Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Second Year Electrical Engineering

(2019 Course)

(w.e.f. AY: 2020-21)

Savitribai Phule Pune University

Syllabus: Second Year (SE) Electrical Engineering (2019 Course) w.e.f. AY:2020-2021

SEMESTER-I

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
207006	Engineering Mathematics-III	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203141	Power Generation Technologies	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203142	Material Science	03	04#	--	30	70	25	--	25	**150**	03	02	--	**05**
203143	Analog and Digital Electronics	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203144	Electrical Measurement & Instrumentation	03	04#	--	30	70	25	25	--	**150**	03	02	--	**05**
203150	Applications of Mathematics in Electrical Engineering	--	02*	--	--	--	25	--	--	**25**	--	01	--	**01**
203151	Soft Skill	--	02	--	--	--	25	--	--	**25**	--	01	--	**01**
203152	Audit Course-III	--	--	--	--	--	--	--	--	--	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

SEMESTER-II

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
203145	Power System-I	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203146	Electrical Machines-I	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203147	Network Analysis	03	02	--	30	70	25	--	--	**125**	03	01	--	**04**
203148	Numerical Methods & Computer Programming	03	02	--	30	70	--	25	--	**125**	03	01	--	**04**
203149	Fundamental of Microcontroller and Applications	03	04$	--	30	70	25	--	25	**150**	03	02	--	**05**
203152	Project Based Learning	--	04	--	--	--	50	--	--	--	--	02	--	--
203153	Audit Course-IV	--	--	--	--	--	--	--	--	--	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

* - Lab sessions on application of Mathematics in Electrical Engineering using professional software.

- Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week :Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field .

$ - Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week : IOT application in Electrical Engineering using microcontroller and GSM module to bridge gap between curriculum and enhance application knowledge.

Abbreviation: TH: Theory, PR: Practical, TUT:Tutorial, ISE: Insem Exam, ESE: End Sem Exam, TW: Term Work, OR: Oral

207006: Engineering Mathematics-III

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisites: - Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Vector algebra and Algebra of complex numbers.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary differential equations, Laplace transform, Fourier transform & Z-transform, Statistics & Probability, Vector Calculus and functions of a Complex Variable. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

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

CO1:Solve higher order linear differential equation using appropriate techniques to model and analyze electrical circuits.

CO2: Apply Integral transforms such as Laplace transform, Fourier transform and Z-Transform to solve problems related to signal processing and control systems.

CO3: Apply Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to energy management, power systems, testing and quality control.

CO4: Perform Vector differentiation and integration, analyze the vector fields and apply to wave theory and electro-magnetic fields.

CO5: Analyze Complex functions, conformal mappings, and perform contour integration in the study of electrostatics, signal and image processing.

Unit I: Linear Differential Equations (**LDE**) and Applications (08Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral,General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II: Laplace Transform (**LT**) (07Hours)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear differential equations.

Unit III: Fourier and Z - transforms (08 Hours)

Fourier Transform (**FT**): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.

Z - Transform **(ZT):** Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit IV: Statistics and Probability (07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test.

Unit V: Vector Calculus (08 Hours)

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI: Complex Variables (08 Hours)

Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).

203141: Power Generation Technologies

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite:

- Fuel calorific value.
- Semiconductor materials for PV cells.
- Work, power and energy calculation.

Course Objective:

- To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.
- To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.
- To commence interconnection of energy source to gird, stand alone and hybrid system.

Course Outcome: Upon successful completion of this course, the students will be able to:
CO1: Identify components and elaborate working principle of conventional power plants.
CO2: Recognize the importance and opportunities of renewable energies.
CO3: Calculate and control power output of wind solar, and hydro power plant.
CO4: Describe process of grid interconnection of distributed generation and requirements.
CO5: Interpret the environmental and social impact of various generation technologies.

Unit 01: Thermal Power Plant (06 hrs)

Basic thermodynamic cycles: Carnot cycle, Rankine cycle; Actual Rankine cycle; Reheat cycle (theoretical only); heat rate (Numerical on Heat rate).
Thermal Power Plants: Site selection, Main parts and its working. Types of boilers (FBC, Fire tube, and Water tube). Assessment of heat recovery systems Steam turbines Fuel Handling, Ash disposal and dust collection, Draught systems, electrostatic precipitator.

Unit 02: Nuclear, Diesel, Gas Power Plant (6 Hrs)

A. Nuclear Power Plant: Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal.
B. Diesel Power Plants: Main components and its working, Diesel plant efficiency and heat balance (Numerical), Site selection of diesel power plant.
C. Gas Power Plant: Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants, concept of heat to power ratio.

Unit 03: Hydro Power Plant (6 Hrs)

Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydro graphs and number of turbine required. Small, mini and micro hydro power plant (Introduction only).

Unit 04: Wind Energy Systems (6 Hrs)

Historical Development of Wind Power, Types of wind turbine, Impact of Tower Height, Power in the Wind. Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind (Numerical). Wind Turbine Generators (WTG) - Synchronous and Asynchronous (block diagrams only), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.

Unit 05: Solar Energy (6 Hrs)

Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. Over view of recent development of PV technologies. A Generic

Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, Numerical on number of solar panel selection. The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I–V curves, System: Introduction to the Major Photovoltaic System Types.

Unit 06: Other Sources and Grid Connection (6 Hrs)

Biomass energy, conversion to electricity, municipal solid waste to energy conversion, geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection criteria, stand alone, hybrid stand alone and grid connected renewable systems and their requirements.

Industrial Visit: One industrial visit to conventional /non-conventional power plant is necessary. A separate report file should be maintained in the department.

Text Books:

[T1] P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
[T2] Dr. P. C. Sharma, "Power Plant Engineering", S.K. Kataria Publications.
[T3] R. K. Rajput, "A text book on Power System Engineering", Laxmi Publications (P) Ltd.
[T4] Chakrabarti, Soni, Gupta, Bhatnagar, "A text book on Power System Engineering", DhanpatRai publication.
[T5] R.K. Rajput, "Non-Conventional Energy Sources and Utilization", S. Chand Publications.
[T6] M.M. Wakil, "Power Plant Engineering", McGraw Hill, Indian Edition.
[T7] G. D. Rai, "Renewable Energy Sources", Khanna Publications.
[T8] Chetan singh solanki " Solar Photovotaics: Fundamentals, Technology and Application" PHI Publications.

Reference Books:

[R1] Arora and Domkundwar, "A Course in Power Plant Engineering", DhapatRai Publication.
[R2] Dr. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publication.
[R3] Mukund Patel, "Wind and Solar Power Plants", CRC Press.
[R4] Gilbert Masters John, "Renewable Energy", Wiley and sons' publications.
[R5] Robert Foster, Majid Ghassemi, Alma Cota "Solar Energy" CRC Press

Unit	Text Books	Reference Books
1	T1, T2, T3	R1
2	T1, T2, T3	R1
3	T1, T2, T3	R1
4	T6, T7	R3, R4
5	T5, T6, T8	R2, R3, R4, R5
6	T5, T7	R4

203142: Material Science

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating, magnetic and resistive along with their basic characteristics.

Course Objectives: The course aims to :

1. Explain classification,properties and characteristics of electrical engineering materials.
2. Describe applications and measuring methods for parameters of dielectric, insulating, magnetic, conducting and resistive materials.
3. Illustrate solving of simple problems based on dielectric, magnetic and conducting materials.
4. Impart knowledge of Nano-technology to electrical engineering.5. Demonstrate testing methods of dielectric, insulating, magnetic, conducting and resistive materials as per IS.
5. Enable students to create self learning resource material through active learning based on practical /case study/assignments.

Course Outcomes:

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

CO1: Discuss classification,properties and characteristics of different electrical engineering materials.

CO2: State various applicationsmeasuring methods for parameters of different classes of electrical engineering materials.

CO3: Solve simple problems based on dielectric, magnetic and conducting materials.

CO4: Apply knowledge of Nano-technology to electrical engineering.

CO5: Execute tests ondielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of thematerials.

CO6: Create learning resource material ethically to demonstrate **self learning leading to** lifelong learning skills and usage of ICT/ online technology through collaborative/active learning activities.

Unit 01: Dielectric Properties of Insulating Materials: (6 Hrs)

Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations-Electronic, Ionic and Orientation Polarization (descriptive treatment only), Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta.

Unit 02: A) Dielectric Breakdown: (2 Hrs) Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.

Unit 02: B) Testing of Materials: (4Hrs) Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.

1. Measurement of dielectric loss tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of dielectric strength of solid insulating material-IS 2584.
3. Measurement of dielectric strength of liquid insulating material -IS 6798.
4. Measurement of dielectric strength of gaseous insulating material as per IS.

Unit 03 : Insulating Materials, Properties & Applications: (6 Hrs)

Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF_6.

Insulating Materials for Power and Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

Unit 04 : Magnetic Materials: (6 Hrs)

Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Anti-ferromagnetism, Ferrites, Applications of Ferro magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials.

Unit 05 : Conducting Materials: (6 Hrs)

General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High and Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Kanthal, Silver and Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Electrical Carbon Materials. Materials used for Lamp Filaments, Solders, Metals and Alloys for different types of Thermal Bimetal and Thermocouples.

Unit 06 : Nanotechnology: (6 Hrs)

Introduction, Concepts of Energy bands and various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires. Nano materials used in Batteries, Photovoltaic Cells and in Supercapacitors.

Industrial Visit:

Minimum one visit should be arranged to an industry related to manufacturing of batteries, capacitors, cables, transformers, motors (Any one industry). A hand written report should be submitted by every student as a part of term work

***Guidelines for TW Assessment will be given later.**

There is **Term Work of 25 marks**for the subject.

Practical section will comprise of two parts: (Refer SE Structure 2019 Pattern)

PART A: 2 Hours per week:

Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory. Out of 25 marks of Term Work, **15 Marks** will be based on continuous assessment that should be carried out such as checking of previous experiment along with its mock oral session (minimum 4-5 questions to each student), while conducting new experiment.

PART B: 2 Hours a week:

Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field. **10 Marks**

List of Experiments:

Part A: Term Work **(TW): 15 Marks**

List of total 12 numbers of experiments out of which conduction of 8 numbers of experiments will be mandatory.

1. To measure dielectric strength of solid insulating material-IS 2584.
2. To measure dielectric strength of liquid insulating material-IS 6789.
3. To measure dielectric strength of gaseous insulating material as per IS using Sphere Gap-Unit.
4. To obtain hysteresis loop of the ferromagnetic material.
5. To understand the principle of thermocouple and to obtain characteristics of different thermocouples.
6. To measure insulation resistance and kVAr capacity of power capacitor.
7. To measure resistivity of high resistive alloys.
8. To observe development of tracks due to ageing on different insulating materials e.g. Bakelite, Perspex, polyesters, Mica, Fiberglass etc.
9. Testing of resins and polymers.
10. Measurement of Tangent of Dielectric Loss Angle (tan δ) of solid/liquid dielectric materials.
11. Measurement of Flux Density by Gauss-meter.
12. Write report on visit to an industry related to manufacturing of batteries, capacitors, cables,

transformers (Any one industry).

List of Experiments: Part B:Part B :2 Hours per week (**Term Work(TW) : 10 Marks) (Total 6 activities from the list below are mandatory for evaluation of Term Work for Part B. Activity numbers 1, 4 and 6 are compulsory)**

Practical/case studies/assignments to enable self,active, collaborative **learning leading to** lifelong learning, based on advances related to subject to bridge gap between curriculum and enhance application knowledge of the subject.

Guidance/monitoring/assessment/presentation/field visits /expert sessions related activity can be carried out in **'Part B'** practical schedules .

1) Review of research/on line literature from latest journal papers /transactions related to different insulating, magnetic, semiconducting and conducting materials, advanced material developments and their applications. Draft of paper, presentation among students, in conference /publishing it.
2) Detailed case study of complete insulation system in transformer, comparison of various types of solid, liquid materials and study of recent advances related with major and minor insulating materials.
3) Detailed study of patents on caster oil used in transformer, its properties and comparison with other liquid insulating material.
4) Mini project on development of prototype of various electrical gadgets right from draft of specifications,design, selection of conducting, magnetic and insulating material.
5) Testing and diagnosis of induction motor, cable, transformer insulation by measurement of Polarization index, Dielectric Absorption Ratio, Step Voltage, dielectric discharge and ramp testing using 5/10KV IR Tester.
6) Laboratory visits/survey/role play/games/debates/any activity focusing collaborative, student centrist, active learning on Industrial/ Social/ Sustainability/ Public Health/ Safety/Ethical/Cultural/ Societal and Environmental aspects related to advanced materials Presentations of industrial case studies related with material science.
7) Two - Three household appliances like mixer -motor, ceiling fan- motor etc can be opened up by students either individually or by group of students and analyzed w.r.t. the materials found in it. Name each material used and to which category of materials does it belong, other applications of the same materials can be listed.
8) Detailed study of insulation system of resin casted transformer, comparison of various resins, study of testing of insulation system with applicable IS/IEC /IEEE standards
9) Visit to NABL accredited Laboratory to study testing of oil for DGA, furan analysis, study of equipment's used, test procedure and applicable IS/IEEE/IEC standard and recommended limits.
10) Discussions/Presentations/any activity using or related to IS/ IEC /IEEE standards/Recent Patents related with insulating, conducting and magnetic materials .
11) Case study on failure modes of various insulating materials and measures to reduce failure. Recent advancement in testing and diagnostic of solid and liquid insulating materials.
12) Case study on recent advancement of magnetic materials, high temperature superconductors and its applications.
13) Any activity using advanced ICT tool like Virtual Labs/animations/simulations/advanced software/on line certificate course like NPTEL/on line quiz etc related to curriculum.

Guidelines for Instructor's Manual - Practical Sessions

Instructor's Manual should contain following things related to every experiment-

1. The circuit diagram of the experiment should be drawn at the start.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Five - six questions based on that experiment should be written at the end.

Guidelines for Student's Lab Journal

Student's Lab Journal should be **Hand Written/ Drawn** containing, following things related to

every experiment-

1. The circuit diagram of the experiment should be drawn on the graph paper at the start of the experiment.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Students should write answers to five - six questions based on that experiment at the end.

Guidelines for Laboratory Conduction

1. The circuit diagram should be explained to students in such a way that they should be able to develop it at their own.
2. Detail explanation of the experiment along with its circuit diagram, observation table, calculations, result table and plotting of graphs (if any).
3. While conducting new experiment, assessment of previous experiment should be carried out by its checking along with its mock oral session (minimum 4 -5 questions to each student).

Text Books:

[T1] "A Course in Electrical Engineering Materials", by S.P. Seth, Dhanpat Rai and Sons publication.
[T2] A Textbook of "Electrical Engineering Materials" by R.K.Rajput, Laxmi Publications (P) Ltd.
[T3] "Electrical Engineering Materials", by T.T.T.I, Madras.
[T4] "Electrical Engineering Materials", by K. B. Raina and S. K. Bhattacharya, S. K. Kataria Sons.
[T5] "Material Science for Electrical Engineering", by P.K. Palanisamy, Scitech Pub. Pvt. Ltd., Chennai (India).
[T6] "Introduction to Nanotechnology" by Charles P. Poole, Jr. Frank & J. Ownes (Wiley Student Edition)

Reference Books:

[R1] "Electrical Power Capacitors-Design & Manufacture", by D. M. Tagare, Tata McGraw Hill Publication.
[R2] "Electrical Engineering Materials", by S. P. Chalotra and B. K. Bhattacharya, Khanna Publishers, Nath Market.
[R3] "Electrical Engineering Materials", by C. S. Indulkar and S. Thiruvengadam, S. Chand and Company Ltd.
[R4] "High Voltage Engineering" by Kamraju and Naidu, Tata McGraw Hill Publication.
[R5] "Introduction to Material Science for Engineering", Sixth Edition by James F. Shackelford & M. K. Muralidhara, Pearson Education.
[R6] "Insulation Technology Course Material" of IEEMA Ratner, Pearson Education.
[R7] "Materials Science for Engineering Students", by Traugott Fischer, Elsevier Publications.
[R8]"Energy Conversion Systems", by Rakosh Das Begamudre, New Age International Publishers.
[R9] "Advanced Nanomaterials and Their Applications in Renewable Energy", by Jingbo Louise Liu, Sajid Bashir, ELSEVIER Publications.

Unit No.	Text Book	Reference Book
1	T1, T2	R1, R3, R8
2	T1, T2, T3	R1, R2, R4
3	T1, T2, T3, T4	R1, R3, R4, R6
4	T1, T2, T3, T4	R3, R5
5	T1, T2, T4	R7, R8
6	T6	R9

203143: Analog And Digital Electronics

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite: Basic Electronics Engineering, Numbering system, Logic Gates and flip flops,Diode and BJT

Course Objectives:

1) To use K map for Boolean algebra reduction and design digital circuit
2) To introduce digital memories and logical families.
3) To construct sequential and combinational circuits using flip flops and K map
4) To develop the concept of basics of operational Amplifier and its applications.
5) To design uncontrolled rectifier

Course Outcomes: Upon successful completion of this course, the students will be able to :-

CO1: Design logical, sequential and combinational digital circuit using K-Map.
CO2: Demonstrate different digital memories and programmable logic families.
CO3: Apply and analyze applications of OPAMP in open and closed loop condition.
CO4: Design uncontrolled rectifier with given specifications

Unit 01 : Design of combinational circuit:(6 hrs)

Booleans algebra, De-Morgan theory etc, Karnaugh map: structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map. Design of combinational circuits using Boolean expression and K-map, encoder, decoder, half and full adder.

Unit 02: Design of sequential circuit:(6 hrs)

Introduction to sequential circuit. Design of synchronous (K-map) and asynchronous counters. Up down counters, N modulo counters, Shift registers, ring and twisted ring counters

Unit 03: Digital memories and logic families:(6 hrs)

A) Digital memories: SRAM, DRAM, ROM, EPROM
B) **Digital logic families:** PAL,PLA, CPLD, FPGA

Unit 04: Operational Amplifier Applications: (6 hrs)

Open loop and close loop configuration of Op-Amp. Applications of Op- Amp- zero crossing detectors, Comparator, Schmitt trigger, V-I and I-V converters, Instrumentation amplifier, peak detector, Waveform generation using Op-amp - sine, square, saw tooth and triangular generator,

Unit 05: Other Analog circuits:(6 hrs)

Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters using OPAMP, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using IC78xx, 79xx, LM 317

Unit 06: Diode rectifier:(6 hrs)

Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load.

List of Experiments:

Perform any **eight (three experiment should be on bread board/trainer kit)** experiment from following list:

1. Design of logical circuit for display of decimal number on seven segment display. **(Hardware)**
2. Deign 3:8 decoder for binary to octal decoding.**(Hardware)**
3. Design three bit full adder using any open source software. **(Software)**
4. Design logical circuit to convert binary to EXCESS 3/Gray number system. **(Hardware)**
5. Design digital clock or stop watch using decade counter.(IC74192) **(Hardware)**
6. Find phase angle difference between same frequency signal using ZCD and AND gate. **(Hardware)**
7. Design of comparator and schmitt trigger. **(Hardware)**
8. Study of Instrumentation amplifier using three Op-amp, CMRR measurement **(Hardware)**

9. Design sine, and triangular wave generator. **(Hardware)**
10. Design first order high pass and low pass filter using OPAMP in any open source software. (For this provide one statement to each of four students to perform with desired cut-off frequency. Each group will demonstrate their result and prepare documentation) **(Software)**
11. Design of monostable mutivibrator using IC555 and digital circuit to count number of pulses. **(Hardware)**
12. Design astable multivibrator using IC-555. **(Hardware)**
13. Design of single phase bridge rectifier with output voltage and specified ripple.(this practical should be design by each students, perform in simulation and demonstrate with hardware in laboratory with design documents) **(Software and Hardware)**

Guidelines for Instructor's Manual Practical Sessions

The Instructor's Manual should contain following related to every experiment: Brief theory related to the experiment,Connection diagram /circuit diagram, Observation table,,Sample calculations for one reading,Result table, Graph and Conclusions,,Data sheets of the ICs used. Few questions related to the experiment (10 marks) List of components required with their specifications .

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment: Theory related to the experiment, Connection diagram /circuit diagram , Observation table, Sample calculations for one reading, Result table, Graph and Conclusions, Data sheets of the ICs used, List of components required with their specifications,

Guidelines for Lab Assessment

- There should be continuous assessment.
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do connections on bread board and get the results.
- Timely submission of journal.

Guidelines for Laboratory Conduction

- First half an hour should be utilized for explaining the circuit diagram and theory related to the experiment.
- Next one hour for connection and conduction of the experiment.
- Remaining half an hour for continuous assessment and timely checking of the experiment (This time slot can be adjusted as per convenience)
- Separate breadboard should be provided for every student for those experiments which are compulsory to be performed on breadboard or trainer kit (**ready made set up is not allow**)

Books & Other Resources:

Text Books:

[T1] Floyd and Jain, "Digital Fundamentals", Pearson Education.
[T2] R. P. Jain, "Digital Electronics", Tata McGraw Hill, New Delhi.
[T3] Malvino, "Digital Computer Electronics- An Introduction to Microcomputers," Tata McGraw Hill.
[T4] Gaikwad R., "Operational Amplifier", PHI New Delhi.
[T5] Floyd, "Electronics Devices", Pearson Education.
[T6] Mottershed, "Electronics Devices & Circuits", PHI New Delhi
[T7] Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd edition, Pearsons Education.
[T8] Fundamental of digital circuits, 4th Edition, by A Anand Kumar, PHI learning private limited publication

Reference Books:

[R1] Tokheim, "Digital Electronics-Principles and Application", 6th edition, Tata McGraw Hill, New Delhi.
[R2] A Jaico and Charles H. Roth, "Fundamentals of Logic Design" Jr. Forth Edition.
[R3] K. R. Botkar, "Integrated Circuits", Khanna Publication, New Delhi.
[R4] James, "Operational Amplifier and Linear Integrated Circuits Theory and Application."
[R5] P John Paul, "Electronics Devices and circuits", New Age international Publications.

[R6] P. S. Bimbhra, "Power Electronics", Khanna Publications.
[R7] NPTEL course on Digital Electronics Circuit, IIT, Kharagpur.
https://nptel.ac.in/courses/108105132/
[R8] NPTEL course on Integrated circuit, MOSFET, OPAMP and there applications IISC Banglore. https://nptel.ac.in/courses/108/108/108108111/
[R9] NPTEL course on power electronics by IIT Kharagpur.
https://nptel.ac.in/courses/108/105/108105066/

Unit 01	**Test Books**	**References**
1	T1, T2, T8	R1, R7
2	T1, T2, T3, T8	R2, R7
3	T8	R7
4	T4, T5	R3, R4, R8
5	T4, T5	R3, R4, R8
6	T7	R6, R9

203144: Electrical Measurements and Instrumentation

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Practical** : 25 Marks

Course Objectives:

1. To understand the necessity and importance of measurement and instrumentation.
2. To know about various types of measurement techniques, instruments and sensors.
3. To learn to apply proper methods of measurement and use of sensors in instrumentation.

Course Outcomes:

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

CO1: Define various characteristic and classify measuring instruments along with range extension techniques.

CO3: Apply measurement techniques for measurement of resistance, inductance and capacitance.

CO4: Demonstrate construction, working principle of electrodynamo type and induction type instruments for measurement of power and energy.

CO5: Make use of CRO for measurement of voltage, current and frequency.

CO6: Classify transducer and apply it for measurement of physical parameters in real time.

Unit 01: (7 Hrs)

A. Classification of Measuring Instruments: Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) instruments (attraction and repulsion). block diagram and operation of digital ammeter & voltmeter.

B. Range Extension: Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02: (6 Hrs)

A. Measurement of Resistance: Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger. Earth tester for earth resistance measurement.

B. Measurement of Inductance: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Maxwell's inductance, Maxwell's inductance – Capacitance Bridge, Anderson's bridge.

Unit 03: (6 Hrs)

Measurement of Power: Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method.

Unit 04: (5 Hrs)

Measurement of Energy: Construction, working principle, torque equation of single phase conventional (induction type) energy meter. Block diagram and operation of single phase and three phase static energy meter. Calibration of static energy meter. TOD meter.

Unit 05: (6 Hrs)

A. Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO.

B. Transducers: Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers.

C. Pressure Measurement: Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.

Unit 06: (6 Hrs)

A. Level Measurement: Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic.

B. Displacement Measurement: LVDT & RVDT – construction, working, applications, specifications, advantages & disadvantages, effect of frequency on performance.

C. Strain Gauge: Introduction, definition of strain, types of strain gauge: wire strain gauge, foil strain gauge, semiconductor strain gauge; their construction, working, advantages and disadvantages.

Industrial Visit(s)

Minimum one visit should be arranged to electrical instrument manufacturing company or where electrical instruments are calibrated or where various measuring instruments (Electrical/Mechanical) can be seen or observed.

List of Experiments

Practical section will comprise of two part; part A and part B.

Practical examination will be conducted on Part A.

Distribution of term works marks; Part A : 10 Marks, Part B : 15 Marks.

Part A: Minimum eight experiments are to be conducted from the following experiments:

1. Extension of ammeter range using CT, voltmeter range using PT and watt meter range using CT / PT.
2. i) Measurement of medium resistance by Ammeter- Voltmeter method.
   ii) Measurement of low resistance using Kelvin's Double Bridge.
3. Measurement of inductance using Anderson's bridge / Maxwell's bridge.
4. Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two way switch.
5. Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.
6. Measurement of three phase active & reactive power by two wattmeter method procedure.
7. Measurement of active power in three phase, four wire system using three CTs & two wattmeter.
8. Calibration of single phase wattmeter at different power factors.
9. Calibration of single phase static energy meter at different power factors.
10. Measurement of voltage, current, time period, frequency & phase angle using CRO.
11. To study and plot the characteristics of LVDT.
12. Electrical methods for measurement of liquid level.

Part B: Minimum eight experiments / case studies are to be conducted from the following:

1. Study of various standards (IS/IEC) related to calibration process of various instruments and NABL accredited Test Laboratory visit.
2. Measurement of soil resistivity using four pin wenner method.
3. Study of programmable LCR meter; Measure L, C, R, Q, dissipation factor and power factor of given component.
4. Demonstration of Power analyser and multifunction meter for measurement of various

electrical quantities.

5. Study of Digital Storage Oscilloscope:
   a) Different modes in DSO such as Roll, Average, Peak detection.
   b) Capture transients
   c) FFT analysis
   d) Various MATH operations
6. Study and demonstration of net meter and four quadrant TOD Meter.
7. Detailed study of various temperature transducers, their selection procedure, specifications, characteristics and comparison, calibration process of temperature transducer.
8. Determination of polarities and ratio, phase angle and ratio error of various CTs and PTs.
9. Study and demonstration of DIAF / Woodward alternator synchronization relay used in industrial power system for synchronization of DG sets and Alternators.
10. Detailed study of on line Energy Monitoring System, various parameters, EMS software capabilities, trending with IOT applications. Demonstration of EMS system by inviting Expert.
11. Virtual instrument modeling using software like LABVIEW.
12. Study of advanced metering infrastructure in smart grid.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- The instructor's manual need to include prologue (about University / program / institute / department / foreword / preface etc), University syllabus, conduction and assessment guidelines, topics under consideration - concept, objectives, outcomes, list of experiments, references etc.
- The feedback seeking sheet for enhancement of instructor's manual may be added as annexure.

Guidelines for Student's Lab Journal

- The laboratory experiments are to be submitted by student in the form of journal.
- Journal consists of prologue, Certificate, table of contents, and write-up of each experiment (Title, Objectives, Outcomes, List of apparatus, Circuit diagram, Theory, Observation Table, Sample Calculation, Result Table, Conclusion / Analysis, exercises - MCQs, assignments, Date of Completion, Assessment grade and assessor's sign with date).

Guidelines for Lab /TW Assessment

- Each experiment will be assigned grade based on parameters with appropriate weightage.
- Suggested parameters include - timely completion, performance, innovation, punctuality and neatness.

Guidelines for Laboratory Conduction

- The instructor is expected to shortlist necessary experiments from the suggested list of experiments. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
- Proper safety instructions and demonstration of the experiment is to be given before asking the students to perform the experiment. The experiment is carried out by the students under the supervision of the instructor.
- The instructor should take utmost care towards safety of the students, self and other hazards that may be caused by improper operation of the equipment.
- The instructor may also design an experiment which is relevant to the subject and beyond the scope of syllabus.

Text Books

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation", Dhanpat Rai & Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation", S. K. Kataria & Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis", Tata

McGraw Hill.

Reference Books

[R1] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments", Reem Publications.
[R2] Dr. Rajendra Prasad, "Electronic Measurements & Instrumentation", Khanna Publishers.
[R3] Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI Publication.
[R4] M. M. S. Anand, "Electronics Instruments and Instrumentation Technology", PHI Publication.

Unit	Text Books	Reference Books
I	T1,T2,T3,T4	R1,R2,R3,R4
II	T1,T2	R1,R4
III	T1,T2	R1,R2
IV	T1,T2	R1,R2
V	T1,T2,T3,T4	R2,R3,R4
VI	T1,T2,T3	R2,R3

203150: Applications of Mathematics in Electrical Engineering

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Prerequisite: Basic mathematics, Engineering Mathematics-I, II

Course Objective: Course Objectives are:

- To relate mathematics and electrical problems.
- To introduce software solution
- To develop mathematical and complex problem solving skill.

Course Outcome: At the end of this course, learner will be able to

CO1: Apply fundamentals of mathematics in solving electrical engineering problem

CO2: Analyze complex electrical engineering problem using mathematical techniques.

CO3: Implement program and simulation for problems in electrical engineering.

CO4: Demonstrate self lifelong learning skills with applications of mathematics in electrical engineering through software.

Perform any **Eight** experiments from following list using any professional software:

1. To solve ordinary differential equations in electrical circuits or DC motors:
2. To apply Laplace Transform for solving ordinary differential equations in electrical circuits or DC motors:
3. To analyze the waveform generated using Fourier series.
4. To solve difference equations using z-Transform:
5. To Perform convolution of two discrete signal using software programming:
6. To solve linear simultaneous equations from electrical network (KVL/KCL) using software programming:
7. To determine a phasor of AC signal using Discrete Fourier Transform.
8. To perform mathematical addition, subtraction, multiplication and division of electrical signals.
9. To calculate rms and average values of given waveform using software programming.
10. To calculate electrical power under sinusoidal and non sinusoidal voltage and current

Perform any **Two** experiments from following list using any professional software:.

1. To determine maxima and minima of single/two variable problem.
2. To convert three phase electrical signal quantities dq0 transformation.
3. To apply partial difference equation in Electromagnetic (Maxwell equation)
4. To apply graph theory in network analysis
5. To calculate poles and zeros in complex electrical network.

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm
- Three to four different sets of problem statement
- Solve numerical using appropriate method
- Ten questions based on experiment
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm
- Problem statement
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on experiment

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

203151: Soft Skill

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Course Objective: The course aims to:-

- To possess knowledge of the concept of Self-awareness and Self Development.
- To understand the importance of Speaking Skills, listening skills, Presentation Skills and leadership skills.
- To gain the knowledge of corporate grooming & dressing, Email & telephone etiquettes, etiquette in social & office setting.
- To get conversant with Team work, Team effectiveness, Group discussion, Decision making.
- To recognize the importance of time management and stress management.

Course Outcome: Students will be able to :-

CO1: DoSWOC analysis.

CO2: Develop presentation and take part in group discussion.

CO3: Understand and implement etiquette in workplace and in society at large.

CO4: Work in team with team spirit.

CO5: Utilize the techniques for time management and stress management.

Unit 01 : Self-Awareness & self-Development: (4Hrs)

A) Self-Assessment , Self-Appraisal, SWOT, Goal setting - Personal & career - Self Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self-appraisal, Personal Goal setting,

B) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting and prioritization.

Unit 02 : Communication Skill: (6 Hrs)

A) Importance of communication, types, barriers of communication, effective communication.

B) Speaking Skills: Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self-expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

C) Listening Skills:Law of nature- you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, Avoid selective listening

D) Group Discussion:Characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

E) Presentation skills:Planning, preparation, organization, delivery.

F) Written Skills: Formal & Informal letter writing, Report writing, Resume writing - Sentence structure, sentence coherence, emphasis. Paragraph writing. Letter writing skills – form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

Unit 03 : Corporate / Business Etiquette: (2 Hrs)

Corporate grooming & dressing, Email & telephone etiquette, etiquette in social & office setting: Understand the importance of professional behavior at the work place, Understand and Implement etiquette in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquette (targeted at young professionals who are just entering business environment), Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

Unit 04 : Interpersonal relationship: (4 Hrs)

A) Team work, Team effectiveness, Group discussion, Decision making – Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.

B) Group Discussion- Preparation for a GD, Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD, Conflict management, Do’s and Don’ts in GD

Unit 05 : Leadership skills: (2 Hrs)

Leaders' role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example,effective feedback.

Unit 06 : Other skills: (2 Hrs)

A) Time management- The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to priorities using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions , to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individualized plan of action.

B) Stress management- understanding the stress & its impact, techniques of handling stress.

C) Problem solving skill, Confidence building Problem solving skill, Confidence building

Term Work/Assignments: Term work will consist the record of any 8 assignments of following exercises

1. SWOT analysis
2. Personal & Career Goal setting – Short term & Long term
3. Presentation Skill
4. Letter/Application writing
5. Report writing
6. Listening skills
7. Group discussion
8. Resume writing
9. Public Speaking
10. Stress management
11. Team Activity-- Use of Language laboratory

Teaching Methodology:

Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below.

Practical Assignments (Term work)

Minimum 8 assignments are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should explain the topics mentioned in the syllabus during the practical sessions followed by the actual demonstration of the exercises. Students will submit report of their exercise (minimum 8) assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed.

1. **SWOT analysis**: The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.
2. **Personal & Career Goal setting** – Short term & Long term
3. **Presentation Skills**: Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
4. **Letter/Application writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
5. **Report writing**: The teacher should teach the students how to write report. The teacher should give proper format and layouts. Each student will write one report based on visit / project /

business proposal etc.

6. **Listening skills**: The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.

7. **Group discussion**: Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.

8. **Resume writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.

9. **Public Speaking**: Any one of the following activities may be conducted : A) Prepared speech(topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver. B) Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic) C) Story telling (Each student narrates a fictional or real life story for 5 minute search) D) Oral review(Each student orally presents a review on a story or a book read by them)

10. **Team Activity**-- Use of Language laboratory

Text Books:

[T1] Sanjay Kumar and PushpaLata, “Communication Skills”, Oxford University Press.

[T2] Krishna Mohan, MeeraBanerji, “Developing Communication Skill”, McMillan India Ltd.

[T3] Simon Sweeney, “English for Business Communication”, Cambridge University Press

Reference Books:

[R1] Accenture, Convergys, Dell et.al, “NASSCOM-Global Business Foundation Skills, Foundation Books, Cambridge University Press.

[R2] E. H. McGraw, “Basic Managerial Skills for all”, Eastern Economy Edition, Prentice hall

[R3] Barun K. Mitra, “Personality Development and Group Discussions”, Oxford University Press.

[R4] PriyadarshiPatnaik, “Group Discussions and Interview Skills: Foundation Books”, Cambridge University Press.

[R5] Napoleon Hill, “Thinks and Grow Rich”, Ebury Publishing, ISBN 9781407029252.

[R6] Tony Robbins, “Awaken the Giant Within”, Harper Collins Publishers, ISBN139780743409384. S.E. Electrical Engineering (2015 course) – Savitribai Phule Pune University 25

[R7] Wayne Dyer, “Change Your Thoughts, Change Your Life”, Hay House India, ISBN-139788189988050.

[R8] Stephen Covey, “Habits of Highly Effective People”, Pocket Books, ISBN139781416502494.

[R9] Dr. Joseph Murphy, “The Power of Your Subconscious Mind”, MaanuGraphics, ISBN-13 9789381529560.

[R10] Daniel Coleman, “The new Leaders”, Sphere Books Ltd, ISBN-139780751533811.

[R11] Richard Koch, “The 80/20 Principal”, Nicholas Brealey Publishing , ISBN-13 9781857883992.

[R12] Julie Morgenstern, “Time management from inside out”, Owl Books (NY),ISBN-13 9780805075908.

[R13] Shiv Khera, “You can win”, Macmillan, ISBN-139789350591932.

[R14] Gopalaswamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”

203152 : Audit Course-III

List of three audit course is provided. Students can choose any one from 203152(A) 203152(B) and 203152(C)

203152 (A) : Solar Thermal System

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Description: The course will introduce the basics of: solar energy, availability, applications, heat transfer as applied to solar thermal systems, various types of solar thermal systems, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The field visits will be designed for first-hand experience and basic understanding of the system elements.

Course Objective:

- To understand basics and types of solar thermal systems.
- To get knowledge of various types of concentrators.
- To make students aware of different Standards and certification for Concentrator Solar Power.

Course Outcome: Student will be able to

CO1: Differentiate between types of solar Concentrators

CO2: Apply software tool for solar concentrators

CO3: Design different types of Solar collectors and balance of plant

Course Contents:

- Sun, Earth and seasons
- Solar Radiation
- Basics of heat transfer
- Absorption, reflection and transmission of radiation
- Types of Solar thermal systems
- Basic design of different types of systems
- Applications of solar thermal systems and their economics
- Need for solar concentration
- Various types of solar concentrators
- Movement of Sun and tracking
- Control systems for solar tracking
- Concentrating solar thermal (CSP)
- Concentrating solar PV (CPV)
- Balance of plant for CSP
- Critical points in concentrating solar system installation
- Operation and maintenance of CSP
- Typical financial analysis of CSP
- Software tools for concentrating solar power
- Environmental impact assessment
- Standards and certification for CSP
- Basics of solar thermal (STH) systems
- Elements of various STH systems
- Design, materials and manufacturing of
  - Flat plate solar collector
  - Evacuated tube solar collector
  - Parabolic trough collector
  - Dish type solar concentrators
  - Concentrating PV systems
  - Balance of plant
- Manufacturing standards

- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Assignment

- Design of solar thermal system for residential/ commercial building.

References:

1. Trainers Textbook Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India
2. Students Workbook for Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India

203152 (B) : C Language Programming

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Course Objective:

- To give basic idea about C programming language
- To prepare students for writing algorithm, draw flow chart and program in C language
- To learn data types and syntax in C language.

Course Outcome: Student will be able to

CO1: Elaborate data types, arithmetic, logical and conditional operators

CO2: Apply control and looping statements in C programming

CO3: Write programming using C language with functions, arrays and pointers.

Course Contents:

Unit 01: The language of C : Phases of developing a running computer program in C, Data concepts in C :Constants, Variables, Expressions, Operators, and operator precedence in C., Statements : Declarations, Input-Output Statements, Compound statements, Selection Statements. Conditions, Logical operators, Precedence. Repetitive statements, While construct, Do-while Construct, For construct., Data types, size and values. Char, Unsigned and Signed data types. Number systems and representations. Constants, Overflow., Arrays. Strings. Multidimensional arrays and matrices.

Unit 02: Functions :The prototype declaration, Function definition.Function call : Passing arguments to a function, by value, by reference. Pointers : Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer

Assignment

- Write C program for arithmetic operations such as +,-,*,/,%.
- Write C program for decision making statements such as if, else-if etc.
- Write C program for Representative statements such as for, while, do-while.
- Write C program to determine roots of an quadratic equation using functions.
- Write C program to enter matrix data and printing its inverse.
- Write C program to demonstrate use of pointers.

References:

1. A.R. Bradley, "Programming for Engineers", Ringer, 2011
2. Hankering and Chitchat, "The C Programming Language", (2nd ed.) Prentice Hall, 1988

203152(C) Japanese Language-I

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Course Objective:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome: On completion of the course student

- Will have ability of basic communication.
- Will have the knowledge of Japanese script.
- Will get introduced to reading , writing and listening skills
- Will develop interest to pursue professional Japanese Language course.

Course Contents:

Unit 1: Introduction to Japanese Language. Hiragana basic script, colors, Days of the week

Unit 2: Hiragana: modified Kana, double consonant, Letters combined with ya, yu, yo Long vowels, Greetings and expressions

Unit 3: Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one's age.

References:

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Text book 1-1 (IndianEdition), Goyal Publishers & Distributors Pvt. Ltd.

Guidelines for Conduction

(Any one or more of following but not limited to)

- Guest Lectures
- Visiting lectures
- Language Lab

Guidelines for Assessment (Any one of following but not limited to)

- Written Test
- Practical Test
- Presentation
- Paper
- Report

203145: Power System-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite courses if any: Power Generation, Various insulating materials and properties, Knowledge of fundamentals of electrical circuit components and engineering mathematics.

Course Objectives:

1. To learn the basic structure of electrical power systems, various electrical terms related with power system and understand various types of tariff.
2. To understand the specifications and applications of various major electrical equipment present in power plant.
3. To get the knowledge of mechanical and electrical design of overhead and underground transmission system.
4. To learn representation of transmission lines for performance evaluation.

Course Outcomes:

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

CO1: Recognize different patterns of load curve and calculate associated different factors with it and tariff.

CO2: Draft specifications of electrical equipment in power station.

CO3: Design electrical and mechanical aspects in overhead transmission and underground cables.

CO4: Evaluate the inductance and capacitance of different transmission line configurations.

CO5: Analyse the performance of short and medium transmission lines

Unit 01: Structure of Electrical Power Systems and Tariff [6Hrs]

A) Structure of Electrical Power Systems: Structure of electrical power system, Different factors associated with generating stations such as Connected load, Maximum demand, Demand factor, Average load, Load factor, Diversity factor, Plant capacity factor, Reserve capacity, Plant use factor, Load curve, Load duration curve, Concept of base load and peak load stations, Advantages of interconnected grid system, Fitting of available generating station into the area load duration curve. **[4 Hrs]**

B) Tariff: Introduction of Tariff, Tariff setting principles, desirable characteristics of tariff, various consumer categories and implemented tariff such as two part tariff, three part tariff(Numerical on two part and three part tariff), Time of day tariff for H.T and L.T industrial and commercial consumers, Introduction to Availability based tariff (ABT), kVAh tariff(Descriptive treatment only).[**2 Hrs**]

Unit 02 Major Electrical Equipment's in Power Station & Underground Cables [6Hrs]

A) Major Electrical Equipment's in Power Station: Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, Power transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays. Current transformers, potential transformers, Lightning arresters, Earthing switches, isolators, Carrier current equipment's (P.L.C.C), Control panels, battery rooms, metering and other control room equipment in generating station**. [3Hrs]**

B)Underground Cables: Construction of Cables, Classification of cables, XLPE cables, Capacitance of single core and three core cable, Dielectric stresses in single core cable, Grading of cables, inter sheath grading, capacitance grading. **[3Hrs]**

Unit 03: Mechanical Design of Overhead lines and Insulators: [6Hrs]

A) Mechanical Design of Overhead lines: Main components of overhead lines, Various types of line supports, Conductor spacing, Length of span, Calculation of sag for equal and unequal supports and effect of ice and wind loading. **[3Hrs]**

B) Overhead Line Insulators: Types of insulators, its construction and their applications such as Pin type, Suspension type, Strain type, Shackle type, Post insulators, bushing. Potential distribution over suspension insulators, String efficiency, (Numerical on string efficiency and up to four discs only), Methods of improving string efficiency (Descriptive treatment only). **[3Hrs]**

Unit 04:Resistance and Inductance of Transmission Line: [6Hrs]

Resistance of transmission line, Skin effect and proximity effect, Factors responsible for production of these effects, Internal and external flux linkages of single conductor, Inductance of single phase two wire line, Necessity of transposition, Inductance of three phase line with symmetrical and unsymmetrical spacing with transposition, Concept of G.M.R and G.M.D, Inductance of bundled conductors.

Unit 05: Capacitance of Transmission Line: [6Hrs]

Electric potential at single charged conductor, Potential at conductor in a group of charged conductors, Capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R and G.M.D for capacitance calculations, need of transposition for capacitance calculations, Capacitance of three phase line with symmetrical and unsymmetrical spacing with transposition. Capacitance of single circuit and double circuit three phase line with symmetrical and unsymmetrical spacing considering transposition (without considering earth effect).

Unit 06: Performance of Transmission Line [6Hrs]

Classification of lines based on length and voltage levels such as short, medium and long lines, Performance of short transmission lines with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Π' and 'Nominal T' circuits using R,L and C parameters, Ferranti effect, Representation of 'T' and 'Π' models of lines as two port networks, Evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of efficiency and regulation of short and medium lines**.**

Industrial Visit: Compulsory one visit to EHV substation is recommended

Text Books:

[T1] V.K.Meheta, Rohit Mehta, "Principles of Power System", S. Chand Publication.
[T2] J.B.Gupta, "Transmission and Distribution", S.K.Kataria and Sons, New Delhi.
[T3] J.B.Gupata,"Generation and Economic Considerations",S.K.Kataria & Sons, New Delhi.
[T4] Dr.B.R.Gupta, "Generation of Electrical Energy", S. Chand Publication.
[T5] A Chakraborty, M.L.Soni, P.V. Gupta, U.S.Bhatnagar,"A text book on Power System Engineering", Dhanpatrai & Co, Delhi.
[T6] S.N.Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

[R1] Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications
[R2] D. Das," Electrical Power System", New Age Publication
[R3] W.D.Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] M.V.Deshpande," Elements of Power Station Design", Wheeler Publishing.
[R5] I.J. Nagrath and D.P.Kothari," Modern Power System Analysis", Tata McGraw Hill
[R6] NPTEL course on Power System Engineering, IIT Kharagpur
https://nptel.ac.in/courses/108/105/108105104/
[R7] NPTEL course on Power System Analysis, IIT Kharagpur
https://nptel.ac.in/courses/108/105/108105067/
[R8] NPTEL Power System Analysis, IIT Kharagpur
https://www.youtube.com/playlist?list=PLRWKj4sFG7-6gWwDMLI0Wy5DDRqyKP1uQ
[R9] MAHADISCOM Website for tariff:
https://wss.mahadiscom.in/wss/wss?uiActionName=getEnergyBillCalculator
[R10] Maharashtra Electricity Regulatory Commission www.merc.gov.in

Units	Text Books	Reference Books
1	T1,T3,T6	R1,R3,R4,R8,R9,R10
2	T1,T4	R4,R6
3	T1,T5	R4,R6
4	T1,T2,T5,T6	R1,R7,R8
5	T1,T2,T5,T6	R1,R7,R8
6	T1,T2,T5	R3,R5,R7,R8

203146: Electrical Machines-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite:

- Magnetic circuit, mutual induced EMF, dynamically induced EMF, Direction of magnetic field in current carrying conductor, Flemings LHR & RHR, Electromechanical energy conversion.

Course Objective:

- To understand energy conversion process.
- To understand selection of machines for specific applications.
- To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.
- To test & analyse the performance of machine.

Course Outcome: Upon successful completion of this course, the students will be able to:

CO1: Evaluate performance parameters of transformer with experimentation and demonstrate construction along with specifications as per standards.

CO2: Distinguish between various types of transformer connections as per vector groups with application and to perform parallel operation of single/three phase transformers.

CO3: Select and draft specifications of DC machines and Induction motors for various applications along with speed control methods.

CO4: Justify the need of starters in electrical machines with merits and demerits.

CO5: Test and evaluate performance of DC machines and Induction motors as per IS standard.

Unit 01: Transformers: (6 Hrs)

Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer, Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Auto transformers, their ratings and applications. Comparison with two winding transformers with respect to saving of copper and size.

Unit 02: (6 Hrs)

Transformers:

Polarity test. Parallel operation of single-phase transformers, conditions to be satisfied, loadsharing under various conditions. & Welding Transformer

Three Phase Transformers:

Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V connections. Three winding (tertiary windings) transformers

Unit 03: D.C. Machines (Part-1): (6 Hrs)

Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F, torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.

Unit 04: D.C. Machines (Part-2): (6 Hrs)

Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors.

Commutation: Process of commutation, time of commutation, reactance voltage, different form

of commutations, causes of bad commutation and its remedies (Descriptive treatment only)

Unit 05: Three Phase Induction Motor: (6 Hrs)

Construction: Stator, Squirrel cage & wound rotors. Production of rotating mmf. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram, Relation between rotor input power, rotor copper loss & gross mechanical power developed, efficiency.

Unit 06: Three Phase Induction Motor: (6 Hrs)

Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors, comparison of various starters. Testing of three phase induction motor as per IS 325 & IS 4029.

Industrial Visit:

Minimum One visit to above machines manufacturing industry (mentioned in syllabus) is recommended.

List of Experiments:

Compulsory Experiments:

1. O.C. and S.C. test on single phase Transformer
a. Determination of equivalent circuit parameters from the test data
b. Determination of voltage regulation and efficiency
2. Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedance.
3. Speed control of D.C. Shunt motor and study of starters.
4. Load test on 3-phase induction motor.

Any four experiments are to be conducted of following experiments:

1. Polarity test on single phase and three phase transformer.
2. Brake test on D.C. Shunt motor
3. Load characteristics of D.C. series motor.
4. Hopkinson's test on D.C. shunts machines.
5. No load & blocked-rotor test on 3-phase induction motor:

a) Determination of parameters of equivalent circuit.
b) Plotting of circle diagram.

6. Calculation of motor performance from (a) & (b) above.
7. Determination of sequence impedance of the transformer
8. To study Sumpner's test.
9. Measurements of non-sinusoidal current waveform of transformer at no load
10. Swinburne Test on DC shunt Motor.

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", Dhanpat Rai& Sons.
[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
[T4] Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, Third Edition.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", TataMcGraw

Hill Publication Ltd., Fifth Edition.
[R3] A.S. Langsdorf, "Theory and performance of DC machines", Tata McGraw Hill.
[R4] M.G. Say, "Performance and Design of AC. Machines", CBS Publishers and Distributors.
[R5] Smarajit Ghosh, "Electrical Machines", Pearson Education, New Delhi.
[R6] Charles I Hubert, "Electrical Machines Theory, Application, & Control", Pearson Education, New Delhi, Second Edition.

Unit No.	Text Book	Book Reference
I	T1, T2, T3, T4	R2, R4, R5
II	T1, T2, T3, T4	R2, R4, R5
III	T2, T3, T4	R1, R3, R5
IV	T2, T3, T4	R1, R3, R5
V	T1, T3, T4, T5, T6	R4, R5, R6
VI	T1, T3, T4, T5, T6	R4, R5, R6

203147: Network Analysis

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks

Prerequisite:

Terminology of electrical networks, series and parallel combinations of resistance, Laplace transforms , linear differential equations.

Course Objective:

1. To develop the strong foundation for Electrical Networks.
2. To develop analytical qualities in Electrical circuits by application of various theorems.
3. To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach.
4. To apply knowledge of laws and Network theory for analysis of 2-port networks and design of other circuits like filters.

Course Outcome:

Upon successful completion of this course, the students will be able to :-

CO1: Calculate current/voltage in electrical circuits using simplification techniques, Mesh, Nodal analysis and network theorems.

CO2: Analyze the response of RLC circuit with electrical supply in transient and stead state.

CO3: Apply Laplace transform to analyze behaviour of an electrical circuit.

CO4: Derive formula and solve numerical of two port network and Design of filters

CO5: Applyknowledge of network theory to find transfer function, poles and zeroes location to perform stability analysis and parallel resonance

Unit 1 Types of Network, Mesh and Nodal analysis [6 Hrs]

Lumped and Distributed, Linear and Nonlinear, Bilateral and Unilateral, Time-variant and Time-invariant. Independent and Dependent (controlled) voltage and current sources. Concept of voltage and current divider, Source transformation and shifting. Network Equations: Network equations on Loop basis and Node basis, choice between Loop analysis and Nodal analysis. Concept of super node and super mesh, mutual inductance, Dot convention for coupled circuits, Concept of duality and dual networks.

Unit 2: Network Theorem:[6 Hrs]

Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity, Millman theorems applied to electrical networks with all types of sources.

Graph Theory : Tree ,Co-tree, Incidence matrix ,F-cutest Matrix, Tie set B Matrix

Unit 3: Transients in RLC circuit[6 Hrs]

Solutions of differential equations and network equations using classical method for R-L, R-C and R-L-C circuits, Initial and Final Condition (series and parallel).

Unit 4: Laplace Transform[6 Hrs]

Basic Properties of Laplace Transform, Laplace Transform of Basic R, L and C components, Solutions of differential equations and network equations using Laplace transform method for RL, R-C and R-L-C circuits (series and parallel), Inverse Laplace transforms, transformed networks with initial conditions. Analysis of electrical circuits with applications of step, pulse, impulse & ramp functions, shifted & singular functions the convolution integral,application of initial and final value theorem.

Unit 5 Two port network and Filters [6 Hrs]

Two Port Network: Z, Y, H and transmission parameters, Interrelations between parameters. Introduction to passive filters, low pass filters, high pass filters and m-derived LPF and HPF filters and design.

Unit 6 Network Functions: [6 Hrs]

Poles and Zeros: Terminal pairs or ports, network functions for the one port and two ports, the calculation of network functions, general networks. Poles and zeros of network functions, Restrictions on poles and zeros locations for transfer functions and driving point function, Time –

domain behavior from the pole and zero plot. Stability of active networks. Parallel Resonance, Resonance frequency, Quality factor, Current and resonance.

List of Experiments: Any four experiments from the first five of the following and any four experiments from rest of the list. (Minimum four experiments should be based on simulation software along with hardware verification)

1. Verification of Superposition theorem in A.C. circuits.
2. Verification of Thevenin's theorem in A.C. circuits.
3. Verification of Reciprocity theorem in A.C. circuits.
4. Verification of Millmans' theorem.
5. Verification of Maximum Power Transfer theorem in A.C. circuits.
6. Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor)
7. Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit)
8. Determination of time response of R-L-C series circuit to a step D.C. voltage input.
9. Determination of parameter of Two Port Network.
10. Determination of current under parallel Resonance condition .
11. Determination of Resonance, Bandwidth and Q factor of R-L-C series circuit.

Guidelines for Instructor's Manual

- Specify objective(s) of the experiment.
- List out equipment required to perform the experiment with their ratings.
- Include circuit diagram with specifications.
- Related theory of the experiment must be included.
- Include step by step procedure to perform the experiment.
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable.
- It should include the formula required to calculate desired results. Instructions for plotting the graphs must be included wherever required.
- Provide space to write conclusion on their own.
- For simulation experiments using MATLAB, the Simulink diagram with proper details must be included.

Guidelines for Student's Lab Journal

- Students are expected to write the journal in the following sequence:
  - Aim
  - Equipment
  - Circuit diagram
  - Theory
  - Procedure
  - Observation table
  - Calculations
  - Graphs
  - Conclusion.
- Students are expected to draw the circuit diagrams on 1mm graph paper.
- For plotting the characteristics they must use 1mm graph papers.
- Students should write conclusion.
- Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Lab

- TW Assessment should be on the basis of:
- Neatness of circuit diagram.
- Completed write up including theory, procedure.
- The detail calculations to obtain results.
- Graph with title, scale, labeling of axes etc.
- Conclusion.

- Punctuality, discipline, attendance, understanding and neatness of the journal. Few questions on the basis of the experiment can be asked to verify the understanding of the students about that experiment.

Guidelines for Laboratory Conduction

- Give the safety instructions to students.
- Allow 4-5 students per group for performing the experiment.
- Explain theory related to the experiment to be conducted.
- Introduce the equipment required to students.
- Explain students the calibration process of equipment.
- Explain the circuit diagram of the experiment.
- Connections should be completed by the students according to circuit diagram. Perform the experiment in the presence of instructor.
- Verify the results obtained.

Text Book:

[T1] Network Analysis Third Edition by M. E. Van Valkenburg, Prentice Hall of India Private Limited.
[T2] Network Analysis & Synthesis by G. K. Mittal, Khanna Publication.
[T3] Network Analysis and Synthesis by Ravish R Singh, McGraw Hill.
[T4] Introduction to Electric Circuits by Alexander & Sadiku, McGraw Hill.
[T5] Introduction to Electric Circuits by S. Charkarboorty, Dhanpat Rai & Co.
[T6] Fundamentals of Electrical Networks by B.R.Gupta & Vandana Singhal- S.Chand Publications 8. Electrical Circuit Analysis 2nd Edition by P. Ramesh babu, Scitech Publication India Pvt Ltd.

Reference Books:

[R1] Network Analysis by Cramer , McGraw Hill Publication.
[R2] Engineering Circuit Analysis by William H. Hayt, Jr. Jack E. Kemmerly, McGraw Hill Publication.
[R3] Schaum's Outline of Electric Circuits, McGraw-Hill Education; 7 edition

Unit	Text book	Reference
1	T1,T2, T3 T5	R1,R3
2	T1,T2, T3, T4	R1,R3
3	T2, T3,T5	R2,R3
4	T2, T3,T5	R2,R3
5	T2, T3, T4	R3
6	T5,T6	R3

203148: Numerical Methods and Computer Programming

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 25 Marks

Prerequisite:

1. Differentiation and integration of a single real variable, ordinary differential equations.
2. Programming and Problem solving.
3. Linear Algebra.

Course Objectives:

1. To emphasize the need of computational techniques and analyze errors involved in the computation.
2. To provide sound knowledge of various numerical methods.
3. To apply various numerical methods to obtain solution of different types of equations such as transcendental, simultaneous, ODE etc. and also for interpolation, integration and differentiation.
4. To impart skills to develop algorithms and programs for various numerical methods.

Course Outcomes:

On completion of the course, student will be able to

CO1: Demonstrate types of errors in computation and their causes of occurrence.

CO2: Calculate root of algebraic and transcendental equations using various methods.

CO3: Apply numerical methods for various mathematical problems such as interpolation, numerical differentiation, integration and ordinary differential equation.

CO4: Solve linear simultaneous equation using direct and indirect method.

CO5: Develop algorithms and write computer programs for various numerical methods.

Unit 01 : Numerical Computations, Errors and Concept of root of equation (6hrs)

A) Basic principle of numerical computation. Floating point algebra with normalized floating point technique, Significant digits. **Errors**: Different types of errors, causes of occurrence and remedies to minimize them, Generalized error formula (Derivation and Numerical)

B) **Concept of roots** of an equation. Descartes' rule of signs, Intermediate value theorem, Roots of Polynomial Equations using Birge-Vieta method.

Unit 02: Solution of Transcendental and polynomial equation and Curve Fitting: (6hrs)

A) Solution of Transcendental and polynomial equation using Bisection, Regula- Falsi, Newton-Raphson method for single variable and two variables.

B) Curve fitting using least square approximation – First order and second order

Unit 03: Interpolation (6hrs)

Forward, Backward, Central and Divided Difference operators, Introduction to interpolation.

A)Interpolation with equal Intervals - Newton's forward, backward interpolation formula (Derivations and numerical), Stirling's and Bessel's central difference formula (Only numericals)

B) Interpolation with unequal Intervals- Newton's divided difference formula and Lagrange's interpolation (Derivations and numerical).

Unit 04: Numerical Differentiation and Integration (6hrs)

A) **Numerical Differentiation** using Newton's forward and backward interpolation formula (Derivation and numerical).

B) Numerical Integration: Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single integral. Numerical on double integrals using Trapezoidal and Simpson's 1/3 rd rule.

Unit 05:Solution of linear simultaneous equation (6hrs)

A) Solution of linear simultaneous equation: Direct methods - Gauss elimination method, concept of pivoting – partial and complete. Gauss Jordan method, Iterative methods – Jacobi method and Gauss Seidel method.

B)Matrix Inversion using Gauss Jordan method

Unit 06: Solution of Ordinary Differential Equation(ODE) (6hrs)

A) Solution of First order Ordinary Differential Equation (ODE) using Taylor's series method, Euler's method, Modified Euler's method (Derivation and numerical). Runge-Kutta fourth order method (Numerical).

B)Solution of Second order ODE using 4th order Runge-Kutta method (Numerical)

List of Experiments:

Develop computer program using **Python language**

Compulsory Experiments-1,2,3,4,7,10

Any one from 5 or 6 and any one from 8 or 9

1. Develop algorithm, draw flow chart and write a program to implement following:
   (a) for loop and while loop-- application in Descarte's rule of sign.
   (b) if-else and functions-- application in Intermediate value theorem.
   (c) 2DArray formation-- application in matrix data entry, transposition and printing matrix.
2. Develop algorithm, draw flow chart and write a program to implement Birge-Vieta method.
3. Develop algorithm, draw flow chart and write a program to implement Bisection/Regula falsi /Newton-Raphson method (single variable) in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Finding critical clearing angle in power system stability (give equation directly)
   (b) Relation between voltage and current in solar PV.
4. Develop algorithm, draw flow chart and write a program to implement curve fitting using least square approximation in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging.
   (b) Relate temperature and resistance in thermocouple.
   (c) Current through inductor during excitation.
5. Develop algorithm, draw flow chart and write a program to apply Newton's forward/backward interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging
   (b) Relation of speed and armature voltage in DC motor.
   (c) Relation of breakdown voltage and thickness of insulation
6. Develop algorithm, draw flow chart and write a program to apply Newton's divided difference/Lagrange's interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Power transfer equation to find power at particular angle
   (b) Transformer efficiency at particular loading (data of % loading and efficiency in known at a particular power factor)
   (c) Growth of electricity consumption in India (year Vs. Per capita electrical consumption).
7. Develop algorithm, draw flow chart and write a program to implement trapezoidal/ Simpson (1/3)rd rule in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) RMS/Average value of given waveform.
   (b) Finding current through first order circuit (RL series)
   (c) kWh consumption from load curve
   (d) Magnetic field intensity in overhead transmission line
8. Develop algorithm, draw flow chart and write a program to implement Gauss elimination/Jordan in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
9. Develop algorithm, draw flow chart and write a program to implement Gauss Jacobi/Seidel in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
10. Develop algorithm, draw flow chart and write a program to implement Modified Euler's/4^{th} order RK method in following applications (formulate problem statement in any one of following area(but not limited to)
   (a) Response of RC series circuit with DC
   (b) Response of RL circuit with DC
   (c) Deflection angle in MI type instrument

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm and Flowchart of the method
- Three to four different sets of problem statement for numerical method

- Solve numerical using appropriate method
- Ten questions based on method and related Python commands
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm and Flowchart of the method
- Problem statement for numerical method
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on method and related Python commands

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken in the lecture prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

Books & Other Resources:

Text Books:

[T1] M. K. Jain, S.R.K. Iyangar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Publications.
[T2] Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences", Khanna Publishers.
[T3] P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis", Krishna Prakashan Media Ltd, Meerut**.**
[T4] T. Veerarajan and T. Ramchandran, "Numerical Methods with Programs in C and C++", Tata McGraw Hill Publication.
[T5] S Arumugam, "Numerical Methods" Scitech Publication

Reference Books:

[R1] J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH, New Delhi.
[R2] Steven Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publication.
[R3] S.S. Sastry, "Introductory methods of Numerical Analysis", PHI Learning Private Ltd.
[R4] P. Thangaraj, "Computer oriented Numerical Methods", PHI Learning Private Ltd.
[R5] Yashwant Kanitkar, "Let us Python", pbp publications
[R6] NPTEL course on Numerical Analysis, IIT, Roorkee.
https://nptel.ac.in/courses/111107062/
[R7] NPTEL course on MATLAB Programming on Numerical Computation, IIT Madras
https://nptel.ac.in/courses/103106118/
[R8] NPTEL course on Python for Data Science, IIT Madras
https://nptel.ac.in/courses/106106212/
[R9]Jaan Kiusalaas, "Numerical methods in Engineering with Python", Cambridge University Press

Unit No	Text Books	References
1	T5, T4	R2, R3, R6
2	T1, T5	R2, R3, R6
3	T3, T4, T5	R4, R2, R1, R6, R7
4	T2, T3,T5	R2, R3, R7
5	T2, T3,T5	R2, R3, R7
6	T2, T3,T5	R2, R3, R6, R7
Python	--	R5, R8,R9

203149: Fundamental of Microcontroller and Applications

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

- Knowledge of numbering systems and Boolean algebra.
- Knowledge of combinational and sequential logic circuits.

Course Objective: Objectives of the course are to

- Explain the microcontroller architecture & describe the features of a typical microcontroller.
- To use the 8051 addressing modes and instruction set and apply this knowledge to develop programs in assembly language and C language.
- To define the protocol for serial communication and understand the microcontroller development systems.
- Explain the interrupt structure of the microcontroller and to develop programs related to interrupt handling
- To introduce students to Global System for Mobile Communication (GSM)
- To provide students with interfacing concepts and develop interfacing circuits for simple devices.

Course Outcome: Upon successful completion of this course, the students will be able to:-

CO1: Describe the architecture and features of various types of the microcontroller.

CO2: Illustrate addressing modes and execute programs in assembly language for the microcontroller.

CO3: Write programs in C language for microcontroller 8051.

CO4: Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809

CO5: Define the protocol for serial communication and understand the microcontroller development systems.

CO6: Interface input output devices and measure electrical parameters with 8051 in real time.

Unit 01 : (6 Hrs)

Introduction to concept of microcontroller, Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer. Overview of special function registers,Data transfer instructions and programs in assembly language.

Unit 02 : (6 Hrs)

Arithmetic and logical instructions and programs in assembly language.Boolean and Program Branching instructions and programs in assembly language.Addressing modes of 8051.

Unit 03 : (6 Hrs)

8051 Programming in C , Data types in C . Ports of 8051, their use, and programming in C (Byte Level and Bit-level). Time delay programming in C.

Timers and counters in 8051, Timer modes 0,1,2 and its programming in C and counter-programming.

Unit 04 : (6 Hrs)

Interrupt structure of 8051 and SFR associated with interruptsProgramming of External hardware interrupts in C.Interfacing of ADC 0809 with 8051.

Unit 05 : (6 Hrs)

Serial port Structure in 8051. Programming of Serial port for transferring and receiving data in C in mode 1.

Introduction to GSM module, AT commands, Programming to send and read SMS.

Unit 06 : (6 Hrs)

Measurement of electrical parameters such as voltage, current (Theoretical Treatment only).

Interfacing of Stepper motor with 8051 and its programming in C.Interfacing and programming of single Key, LED, and Relay with 8051 in C.

Guidelines for Instructor's Manual

1. Commands to be followed to operate the 8051 microcontroller kit.
2. The architecture of the 8051 microcontroller kit-Functional block diagram & its explanation.
3. Pin Diagram of 8051 microcontrollers with a description of all the 40 pins.
4. Addressing modes-Explanation with an example.
5. Instruction set for Data transfer, Arithmetic, Logical, Branching & Bit manipulation along with an explanation.
6. User manuals of all the interfacing kits such as stepper motor, DC motor, DAC, ADC &LED.

Guidelines for Student's Lab Journal

1. Title of the program.
2. The program has to be written in the following format. Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on a separate page.

Guidelines for Laboratory Conduction

1. Each group in the lab should have not more than three students.
2. Each student within the group has to enter and execute the program turn wise.
3. A faculty member has to check the result of all the groups after the execution of the program.

List of Experiments:

PART A: [TW: 15 Marks]

Compulsory Experiments:

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for the arithmetic operation of 8-bit numbers.
3. Assembly Language Program for finding the largest number and smallest number from a given an array of 8-bit numbers.
4. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order and descending order.

Any four experiments are to be conducted of the following experiments using embedded C :

1. Implementation of Serial Communication by using 8051 serial ports.
2. Programming using a cross-assembler.
3. The blinking display of LED's interfaced with 8051.
4. Interfacing of 8 bit DAC 0808 with 8051 to generate various waveforms.
5. Interfacing of 8 bit ADC 0809 with 8051 Microcontroller.
6. Interfacing of the relay with 8051.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of matrix keyboard/ 7 segment display with 8051.
9. Interfacing of LCD with 8051.

PART B: [TW: 10 Marks]

Prerequisite: Programming exercises of C language.

Compulsory Experiments:

1. Study of GSM Module SIM800/SIM900/QUECTEL M95 and AT Commands
2. Study of IoT system
3. Interfacing of GSM with a computer through COM port to Send and Receive SMS.
4. Interfacing GSM with 8051 trainer kit and develop a program to send AT commands.

Any two experiments are to be conducted of the following experiments:

1. Develop a program in C to read and send SMS from the GSM module.
2. Measurement of physical parameters (Temperature/Pressure/Humidity) using 8051 and send value to GSM after an interval of the specified interval.
3. Measurement of electrical parameters (Voltage/Current) using 8051 and send value to the GSM module after an interval of 10min.
4. Develop a program to turn on and turn off induction Motor using 8051 and GSM module.
5. Development of mobile app for various applications in electrical engineering.

Text Books:

[T1] Muhammad Ali Mazidi, J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearsons Publishers.
[T2] V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
[T3] Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.
[T4] Theagrajan," Microprocessor and Microcontroller", BS Publication.
[T5] K. J. Ayala, "The 8051 Microcontrollers- Architecture, Programming and Applications", Peram International Publications.
[T6] SubrataGhoshal, "8051 microcontroller", Pearsons Publishers.
[T7] Han-Way Huang," Embedded System Design with C8051", Cengage Learning

Reference Books:

[R1] Scott Mackenzie, "8051 Microcontroller", Pearson Education.
[R2] Intel Microcontroller data book.
[R3] Intel Corporation 1990- 8 bit embedded controller handbook.

203152: Project Based Learning

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 04 Hrs/ Week	**PR**:02	**Term Work**: 50 Marks

Preamble: For better learning experience, along with traditional classroom teaching and laboratory learning, project-based learning has been introduced to motivate students to learn by working in a group cooperatively to solve a problem. Project-Based Learning (PBL) is a student-centered and experimental approach to education promoting 'deeper learning' through active exploration of real-world problems and challenges. A central goal of PBL is to facilitate the deeper learning process and support students' acquisition of complex cognitive competencies, e.g., rigorous content knowledge and critical thinking skills. The PBL engages students in the problem definition, design process, contextual understanding, and systems thinking approaches. In the PBL approach, learning based on memorization is de-emphasized and more emphasis is given on understanding and application of engineering design principles. Because of frequent assessments throughout the course, plagiarism can be more easily controlled.

Course Objectives: Objectives of this course are to

1. Impart technical knowledge and skills, and develop deeper understanding to integrate knowledge and skills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovation amongst students
3. Make students aware of their own academic, personal, and social developments.
4. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyond own ideas and knowledge

Course Outcomes: At the end of this project-based learning, students will be able to

CO1: Identify, formulate, and analyze the simple project problem.

CO2: Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.

CO3: Learn to work in teams, and to plan and carry out different tasks that are required during a project.

CO4: Understand their own and their team-mate's strengths and skills.

CO5: Draw information from a variety of sources and be able to filter and summarize the relevant points.

CO6: Communicate to different audiences in oral, visual, and written forms.

Procedure: A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted. The complete work-plan should be divided in the form of the individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be presenting the work completed and submitting the report. A group should be promoted to participate in a competition or write a paper.

A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity. It may have

- ✓ A few hands-on activities that may or may not be multidisciplinary.
- ✓ Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.
- ✓ Activities on solving real-life problems, investigation /study, and writing reports of in-depth study, fieldwork.

Assessment:

The department/mentor is committed to assess and evaluate both students' performance and course effectiveness. The progress of PBL is monitored regularly every week. During the process

of monitoring, continuous assessment and evaluation the individual and team performances are to be measured by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning, and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in the assessment and evaluation processes. Groups may demonstrate their knowledge and skills by developing a solution to the problem, public product, and/or report and/or presentation.

- ✓ Individual assessment for each student (Understanding individual capacity, role, and involvement in the project)
- ✓ Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- ✓ Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities are to be recorded in a PBL workbook regularly, regular assessment of work to be done and proper documents are to be maintained at the department level by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department. Recommended parameters for assessment, evaluation, and weightage are as follows.

- ✓ Idea Inception **(5%)**
- ✓ Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product **(50%)** (Individual assessment and team assessment)
- ✓ Documentation (Gathering requirements, design and modeling, implementation/execution, use of technology and final report, other documents) **(25%)**
- ✓ Demonstration (Presentation, User Interface, Usability, etc.) **(10%)**
- ✓ Contest Participation/ publication **(5%)**
- ✓ Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%)**
- ✓ PBL workbook will serve the purpose and facilitate the job of students, mentors, and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken

203153: Audit Course-IV

List of three audit course is provided. Students can choose any one from 203153(A) 203153(B) and 203153(C)

203153(A): Solar Photovoltaic Systems

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Prerequisite: Completion of FE or equivalent

Description: The course will introduce the basics of: solar energy, availability, semiconductors as photovoltaic convertors and solar cells, applications of photovoltaic, various types of solar photovoltaic systems, and introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The practical will be designed for basic understanding of the system elements.

Course Objective:

- To learn Solar PV system and its appliances
- To get knowledge of balance of PV system, batteries, inverters etc.
- To understand grid tied SPV solar plants

Course Outcome: Students will be able to

CO1: design of Solar PV system for small and large installations

CO2: handle software tools for Solar PV systems

Course Contents:

- Physics of photovoltaic (PV) electricity
- Photodiode and solar cell
- Solar radiation spectrum for PV •
- Types of solar cell and comparison
- Introduction to various types of solar module manufacturing
- Basic system design and economics
- Types of systems
- Common applications of solar PV
- Introduction to solar PV (SPV) systems
- SPV appliances
- Small capacity SPV power plants
- Grid tied SPV power plants
- Large scale SPV power plants
- Balance of system
- Solar inverters
- Batteries
- Financial modelling of SPV
- Operation and maintenance of SPV
- Software tools for SPV
- Environmental impact assessment
- Standards and certification for SPV
- Basics of SPV systems
- Elements of SPV appliances and power plants Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly
- Manufacturing standards
- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication

- Typical shop layouts
- Inventory management
- Economics of manufacturing

Practical:

- PV characterization
- Batteries and energy storage
- PV system design

Assignment

- Design of solar PV system for department / college.

References:

[1] A.S.Kapur -A Practical Guide for Total Engineering of MW capacity Solar PV Power Project
[2] Solanki C.S- Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers- PHI
[3] Solanki C.S- SolarPhotovoltaics - Fundamentals, Technologies and Applications- PHI
[4] S. Sukhatme -Solar Energy : Principles of Thermal Collection and Storage- McGraw Hill

203153(B) Installation & Maintenance of Electrical appliances

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Prerequisite: Completion of FE/DEE or equivalent

Course Objective: This course has been designed to provide the knowledge of Repairing and Maintenance of home appliances. Students will be familiar with maintenance of everyday household necessities.

Course Outcome: At the end of the course the students will be having knowledge of: -

- Observing the safety precautions while working,
- Test line cord for continuity with test lamp/ multimeter
- Dismantle and reassemble an electric iron
- Heater, kettle, room heater, toaster, hair dryer, mixer grinder etc.
- Install a ceiling fan and the regulator
- Check a fluorescent lamp chock, starter and install it
- Domestic installation testing before energizing a domestic installation

Course Contents:

- General safety & electrical safety
  - What is safety, Why safety is needed
  - Tools for electrical safety
  - Safety rules
  - Precaution during electrical maintenance
- Crimping & crimping tool, soldering
  - What is crimping, crimping tool, How to use RJ-11 connector, telephone wire, UTP Cable
  - crimping technique, precaution during crimping
  - Soldering Iron, Soldering wire, Soldering Flux,
  - Soldering method, Zero defect soldering
- Earthing& types of Earthing
  - Introduction of Earthing
  - Need of Earthing, Hazard
  - Types of Earthing
  - Advantage of Earthing, working of Earthing
- Simple house wiring circuit
  - Introduction of Wiring ,types of wiring
  - need of wiring, advantage of wiring
  - wiring methods
  - electrical panel
  - cable type
- Install, service and repair of automatic electric iron, mixer grinder, ceiling and table fan, heater, iron, kettle, washing machine etc
  - Installation procedure of electric iron,
  - Installation procedure mixer grinder
  - Installation procedure of ceiling and table fan,
  - Installation procedure heater, iron, kettle
  - Installation procedure washing machine
  - fault finding & removal of faulty component in electric iron, mixer grinder, ceiling and table fan
  - fault finding & removal of faulty component in heater, iron, kettle, washing machine
- Assemble and install of a fluorescent lamp
  - Parts of fluorescent lamp,
  - Working principle of fluorescent lamp

- Assembling procedure of lamp

- Thermostat heat controls of Automatic electric iron, steam iron, spray irons.
  - Thermostat, Bimetal, Wax Pallet , Gas Expansion, Pneumatic,
  - Bimetallic Switching thermostat, Simple two wire thermostats
  - Combination heating/Cooling regulation, Heat Control of Steam Iron, Electric Iron
- Maintenance of decorative serial lamp for a required supply voltage
  - What is decorative lamp, Working of decorative lamp
  - Description of decorative serial lamp,
  - Maintenance of decorative serial lamp
- Introduction to re- winding Insulating material used
  - Material, Types of Material
  - Insulating Material, Types of Insulating Material
  - Need of insulating material, winding, re-winding

References:

[1] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House
[2] B. K. N. Rao -Hand book of condition monitoring- Elsevier Advance Tech., Oxford (UK).
[3] Eric Kleinert-Troubleshooting and Repairing Major Appliances / Edition 3- McGraw Hill
[4] Service Manual of Electrical Home Appliances

203153(C) Japanese Language-II

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Course Objective:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome: On completion of the course student

- Will have ability of basic communication.
- Will have the knowledge of Japanese script.
- Will get introduced to reading , writing and listening skills
- Will develop interest to pursue professional Japanese Language course.

Course Contents:

Unit 1: Katakana basic Script, Denoting things (nominal & prenominal demonstratives)Purchasing at the Market / in a shop / mall (asking & stating price)

Unit 2: Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowelsDescribing time, describing starting & finishing time (kara ~ made) Point in time (denoting the time when any action or the movement occurs)

Unit 3: Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle

References:

1. Minna No Nihongo, “Japanese for Everyone”, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.

Guidelines for Conduction

(Any one or more of following but not limited to)

- Guest Lectures
- Visiting lectures
- Language Lab

Guidelines for Assessment (Any one of following but not limited to)

- Written Test
- Practical Test
- Presentation
- Paper
- Report