Advanced Microprocessor and Peripherals (Architecture, Programming & Interfacing) by A.K. Roy & K.M. Bhurchandi – TMH Publication (For Module-V to Module- VII)
[3]. The 8051 Microcontroller & Embedded Systems by Mazidi & Mazidi – Pearson / PHI publication (For Module-IV)
[4]. Microcontrollers [theory and applications] TMH publication by Ajay V. Deshmukh. (Chapter – 2 to Chapter – 6)
[5]. Microprocessors and programmed logic (2nd Edition), Pearson Education by Kenneth L. Short

EEP604	HIGH VOLTAGE ENGINEERING	2L:1T:0P	3 Credits

Course Outcomes:

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

CO's	CO Description
CO1	**Read** the terms and numerical methods used in High Voltage engineering.
CO2	**Discuss** the different breakdown mechanisms in dielectrics and liquids.
CO3	**Analyse** the concept of Generation of High Voltages, High Currents, Impulse voltages and currents.
CO4	**Outline** the techniques employed in High Voltage Measurements.
CO5	**Generalize** with non-distractive test techniques in High Voltage Engineering.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	2	2		1								
CO3		2	3		2							
CO4	1		3		2							

CO5	2	2	2		2							
Average	**2**	**2**	**2.7**	**1**	**2**							

DETAILED SYLLABUS

Module I: Introduction (6 Lectures)

Introduction to High voltage Engineering, its scope, Latest Trends, HVDC Transmission. Introduction, breakdown in gases, Townsend's criterion for breakdown, numerical. Streamers theory, Paschen's law, time lag for break down, breaks down under ac voltage, impulse voltage. Break down in electro negative gases, vacuum break down.

Module II: Generation of high voltage (10 Lectures)

Generation of HVAC: Different methods for generation of HVAC in lab, comparison between power and testing transformer, Cascaded transformer method, Resonant transformers, numericals. Generation of HVDC: Rectifier circuits, electrostatic generator, Cockroft Walton voltage multiplier circuit, numericals. Generation of Impulse voltage: Impulse wave and its characteristics, different forms of impulse wave, Different types of impulse generator circuits and their analysis. Multi stage impulse generator, its construction, layout, triggering and synchronization, numericals.

Module III: High Voltage Measurement (6 Lectures)

Purpose of HV testing in lab, sphere gap its construction, working. Use of sphere gaps in HV measurement, factors affecting measurement by sphere gap. CRO- their types, principle and working, recurrent surge oscillograph, measurement using CRO.

Module IV: Over Voltages (12 Lectures)

Origin and characteristics of over voltages on transmission lines, wave propagation, use of modal theory in wave propagation. Reflection and refraction of voltage and current waves over the line, Lattice diagram, Ferro resonance, numerical. External over voltages- Lightning over voltages, theories about lightning, development of lightning stroke, direct and indirect stroke, line model for lightning. Protection against over voltages, use of ground wire, tower footing resistance, lightning arrestors, etc. Insulation co ordination.

Module V: Testing of Insulators (6 Lectures)

Definitions of various terms used in testing, testing of insulators, power transformers, cables. Non destructive Testing- Use of Schering Bridge, Partial discharge technique for testing of insulation.

Text/Reference Books:

[1]. Khalifa **, "**High Voltage Engineering**",** Marcel Dekker; 1st Printing edition,1990.
[2]. Kuffel, **"**High Voltage Engineering**",** Newnes,2000.
[3]. R.D. Begamudre, "EHV AC Transmission Engineering", New Age International,2011
[4]. Kamraju and Naidu, **"**High Voltage Engineering**",** Tata McGraw-Hill Education,2004.
[5]. C.L.Wadhwa, **"**High Voltage Engineering**",** New Age International,2007.

EEP605	ADVANCED CONTROL SYSTEMS	2L:1T:0P	3 Credits

Prerequisite: Control Systems

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Evaluate** the output of a digital system for a given input.
CO2	**Describe** the dynamics of a Linear, Time Invariant systems through difference equations.
CO3	**Analyse** digital systems using the Z-transformation, state space methods.
CO4	**Design** digital controllers for physical systems.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**					**1.5**

Module –I **(10 hours)**

Mathematical modelling of dynamic systems in state space, State space representation of Mechanical and electrical systems, State space representation of transfer functions, relations between state equation and transfer functions, Characteristics equation, egenvalue and eigenvector of state matrix, Solution of time-invariant state equation, determination of State Transition Matrix, Use of Cayley –Hamilton Theorem, Minimal Polynomial, Sylvester's interpolations, Controllability, Observability.

Module –II **(8 hours)**

Introduction to design of control systems in state space, design of phase lead and phase lag controllers in time and frequency domain, Pole placement design, State observers.

Module –III **(4 hours)**

Sampling and signal reconstruction: Definition and Evaluation of Z-Transform, Properties of Z-Transform, Inverse Z-Transform, Mapping between S-plane and Z-plane, System descriptions by difference equations.

Module –III **(10 hours)**

Sampled Data Control Systems: Transfer Function f discrete data systems, Pulse and Z-transform Functions, Transfer Function of discrete data systems with Cascade elements, Transfer Function of Zero- Order and 1st – Order Holds, Transfer Function of Closed Loop discrete data systems, State equations of discrete data systems, Solutions of discrete state equations, discrete state transition equations, Z-Transform solutions of discrete equations,

Transfer Function Matrix and the Characteristic equation, Stability Tests of discrete state equations, Bilinear Transformation Method, Direct Stability Tests.

Module – IV **(10 hours)**

Nonlinear Systems: Common Physical nonlinearities, The Phase-Plane Method, Basic concepts, singular Points, Stability of nonlinear systems, Construction of Phase trajectories, Construction by analytical and graphical methods, System analysis by Phase Plane Method, The Describing function Method: Basic concepts, derivation of describing functions for common nonlinearities, Stability analysis by Describing Function approach, jump resonance, Lyapunov Stability Criterion, Popov's Stability Criterion.

Text Books

1. Modern Control Engineering, K. Ogata (PHI)
2. Automatic Control System, B.C. Kuo (PHI)
3. Digital Control of Dynamic Systems, G. Franklin, J.D Powell, M. Workman (Pearson)

EEP606	DIGITAL CONTROL SYSTEMS	2L:1T:0P	3 Credits

Prerequisite: Control Systems

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Evaluate** the output of a digital system for a given input.
CO2	**Describe** the dynamics of a Linear, Time Invariant systems through difference equations.
CO3	**Analyse** digital systems using the Z-transformation, state space methods.
CO4	**Design** digital controllers for physical systems.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**					**1.5**

DETAILED SYLLABUS

Module I: Sampling and Reconstruction **(8 Lectures)**

Introduction, Examples of Data control systems, Sampler, Sampling Theorem, Signal Reconstruction-Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

Module II: The Z – Transforms (8 Lectures)

Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, inverse Z-transforms, Z-Transform method for solving difference equations; Pulse transforms function

Module III: State Space Analysis (12 Lectures)

State variables, State model for linear continuous-time system. Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, State Space Representation of discrete time systems, Matrix solving discrete time state space equations, Discretization of continuous time state – space equations

Module IV: Controllability, Observability & Stability (8 Lectures)

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability, Transfer matrix. Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation.

Module V: State Feedback Controller (4 Lectures)

Design of state feedback controller through pole placement – Necessary and sufficient conditions.

Text Books:

[1]. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition
[2]. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

Reference Books:

[1]. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison-Wesley Longman, Inc., Menlo Park, CA , 1998.
[2]. Digital Control and State Variable Methods by M.Gopal, TMH.

CSO601	SOFT COMPUTING TECHNIQUES	2L:1T:0P	3 Credits

Course Outcomes:

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

CO1	**Distinguish** the concept between the hard and soft computing techniques.
CO2	**Understand** the basic concept of the Artificial Neural Network (ANN).
CO3	**Understand** the basic concept of the fuzzy logic system
CO4	**Explain** the concept of Genetic Algorithm (GA) and its limitation.
CO5	**Choose** the different kind of evolutionary programming for multi objective optimization problem based on their application.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	1	2							2
CO2	3	3	3	2	2							2
CO3	3	3	3	2	2							2
CO4	3	3	3	3	2							2
CO5	3	3	3	2	2							2
Avg.	**3**	**3**	**3**	**2**	**2**							**2**

DETAILED SYLLABUS

Module I: Fundamentals of Soft Computing Techniques (8 Lectures)

Conventional and Modern Control System, Intelligence, Soft and Hard Computing, Artificial Intelligence.

Module-II: Artificial Neural Network (10 Lectures)

Introduction to Artificial neural networks-biological neurons, Basic models of artificial neural networks- Connections, Learning, Activation Functions, McCulloch and Pitts Neuron.

Learning rule- Hebbian Learning, Perceptron Learning, Delta Learning- Training and Testing algorithm, Adaptive Linear Neuron, Back Propagation Network – Architecture, Training algorithm.

Module-III: Fuzzy Logic System-I (8 Lectures)

Fuzzy Logic- Fuzzy sets- Properties- Operation on fuzzy sets, fuzzy relations- operations on fuzzy relations.

Fuzzy membership functions, fuzzification, Methods of membership value assignments- intuition- inference- rank ordering, Lambda- cuts for fuzzy sets, Defuzzification methods.

Module –IV: Fuzzy Logic System-II (8 Lectures)

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules – Decomposition of rules- Aggregation of rules, Fuzzy Inference Systems- Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – characteristics- classification

Module-V: (6 Lectures)

Introduction to genetic algorithm, operators in genetic algorithm – coding – selection – cross over – mutation, Stopping condition for genetic algorithm flow, Generational Cycle, Applications. Evolutionary Programming, Multi-objective Optimization Problem Solving and its applications, Genetic- neuro hybrid systems, Genetic-Fuzzy rule based system.

Text Books:

[1]. N.P Padhy, Artificial Intelligence and Intelligent Systems- Oxford University Press.

[2]. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing- Wiley India.
[3]. Timothy J. Ross, Fuzzy Logic with engineering applications – Wiley India.
[4]. M.E. E1- Hawary , Artificial Intelligence application in Power Systems, IEEE Press,2009
[5]. Jan Jantzen, Foundations of Fuzzy Control, A practical approach, Wiley,2013
[6]. M Gopal, Digital Control and State Variable Methods, conventional and neural-fuzzy control system, Published by Tata McGraw Hill Education Private Ltd,2012
[7]. David E Goldberg, Genetic Algorithms, published by Pearson 2008

Reference Books:

[1]. Satish Kumar, Neural Networks- Prentice Hall of India.
[2]. N. K. Sinha and M.M. Gupta, Soft Computing and Intelligent Systems: Theory & Applications- Academic Press/ Elsevier, 2009.
[3]. Simon Haykin, Neural Network- A comprehensive Foundation- PHI, Inc.
[4]. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/ Elsevier, 2007.

EEO607	POWER PLANT ENGINEERING	2L:1T:0P	3 Credits

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

CO's	CO Descriptions
CO1	**Describe** and **analyse** different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
CO2	**Analyse** the working and layout of thermal power plants and the different systems comprising the plant and **discuss** about its economic and safety impacts
CO3	To **define** the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.
CO4	**Discuss** and **analyse** the mathematical and working principles of different electrical equipment involved in the generation of power and to **understand** co-generation.
CO5	Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power and to understand co-generation.

CO's-PO's Mappings Matrix:

Enter correlation levels1, 2 or 3 as defined below-
1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	1		2					1

CO2	2	2	3	1	2		1					1
CO3	2		2	1		1	2					1
CO4	2		2	1		1	2					1
CO5	2	2	1	2	1	2	1					1
Avg.	**2**	**2.33**	**2**	**2.67**	**1.33**	**1.33**	**1.66**					**1**

DETAILED SYLLABUS

Module I: Introduction **(10 Lectures)**

Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine power plants, Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers.

Module II: Thermal Power Plants **(10 Lectures)**

Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps super heater- regenerator-condenser- de-aerators, cooling towers, electrostatic precipitators.

Module III: Hydel Power Plant **(8 Lectures)**

Principle of working, Classification, Site selection; Different components & their functions; Types of Dams;Types, Characteristics & Selection of Hydro-Turbines; Mini & Micro Hydro Power Plants, Pumped Storage Power Plants.

Module IV: Diesel And Gas Turbine Power Plant **(8 Lectures)**

Types of diesel plants, components, Selection of Engine type, applications. Gas turbine power plant- Fuels- Gas turbine material, open and closed cycles, reheating, Regeneration and inter cooling, combines cycle.

Module V: Co-Generation **(6 Lectures)**

Concept; Schemes; Brief Description; Benefits & Limitations; Applications. Non-Conventional Energy Sources, Types, Brief Description, Advantages & Limitations.

Text/Reference Books:

[1]. P.K.Nag, "Power Plant Engineering", Tata McGraw Hill Publications.2007

[2]. EI-Wakil M.M, "Power Plant Technology," Tata McGraw-Hill 1984

[3]. Power Plant Engineering, Gautam S, Vikas Publishing House. 2012

[4]. Power station Engineering and Economy by Bernhardt

[5]. G.A.Skrotzki and William A. Vopat- Tata McGraw Hill Publishing Company Ltd.2002

[6]. "Modern Power Station Practice", Volume B, British Electricity International Ltd., Central Electricity Generating Board,Pergamon Press, Oxford.1991

[7]. 'Power Plant Familiarization – Vol. II', NPTI Publication.

CSO602	IMAGE PROCESSING	2L:1T:0P	3 Credits

Course Outcomes:

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

COs	CO Description
CO1	To understand and be able to describe how digital images are represented, manipulated, encoded and processed.
CO2	Analyse algorithm design, implementation and performance evaluation.
CO3	Knowledge of Hardware and Software tools for Image Analysis.
CO4	Design and Analysis of Various Techniques and Process to Understand Image.
CO5	Application of Mathematics for Image Understanding and Analysis.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
CO5	2	-	3	2	-	2	-	-	-	-	-	-
Avg.	**2**	**3**	**3**	**2.33**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**

Module I: (6 Lectures)

For the complete syllabus, results, class timetable and more kindly download iStudy. It's a lightweight, easy to use, no images, no pdfs platform to make student's life easier.

Module II: (8 Lectures)

IMAGE ENHANCEMENT : Spatial Domain: Gray level transformations-Histogram processing-Basics of Spatial FilteringSmoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform-Smoothing and Sharpening frequency domain filters-Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Module III: (8 Lectures)

IMAGE RESTORATION : Image Restoration-degradation model, Properties, Noise models-Mean Filters-Order Statistics-Adaptive filters-Band reject Filters-Band pass Filters-Notch Filters-Optimum Notch Filtering-Inverse Filtering-Wiener filtering

Module IV: (8 Lectures)

For the complete syllabus, results, class timetable and more kindly download iStudy. It's a lightweight, easy to use, no images, no pdfs platform to make student's life easier.

Module V: (10 Lectures)

IMAGE COMPRESSION AND RECOGNITION: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation,

Boundary description, Fourier Descriptor, Regional Descriptors-Topological feature, Texture-Patterns and Pattern classes-Recognition based on matching.

Text/Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.
3. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
6. William K. Pratt, Digital Image Processing John Wiley, New York, 2002
7. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

EE601P	POWER ELECTRONICS LAB	0L:0T:2P	1 Credits

(Any 10)

1. Study of V-I characteristics of DIODE, ZENER, SCR, DIAC, and TRIAC
2. Study of V-I characteristics of UJT, MOSFET, BJT.
3. Different methods of triggering of SCR

   (a) Phase controlled method

   (b) UJT triggering method

   (c) Cosine controlled triggering method
4. Study of TRIAC and full wave voltage control method of it.
5. 1 phase half wave and full wave full controlled converter with R, R-L and D.C motor load with / without freewheel diode
6. 3-phase half and full wave full controlled converter with R, R-L and D.C motor load with/ without freewheeling diodes
7. Study of characteristics curves of a 3 phase diode bridge.
8. Study of DC chopper with PWM controller
9. Study of SCR communication

(a) Forced communication

(b) Load communication

10. Study of single phase series inverter
11. Three phases IGBT based four quadrant chopper drive for D.C motor
12. Study of 1 phase cyclo converter
13. Speed control of a 1 phase Induction motor.
14. AC Voltage control by using TRIAC & DIAC.
15. Oscillation Chopper Circuit.
16. DC Supply using Diode (Hardware).

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE604P	Electrical Simulation Lab	0L:0T:2P	1 Credits

(Any 10)

1. Introduction to MATLAB and its basic commands.
2. Y bus formation for systems, without mutual coupling, by singular transformation.
3. Formation of Z-bus, using Z-bus build Algorithm without mutual
4. To find load flow solution of the given power system using Gauss-Seidel method theoretically for one iteration and obtain full solution using MATLAB.
5. To obtain original phasor from following symmetrical components of voltage in a 3phase system. The symmetrical components are as follows V_{ao}=3.282∟23.960, V_{a1}=14.842∟43.020, V_{a2}=5.766∟-108.720
6. The fuel cost functions for three thermal plants in $/h are given by
   $C_1 = 500 + 5.3\ P_1 + 0.004\ P_1^2$; P_1 in MW
   $C_2 = 400 + 5.5\ P_2 + 0.006\ P_2^2$; P_2 in MW
   $C_3 = 200 + 5.8\ P_3 + 0.009\ P_3^2$; P_3 in MW
   The total load , PD is 800MW.Neglecting line losses and generator limits, find the optimal dispatch and the total cost in $/h by analytical method. Verify the result using MATLAB program.
7. Find optimum loading of generators with penalty factor.
8. Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile.
9. Simulink model for evaluating transient Stability of single machine connected to Infinite bus.
10. To find dynamic response of the given single area load frequency control problem theoretically and to plot and verify the results in SIMULINK.
11. To find dynamic response of the given two - area load frequency control problem theoretically and to plot and verify the results in SIMULINK.
12. Determination of step & impulse response for a Type '0', Type '1', Type '2' systems.
13. Determination of step & impulse response for the first order and second order unity feedback system using Matlab Software.
14. To obtain following using Matlab Software
    a) Pole, zero, gain values from a given transfer function
    b) Transfer function model from pole, zero, gain values
    c) Pole, zero plot of a transfer function
15. Determination of Bode plot, Root Locus and Nyquist plot using Matlab control system toolbox for 2nd order system & obtain controller specification parameters using Matlab Software.
16. Study the effect of addition of poles and zeros to the forward path transfer function of a closed loop system.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE602P	SIGNALS AND SYSTEMS LAB	0L:0T:2P	1 Credits

(Any 10)

1. Generations and capturing various continuous time signals and plot them.
2. Generation and capturing of discrete time signals and plot them.
3. Discretization using different sampling rate and observing aliasing effect.
4. Simulation of continuous time LTI system.
5. Simulation of discrete time LTI systems.
6. Obtaining impulse response of the systems.
7. To study LPF & HPF, band pass and reject filters using RC circuits.
8. To study convolution theorem in time and frequency.
9. To compare Fourier and Laplace transformations of a signal.
10. Domain Computing FT and DTFT of the CT signals and DT sequences.
11. To study Z- transform of: a) Sinusoidal signals b) Step functions.
12. Study of Analog Filters Using Matlab
13. Experiment 10 : DFT & FFT algorithms using Matlab
14. Advanced Matlab Problems related to signals & systems

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE603P	MICROPROCESSORS	0L:0T:2P	1 Credits

	AND MICROCONTROLLER LAB		

(Any 10)

1. Simple arithmetic operations: 8 and 16 bit addition / subtraction / multiplication
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers
   (ii) Programs using Rotate instructions
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. Programming Practices with Simulators/Emulators/open source
6. Read a key , interface display
7. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Conditional jumps, looping (ii) Calling subroutines.
8. Programming I/O Port 8051
   (i) study on interface with A/D & D/A (ii) study on interface with DC & AC motor.
9. Interfacing matrix or keyboard to 8051.
10. Interfacing ADC and DAC to 8086
11. Parallel communication between two microprocessors using 8255.
12. Serial communication between two microprocessor kits using 8251.
13. Data transfer from peripheral to memory through DMA controller 8237/8257.
14. Mini project development with processors.

Electrical & Electronics Engineering

Semester -VII

Branch: Electrical & Electronics Engineering

S.N.	Code	Course Title	Lecture	Tutorial	Practical	Credits
1	ELC701	Protection of Power Apparatus Sy	3	0	0	3
2	PEC-III	Professional Elective-III	3	0	0	3
3	PEC-IV	Professional Elective-IV	3	0	0	3
4	OEC III	Open Elective-III	3	0	0	3
5	OEC IV	Open Elective-IV	3	0	0	3
6	EL701P	Power System Protection and	0	0	2	1
7	EE702D	Project Part - I	0	0	4	2
8	EE703I	Internship Assessment	0	0	2	2
					Total credits	20

Code	Professional Elective-III (Any one)	Code	Professional Elective-IV (Any one)
ELP702	Electrical Drives and Control	EEP704	Antennae & Wave Propagation
ELP703	Utilization of Electrical Power	ELP708	Smart Grid Technology
ELP705	Power Quality	ELP709	Electrical and Hybrid Vehicles
ELP707	HVDC Transmission and FACTS		

Code	Open Elective-III (Any one)	Code	Open Elective-IV(Any one)
ELO710	Soft Optimization Techniques	ELO713	Digital Signal Processing
ELO711	Illumination Technology	ELO714	Energy Storage Systems
ELO712	Process Instrumentation and Control	ELO715	Electrical machine and Power Systems

* Not for EEE Students

Semester -VIII

Branch: Electrical & Electronics Engineering

S.N.	Code	Course Title	L	T	P	Credits
1	EE801D	Project-II			16	08
					Total Credits	08

NOTE- A Student can be allowed to do project outside after the permission of departmental Academic Committee. Those students doing project outside has present their project progress every month. Those students doing project outside can be permitted to present progress every fortnight though video conferencing. Students doing project in house has present their project progress every week.

Electrical & Electronics Engineering

Electrical & Electronics Engineering			
ELC701	**Protection of Power Apparatus and System**	**L**	**T**
		3	**0**

Course Outcomes:

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

CO1: **Analyze** the need of power system protection and **classify** the different types of relay and their operating principle.
CO2: **Distinguish** the difference between the distribution line protection and transmission line protection.
CO3: **Explain** the protection of generator, busbar and transformer and its limitations.
CO4**: Select** the different kind of circuit breaker based on their application.
CO5: **Choose** different type of protective devices against overvoltage as well as for earthing purpose.

CO-PO Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2								1
CO2	3	2		2								1
CO3	2	1		2								1
CO4	3	3		3								1
CO5	3	3		2	3							1
Avg.	**2.8**	**2.4**		**2.2**	**3**							**1**

DETAILED SYLLABUS

Module – I **(5 Lectures)**

Basic concept & components of power system protection, types of relays-their operating principles, characteristics and their uses, Introduction to static relays and its advantages over electromagnetic relays.

Module – II **(8 Lectures)**

Protection of Alternators: Protection of generators against Stator faults, Rotor faults, and abnormal Conditions. Restricted earth fault and Inter-turn fault Protection. Numerical problems on % winding unprotected.

Module III **(8 Lectures)**

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT's Ratio, Buchholz relay Protection.

Module – IV **(8 Lectures)**

Protection of Lines: Over Current, Carrier Current and Three - zone distance relay protection using Impedance relays. Translay relay. Protection of Bus bars –differential Protection.

Module – V **(8 Lectures)**

Theory of arc interruption, types of circuit breakers – air, air-blast, minimum oil, vacuum & SF6, resistance switching, current chopping, auto-reclosing, circuit breaker ratings.

Protection against lightning over voltages - valve type and zinc - oxide lighting arresters,

Module – VI **(5 Lectures)**

Grounded and ungrounded neutral systems, methods of neutral grounding: solid, resistance, reactance, resonant grounding.

Text Books

1. Badri Ram, D. Vishwakarma, "Power System Protection and Switchgear", McGraw Hill, 2nd Edition.
2. Y.G. Paithankar, S.R. Bhide, "Fundamentals of Power System Protection", PHI, 2nd Edition
3. BhuvaneshOza, Nirmal-Kumar Nair, Rashesh Mehta, Vijay Makwana, "Power System Protection & Switchgear, McGraw Hill, 1st Edition.

Reference Books

1. Stanley H. Horowitz, Arun G. Phadke, James K. Niemira, "Power System Relaying", Wiley, 4th Edition.
2. R. van C. Warrington, "Protective Relays Their Theory and Practice", Springer, 1st Edition.

Electrical & Electronics Engineering			
ELP702	**Electrical Drives and Control**	**L**	**T**
		3	**0**

Course Outcomes:

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

CO1: **Classify electric** drives and their specific application in industry.
CO2: **Explain** the operation of electric traction, energy consumption and it's advantages.
CO3: **Make use of** electric heating based on induction principle.
CO4: **List** different light sources and illumination parameters.
CO5: **Demonstrate** electrolytic process and **design** motor control circuit.

COs-POs Mapping:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		1								1
CO2	3	3	1	1								1
CO3	3	3	2	1								1
CO4	3	3	3	1								1
CO5	3	3	3	1								1
Avg.	**3**	**3**	**2.25**	**1**								**1**

DETAILED SYLLABUS

Module – I: Introduction to Electrical Drives **(9 Lectures)**

Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Multi quadrant operation of drives. Load equalization.

Module – II: Starting and Braking of Electrical Drives **(9 Lectures)**

Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting. Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.

Module – III: Solid State Speed Control of DC Motor **(7 Lectures)**

Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. DC chopper drives.

Module – IV: Solid State Speed Control of Induction Motor **(7 Lectures)**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip

power recovery scheme – Using inverters and AC voltage regulators – applications, Static Scherbius drive, Static Kramer drive.

Module-V: Synchronous Motor Drive **(10 Lectures)**

Synchronous motor V/f control, Cycloconverter control, self-controlled synchronous motor drive. Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.

Text Books

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, New Age International Publication.

Reference Books

1. Electric motor drives, R. Krishnan, PHI
2. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
3. Electric Motor & Drives. Austin Hughes, Newnes.

Electrical & Electronics Engineering			
ELP703	**Utilization of Electrical Power**	**L**	**T**
		3	**0**

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

CO's-PO's Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below
2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3							1
CO2	3	2	2				2					1
CO3	3	2	2		2							1
CO4	3	2	2									1
CO5	3	2	2	2	2							1
Avg.	**3**	**2**	**2**	**2**	**2.33**		**2**					**1**

DETAILED SYLLABUS

Module I: Industrial Drives **(12 Lectures)**
Characteristics of electrical motors and their particular application for industrial drives. Motor enclosures, bearing, transmission of drives, choice of motor, motor used for lifts, cranes and general purpose machines, typical application in sugar, textile, paper and steel industries. Motors used in mining operations, rating of electric motors, calculation of size load equation of flywheels electric breaking; plugging, dynamic and regenerative breaking, breaking current, torque, speed time curves (number of revolutions made before stop)

Module II: Electrical Traction **(10 Lectures)**
General features and systems of track electrification, Tractive effort calculation of traction motors, traction motor control (series-parallel control).
Track equipment and collection gear, train movement, speed-time curve, Specific Energy Consumption (SEC) and factors affecting it.

Module III: Electric Heating **(5 Lectures)**
Introduction – Classification of methods of electric heating – Requirements of a good heating material – Design of heating element – Temperature control of resistance furnace – Electric arc furnace – Induction heating.

Module IV: Welding and Illumination **(13 Lectures)**

Dielectric heating – Electric welding – Resistance welding – Electric arc welding. Sources of light, incandescent and fluorescent lamps, Lighting Fittings, reflection factor illumination, calculation, solid angle, candle power, units of light and illumination, power curves, M. H. C. P and M. S. C. P. Illumination level and its measurement coefficient of utilization, waste light factor, illumination calculations for building and playgrounds, flood lighting, industrial lighting, Street lighting.

Module V **(2 Lectures)**

Electrolytic process and motor control circuit

Text Books:

1. "A first course on Electric Drives", S.K.Pillai, Wiley Eastern Ltd.
2. "Utilization of Electrical Energy", (S.I. Units), E.Open Shaw Taylor and V.V.L.Rao, Orient Long man.
3. "Generation, Distribution and Utilization of Electrical Energy", C.L. Wadhwa; Wiley Eastern Ltd.

Electrical & Electronics Engineering			
ELP705	**Power Quality**	**L**	**T**
		3	**0**

Course Outcomes:

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

COs	CO Description
CO1	To understand the various power quality issues.
CO2	Evaluate the power quality indices used in industrial power system.
CO3	Understand various mitigation techniques for compensating devices to improve the power quality.
CO4	Simulate the compensating devices to improve the power quality

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
Avg.	**2**	**3**	**3**	**2.33**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**

DETAILED SYLLABUS

Module - I: Overview of Power Quality (10 Lectures)

Classification of power quality issues, characterization of electric power quality, power acceptability curves – power quality problems: poor load power factor, non linear and unbalanced loads, dc offset in loads, notching in load voltage, disturbance in supply voltage, flicker, transient phenomenon, voltage fluctuations, sags/swells, voltage unbalance, power quality indices, distortion index, C-message index, IT product, IEEE guides and recommended practices.

Module- II: Measurement and Analysis Methods (8 Lectures)

Voltage, current, power and energy measurements, power factor measurement and definitions, time domain methods, Instantaneous Reactive Power Theory, Synchronous Frame Theory, Synchronous Detection Method, instantaneous symmetrical components, Instantaneous real and reactive powers

Module- III: Harmonics & Voltage Fluctuations (8 Lectures)

Sources and effect of harmonics and inter harmonics, voltage fluctuations, flicker and impulses, flicker calculations, effect of voltage fluctuations and impulses, occurrence and causes of voltage unbalance, standardization, decomposition into symmetrical components.

Module IV: Power Quality Improvement-I (8 Lectures)

Utility- Customer interface, harmonic filter: passive, active and hybrid filter, compensation using shunt devices-DSTATCOM, voltage regulation using DSTATCOM, principle, working and construction, algorithms for control of DSTATCOM, some case study examples.

Module V: Power Quality Improvement-II (8 Lectures)

Series compensation, protecting sensitive loads using DVR, principle, working construction and control schemes for DVR, hybrid devices –UPQC, principle, working and construction, some case study examples.

Text /reference Books:

1. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh, Gerard Ledwich, Springer, 2009
2. Power Quality: VAR Compensation in Power Systems R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2008
3. Understanding Power Quality Problems: Voltage Sags and Interruptions, Math H.J. Bollen, Wiley India Pvt Ltd, 2011.
4. Power Quality: Mitigation Technologies in a Distributed Environment,A Moreno Munoz, Springer India Private Limited 2007.
5. Power System Quality Assessment J.Arrillaga, N.R.Watson, S.Chen, Wiley India Pvt Ltd, 2011.

Electrical & Electronics Engineering			
ELP707	**HVDC Transmission and Facts**	**L**	**T**
		3	**0**

Prerequisite: Power Electronics, Power System-II

Course Outcome:-

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

COs	CO Description
CO1	**Compare** HVDC and EHVAC transmission systems
CO2	**Analyze** converter configurations used in HVDC and evaluate the performance metrics.
CO3	U**nderstand** controllers for controlling the power flow through a dc link and compute filter Parameters
CO4	**Apply** impedance, phase angle and voltage control for real and reactive power flow in ac transmission systems with FACTS controller

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	2	3	-	-	2	1	2	2	-	-	-	2
CO2	1	2	-	1	2	2	2	-	-	-	2	-
CO3	-	3	-	2	2	-	-	-	-	-	-	2
CO4	-	3	-	3	3	2	1	-	-	-	-	-
Avg.	**1.5**	**2.75**	**-**	**2**	**2.25**	**1.67**	**1.67**	**2**	**-**	**-**	**2**	**2**

DETAILED SYLLABUS

Module I: HVDC Power Transmission Technology (4 Lectures)

Evolution of HVDC transmission, Comparison of HVDC & HVAC system, Economics of power transmission, Technical performance, Reliability, Applications of HVDC transmission, Types of HVDC transmission links, Components of Converter station, Planning for HVDC transmission, Operating problems in HVDC system.

Module II: Analysis of HVDC converter (7 Lectures)

Introduction, Types of converters, Line commutated converter, Analysis of Line commutated converter, Choice of converter configuration for any pulse number, Analysis of voltage source converter, Basic 2-level Graetz bridge converter, 3 level voltage source converter, Converter charts.

Module III: HVDC System control (7 Lectures)

Principles of HVDC control links, Converter control characteristics, Control schemes & control comparisons, Firing angle control, current & Extinction angle control, Energization & de-energization of bridges, Starting & stopping of DC links, power control. Effects of Harmonics, sources of harmonic generation, Types of filters–Design examples

Module- IV: Flexible AC Transmission Systems (FACTS) (5 Lectures)
FACTS concepts and general system conditions: Power flow in AC systems, Relative importance of controllable parameters, Basic types of FACTS controllers, shunt and series controllers, Current source and Voltage source converters.

Module V: Static Shunt Compensators (8 Lectures)
Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics.

Module VI: Static Series Compensators (6 Lectures)
Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control.

Module VII: Combined Compensators (5 Lectures)
Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, Independent control of real and reactive power

Text Books:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. Narain G.Honorani, Laszlo Gyugyi: Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems, Wiley-IEEE Press, 2000.
4. Yong Hua Song, Allan T Johns: Flexible AC Transmission Systems, The Institution of electrical Engineers, 1999.

Reference Book:

1. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley Inter science, 1971.

Electrical & Electronics Engineering			
EEP704	**Antennae & Wave Propagation**	**L**	**T**
		3	**0**

Electrical & Electronics Engineering			
ELP708	**Smart Grid Technology**	**L**	**T**
		3	**0**

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

CO's	CO Description
CO1	**Understand** features of Smart Grid in the context of Indian Grid
CO2	**Assess** the role of automation in Transmission/Distribution
CO3	**Apply** Evolutionary Algorithms for the Smart Grid/Distribution Generation.
CO4	**Understand** operation and importance of PMUs, PDCs, WAMS, Voltage and Frequency control in Micro Grids

CO's- PO's Mapping:
Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	2	2	-	1	-	-	-	-	-	-
CO2	3	2	2	2	-	2	-	-	1	-	-	-
CO3	3	2	2	2	-	2	-	-	2	-	-	-
CO4	3	2	2	2	-	2	-	-	1	-	-	-
Avg.	**3**	**2**	**2**	**2**		**1.75**			**1**			

DETAILED SYLLABUS

Module I: **(5 Lectures)**
Introduction to Smart Grid, Architecture of Smart Grid System, Standards for Smart Grid System, Elements and Technologies of Smart Grid System.

Module II **(14 Lectures)**
Communication Technologies for Power System: Fiber Optical Networks, WAN base on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee. Information System for Control Centers (ICCS): ICCS Configuration, ICCS communication Network, ICCS Time Synchronization. E-Commerce of Electricity, GIS, GPS.

Module III **(8 Lectures)**
Integration, Control and Operation of Distributed Generation: Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Module IV: **(12 Lectures)**

Monitoring the smart grid: Load dispatch centers, wide-area monitoring system (WAMS), Phasor Measurement Unit(PMU), ;Smart sensors/telemetry, advanced metering infrastructure (AMI);smart metering; smart grid system monitoring; communication infrastructure and technologies; self-healing. Concept of Islanding.

Module V: (3 Lectures)

Micro grid: Integration of distributed energy sources; concept, operation, control and protection of Micro.

Text/Reference Books:

1. Smart power grids by A Keyhani, M Marwali.
2. Computer Relaying for Power Systems by Arun Phadke
3. Microgrids Architecture and control by Nikos Hatziargyriou
4. Renewable Energy Systems by Fang Lin Luo, Hong Ye
5. Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"grid. Hybrid Power Systems: Integration of conventional and non-conventional energy sources.

Electrical & Electronics Engineering			
ELP709	**Electrical and Hybrid Vehicles**	**L**	**T**
		3	**0**

Course Outcomes:

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

CO's	CO Description
CO1	**Demonstrate** the drive train and propulsion unit of hybrid vehicles and their performance
CO2	**Identify** the different possible ways of energy storage.
CO3	**Generalize** the different strategies related to energy management system.
CO4	**Design** the hybrid electric vehicle and battery electric vehicle.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	2	3	3	-	-	-	1	3
CO2	-	2	3	1	3	-	2	1	-	-	-	-
CO3	2	3	-	2	2	-	2	1	-	-	3	1
CO4	3	1	3	3	2	1	2	-	-	-	1	3
Total	**2.67**	**2**	**3**	**1.75**	**2.25**	**2**	**2.25**	**1**	**-**	**-**	**1.67**	**2.33**

DETAILED SYLLABUS

Module I: Introduction to Hybrid Electric Vehicles and Conventional Vehicles (3 Lectures)
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies; Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Module II: Hybrid Electric Drive-trains (6 Lectures)
Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Module III: Electric Propulsion Unit (9 Lectures)

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Module IV: Energy Storage (6 Lectures)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices, Electrical overlay harness and communications.

Module V: Sizing the Drive System (5 Lectures)

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology.

Module VI Energy Management Strategies (13 Lectures)

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, Rule and optimization based energy management strategies (EMS).

Case studies-Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", , John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton , "Electric and Hybrid Vehicles", Routledge, 2016.

Electrical & Electronics Engineering			
ELO710	**Soft Optimization Techniques**	**L**	**T**
		3	**0**

Pre-requisite: None

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	Descriptions
CO1	**Understand** the concepts of population based optimization techniques.
CO2	**Evaluate** the importance of parameters in heuristic optimization techniques.
CO3	**Apply** for the solution of multi-objective optimization.

COs-POs Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	-	-	-	-	-	2
CO2	3	3	2	1	2	-	-	1	-	-	-	2
CO3	3	3	2	1	2	-	-	1	-	-	3	2
Avg.	**3**	**3**	**2**	**1**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**2**

DETAILED SYLLABUS

Module I: Genetic Algorithm and Particle Swarm Optimization (12 Lectures)

Genetic algorithms- Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies - control parameters. Application to SINX maximization problem.

Module II: Ant Colony Optimization and Artificial Bee Colony Algorithms (10 Lectures)

Biological ant colony system - Artificial ants and assumptions - Stigmergic communications - Pheromone updating- local-global - Pheromone evaporation - ant colony system- ACO models- Touring ant colony system-max min ant system - Concept of elistic ants-Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC) algorithms-binary ABC algorithms.

Module III: Shuffled Frog-Leaping Algorithm and Bat Optimization Algorithm (10 Lectures)

Bat Algorithm- Echolocation of bats- Behavior of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse .

Emission- Shuffled frog algorithm-virtual population of frogs-comparison of memes and genes - memeplex formation- memeplex updation.

Module IV: Multi Objective Optimization (4 Lectures)
Application to multi-modal function optimization.Introduction to Multi- Objetive optimization-Concept of Pareto optimality.

Module V: Evolutionary Computing (6 Lectures)
Evolutionary Computing, Simulated Annealing, Random Search, Downhill Simplex Search.

Text Books/Reference:

1. Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation,Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb, Multi-Objective Optimization using Evolutionary Algorithms, John Wiley & Sons, 2001.
3. James Kennedy and Russel E Eberheart, Swarm Intelligence, The Morgan Kaufmann Series in Evolutionary Computation, 2001.
4. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, Swarm Intelligence-From natural to Artificial Systems, Oxford university Press, 1999.
5. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2007.
6. Konstantinos E. Parsopoulos and Michael N. Vrahatis, Particle Swarm Optimization and Intelligence: Advances and Applications, Information science reference, IGI Global, 2010.
7. N P Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005.

Electrical & Electronics Engineering			
ELO711	**Illumination Technology**	**L**	**T**
		3	**0**

Course Outcomes:

After successful completion of the course, students should be able to:

COs	CO Description
CO1	**Evaluate** the characteristics of illumination sources/devices.
CO2	**Understand** and determine the performance of various lighting systems.
CO3	**Design** of lighting controls and management.
CO4	**Understand** the standards of lighting systems and commissioning.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1.Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	-	-	-	-	-	2
CO2	3	3	2	1	1	-	-	1	-	-	-	2
CO3	3	3	2	1	1	-	-	1	-	-	3	2
CO4	3	3	2	1	1	-		1	-	-	-	2
Avg.	**3**	**3**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**

DETAILED SYLLABUS

Module I: Ballast based Systems **(6Lectures)**

Introduction - Magnetic and Electronic Ballast – Dimming Electronic Ballast for Fluorescent lamps - Lamp Ballast interactions – Electronic Ballast for HID Lamps - Pulse start metal halide system, Compact Fluorescent lamp.

Module II: Solid State Lamps **(13 Lectures)**

Introduction - Review of Light sources - white light generation techniques- Characterization of LEDs for illumination application. Power LEDs- High brightness LEDs- Electrical and optical properties – LED driver considerations.

Power management topologies- Thermal management considerations- Heat sink design- photometry and colorimetry - color issues of white LEDs- Dimming of LED sources -Designing usable lamp from white LEDs,- Luminaire design steps-SSL test standards. Dimming control scheme - Lighting controls for LED lamps.

Module III: Lighting Controls & Management **(8 Lectures)**

Introduction to lighting control – lighting control strategies - Energy Management strategies – Switching Control – sensor technology - occupancy sensors – PIR – Ultrasonic – location, coverage area & mounting configuration – special features –

Module IV: Applications of Sensors **(3 Lectures)**

Application. Photo sensors – spectral sensitivity – Photo sensor based control algorithms – Daylight-artificial light integrated schemes.

Module V: Commissioning of lighting controls **(10 Lectures)**

NASHRAE / IESNA standards & energy codes – international energy conservation code – compliance with controls Lighting Control Applications: Commercial lighting – stage and entertainment lighting – Architectural lighting – Residential Lighting Energy Management and building control systems.

Text Books/Reference:

1. Arturas Zukauskus, Michael S. Shur and Remis Gaska, "Introduction to solid state lighting", Wiley- Interscience, 2002.
2. E. Fred Schubert, "Light Emitting Diodes" (2nd edition), Cambridge University Press, 2006.
3. Craig DiLouie, Advanced Lighting Controls: Energy Saving Productivity, Technology & Applications, Fairmont Press, Inc., 2006.
4. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, 1989.
5. Steve Winder, "Power Supplies for LED Driving" Newnens Publication, 2008.
6. Robert S Simpson, Lighting Control: Technology and Applications, Focal Press, 2003.
7. IES Lighting Handbook, 10th Edition IESNA, 2011.

Electrical & Electronics Engineering			
ELO712	**Process Instrumentation and Control**	**L**	**T**
		3	**0**

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Evaluate** the output of a digital system for a given input.
CO2	**Describe** the dynamics of a Linear, Time Invariant systems through difference equations.
CO3	**Analyze** digital systems using the Z-transformation, state space methods.
CO4	**Design** digital controllers for physical systems.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	2
CO2	3	3	2	1	1	-	-	-	-	-	-	2
CO3	3	3	2	1	1	-	-	-	-	-	-	2
CO4	3	3	2	1	1	-		-	-	-	-	2
Avg.	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

DETAILED SYLLABUS

MODULE I: Introduction **(7 Lectures)**

Special Characteristics of process systems: Large time constants, Interaction, Multistaging, Pure Lag; Control loops for simple systems: Dynamics and stability.

MODULE II: **(10 Lectures)**

Generation of control actions in electronic pneumatic controller. Tuning of controllers Zeigler Nichols and other techniques. Different control techniques and interaction of process parameters e.g. Feed forward,cascade, ratio, Override controls. Batch and continuous process controls. Multi variable control. Feed forward control schemes.

MODULE III: **(8 Lectures)**

Control valves, Valve positioners, Relief and safety valves, Relays,Volume boosters, Pneumatic transmitters for process variables.Various process schemes/ Unit operations and their control schemese.g. distillation columns , absorbers, Heat exchangers, Furnaces,Reactors, Mineral processing industries pH and blending processes.

MODULE IV: **(12 Lectures)**

Measurement, control and transmission of signals of process parameters like flow, pressure, level and temperature.

MODULE V: **(5 Lectures)**

Computer control of processes: Direct Digital Control, Supervisory Control and advanced control strategies.

Text/Reference Books:

1. Stephananopoulos G- Chemical Process control- An Introduction to theory and practice, PHI,1990
2. Luyben W L – Simulation and control for chemical engineers,1989, 2nd Edition, McGraw Hill,1989.

Electrical & Electronics Engineering			
ELO713	**Digital Signal Processing**	**L**	**T**
		3	**0**

Course Outcomes:

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

CO's	Description
CO1	**Understand** the concepts of continuous time and discrete time systems.
CO2	**Understand** the concepts of different discrete transforms.
CO3	**Analyze** systems in complex frequency domain.
CO4	**Design** of different types of filters.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
Avg.	**3**	**2.5**	**2.5**	**1.5**								**2**

DETAILED SYLLABUS

Module I: Discrete-Time Signals (04 Lectures)

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp &complex exponentials, arithmetic operations on sequences..

Module II: LTI Systems (06 Lectures)

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non recursive systems.

Module III: Discrete Fourier Transform (10 Lectures)

Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation,DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences-Overlap-Save and Overlap-Add methods with examples and exercises.

Module IV: Discrete Time Fourier Transform (05 Lectures)

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain**.**

Module V: Fast Fourier Transforms (04 Lectures)

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module VI: Z- Transforms (08 Lectures)

Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Perseval's relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.

ModuleVII: Filter Design (5 Lectures)

Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization.

Text Books:

[1]. Digital Signal Processing-A computer based approach, S. Mitra, TMH

[2]. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis& M.G. Manslakis, PHI

[3]. Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

[4]. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Leasrning.

Reference Books

[1]. Digital Signal Processing, Chen, OUP

[2]. Digital Signal Processing, Johnson, PHI

[3]. Digital Signal Processing using MATLAB, Ingle, Vikas.

Electrical & Electronics Engineering			
ELO714	**Energy Storage Systems**	**L**	**T**
		3	**0**

Course Outcomes:

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

CO's	CO Descriptions
CO1	analyze the characteristics of energy from various sources and need for storage
CO2	classify various types of energy storage and various devices used for the purpose
CO3	Identify various real time applications

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1							2
CO2	3	3	3	2	1							2
CO3	3	3	3	2	1							2
CO4	3	3	3	3	1							2
CO5	3	3	3	2	1							2
Avg.	**3**	**3**	**3**	**2**	**1**							**2**

DETAILED SYLLABUS

Module I: Electrical Energy Storage Technologies (08 Lectures)

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

Module II: Needs for Electrical Energy Storage (08 Lectures)

Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

Module III: Features of Energy Storage Systems (08 Lectures)

Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).

Module IV: Types of Electrical Energy Storage systems (06 Lectures)

Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

Module V: Applications (10 Lectures)

Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers),New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems ,Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA–aggregation of many dispersed batteries.

Text Books:

[1]. "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.

[2]. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Book:

[1]. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

Electrical & Electronics Engineering			
ELO715	**Electrical Machine and Power Systems**	**L**	**T**
		3	**0**

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Understand** the construction and principle of operation of transformers, auto transformers, asynchronous and synchronous machines.
CO2	**Evaluate** performance characteristics of induction machine and synchronous machines.
CO3	**Analyze** the effects of excitation and mechanical input on the operation of synchronous machine.
CO4	**Understand** different elements and supply systems of power systems.
CO5	**Determine** the parameters of transmission lines

COs-POs Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	1	1	1					1
CO2	3	1	3	2	2							1
CO3	3	2	3	2	2							1
CO4	3	3	3	3	3		1					1
CO5	3	2	3	2	2							1
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**					**1**

DETAILED SYLLABUS

Module I: Transformers (8 Lectures)

Constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits and phasor diagrams at no load and full load conditions,voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.

Module II: Asynchronous Machines (8 Lectures)

General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.

Module III: Synchronous Machines (9 Lectures)

General constructional features, armature winding, emf equation, effect of distribution and pitch factor,flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit,

determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics.

Module IV: Introduction to Power Systems (9 Lectures)

Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System: different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines: configurations, types of conductors, resistance of line, skin effect.

Module V: Transmission Lines (8 Lectures)

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit ,transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect, surge impedance loading.

Text/Reference Books:

1. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2. M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers, New Delhi, 2008 Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill Publishing company Ltd, 2010.
3. Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
4. Electrical Power Systems, C. L.Wadhwa, New age international Ltd. Third Edition,2010
5. Electric Power Generation, Transmission & Distribution, S.N.Singh, PHI Learning.