

SAVITRIBAI PHULE PUNE UNIVERSITY



FACULTY OF ENGINEERING

**SYLLABUS FOR S. E. (ELECTRICAL
ENGINEERING)**

(2015 course)

WITH EFFECT FROM YEAR 2016-2017

SavitribaiPhule Pune University
S.E. Electrical Engineering 2015 – Course
(w. e. f. 2016-2017)

Semester I													
Sr. No.	Subject Code	Subject Title	Teaching Scheme			Semester Examination Scheme of Marks						Credit	
			Th.	Tut.	Pr.	Paper		TW	PR	OR	Total	TH/TUT	PR+OR
						In Sem(Online)	End Sem						
1.	203141	Power Generation Technologies	04	--	--	50	50	--	--	--	100	04	---
2.	207006	Engineering Mathematics-III	04	01	--	50	50	25	--	--	125	05	---
3.	203142	Material Science	04	--	02	50	50	--	--	50	150	04	01
4.	203143	Analog and Digital Electronics	04	--	02	50	50	25	50	--	175	04	01
5.	203144	Electrical Measurements and Instrumentation	04	--	02	50	50	25	50	--	175	04	01
6.	203151	Soft Skills	--	--	02	--	--	25	--	--	25	--	01
Total											21	04	
7.	203154	Audit Course I	--	--	--	--	--	--	--	--	--	Grade: PP/NP	
Total			20	01	08	250	250	100	100	50	750	25	

Semester II													
Sr. No.	Subject Code	Subject Title	Teaching Scheme			Semester Examination Scheme of Marks						Credit	
			Th.	Tut.	Pr.	Paper		TW	PR	OR	Total	TH/TUT	PR+OR
						In Sem(Online)	End Sem						
1.	203145	Power System I	04	--	--	50	50	--	--	--	100	04	--
2.	203146	Electrical Machines I	04	--	02	50	50	25	50	--	175	04	01
3.	203147	Network Analysis	04	--	02	50	50	50	--	--	150	04	01
4.	203148	Numerical Methods and Computer Programming	04	01	02	50	50	25	50	--	175	05	01
5.	203149	Fundamentals of Microcontroller and Applications	04	--	02	50	50	--	--	50	150	04	01
Total											21	04	
6.	203155	Audit Course II	--	--	--	--	--	--	--	--	--	Grade: PP/NP	
Total			20	01	08	250	250	100	100	50	750	25	

TW: Term Work **OR:Oral** **PR:** Practical

PP: Passed (Only for non-credit courses) **NP:** Not Passed (Only for non-credit courses)

Audit Course

- Audit Course: Optional for 1st and 2nd term of SE Electrical Engineering
- ‘Audit Courses’ means a Course in which the student shall be awarded Pass or Fail only. It is left to the discretion of the respective affiliated institute to offer such courses to the students. Evaluation of audit course will be done at institute level itself.
- Teaching-learning process for these subjects is decided by concern faculty/industry experts appointed by the affiliated Engineering College.
- Marks obtained by student for audit course will not be taken into consideration of SGPA or CGPA.

203154:Audit Course I Solar Thermal Systems.

**203155:Audit Course II (A) Solar PV Systems.
 (B)Installation & Maintenance of Electrical
 appliances.**

203141: Power Generation Technologies

Teaching Scheme
Th:04 Hrs/ Week

Credits
Th/Tut:04

Examination Scheme [Marks]
In Sem (Online):50 Marks
End Sem:50 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 grid, stand alone and hybrid system.

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

- Identify operations of thermal power plant with all accessories and cycles.
- Be aware of the principle of operation, components, layout, location, environmental and social issues of nuclear, diesel and gas power plant.
- Identify and demonstrate the components of hydro power plant and calculation of turbine required based on catchment area.
- Find the importance of wind based energy generation along with its design, analysis and comparison.
- Apply solar energy in thermal and electrical power generation considering energy crisis, environmental and social benefits.
- Understand the operation of electrical energy generation using biomass, tidal, geothermal, hydel plants, fuel cell and interconnection with grid.

Unit 01 : Thermal Power Plant

(9 Hrs)

Basic thermodynamic cycles: Thermodynamic cycle of steam flow; Rankine cycle; Actual Rankine cycle; Reheat cycle; Carnot cycle, heat rate.

Thermal Power Plants: Site selection, Main parts and its working. Types of boilers, Feed water and its treatment, Various boiler controls, assessment of heat recovery systems Steam turbines types, selection and control of turbines.

Fuel Handling: delivery of load, unloading, preparation, transfer, outdoor (dead) storage, indoor (live) storage, In-plant Handling, Coal weighing.

Ash disposal and dust collection: Draught systems, electrostatic precipitator. Recent Development in thermal power plants.

Unit 02 :

(9 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, plant layout. Recent Development in nuclear power plants.
- B. Diesel Power Plants:** Main components and its working, Diesel plant efficiency and heat balance, choice and characteristic of diesel power plant. Selection of components and sizing.
- 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 and concept of heat to power ratio. Recent Development in Gas power plants.

Unit 03 : Hydro Power Plant (8 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 hydrographs and number of turbine required. Control of hydro turbines. Small, mini and micro hydro power plant, Recent Development in hydro power plants.

Unit 04 : Wind Energy Systems (8 Hrs)

Historical Development of Wind Power, Types of wind turbine electrical generators, Power in the Wind, Impact of Tower Height, Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind, Wind turbine power converters (block diagrams), 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 (8 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, 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.

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.

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	R2,R3,R4
6	T5,T7	R4

SE(Electrical/Instrumentation and Control)
207006: Engineering Mathematics-III

Teaching Scheme
Th:04 Hrs/ Week
Tut:01 Hr/Week

Credits
Th/Tut: 05

Examination Scheme [Marks]
In Sem (Online):50 Marks
End Sem:50 Marks
Term Work:25 Marks

Prerequisite:

- Differential and Integral Calculus
- Taylor series and Infinite series
- Differential equations of first order and first degree
- Fourier series, Vector algebra
- Algebra of complex numbers.

Course Objective: After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:-

- Linear differential equations of higher order applicable to Control systems.
- Transforms such as Laplace transform, Fourier transform, Z-Transform and applications to Control systems and Signal processing.
- Vector differentiation and integration required in Electro- Magnetics and Wave theory.
- Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image Processing.

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

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Laplace transform, Fourier transform, Z-Transform and applications to Signal processing and Control systems.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electro-Magnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 01 : Linear Differential Equations (LDE) and Applications (9 Hrs)

LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit 02 : Laplace Transform(LT) (9 Hrs)

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 03 : Fourier and Z - transforms (9 Hrs)

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

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

Unit 04 : Vector Differential Calculus (9Hrs)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit 05 : Vector Integral Calculus and Applications (9Hrs)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.

Unit 06 : Complex Variables (9Hrs)

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

Text Books:

- [T1] Erwin Kreyszig, "Advanced Engineering Mathematics", 9e, (Wiley India).
- [T2] Peter V. O'Neil, "2. Advanced Engineering Mathematics", 7e, (Cengage Learning).

Reference Books:

- [R1] M. D. Greenberg, "Advanced Engineering Mathematics", 2e, Pearson Education.
- [R2] Wylie C.R. & Barrett L.C. "Advanced Engineering Mathematics", McGraw-Hill, Inc.
- [R3] B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.
- [R4] P. N. Wartikar & J. N. Wartikar, "Applied Mathematics (Volumes I and II)", Pune Vidyarthi Griha Prakashan, Pune.
- [R5] B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
- [R6] Thomas L. Harman, James Dabney and Norman Richert, "Advanced Engineering Mathematics with MATLAB", 2e, Brooks/Cole, Thomson Learning.

Guidelines for Tutorial and Term Work:

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

203142: Material Science

Teaching Scheme
Th:04 Hrs/ Week
PR:02 Hrs/ Week

Credits
Th/Tut: 04
PR:01

Examination Scheme [Marks]
In Sem (Online):50 Marks
End Sem : 50 Marks
Oral :50 Marks

Prerequisite:

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

Course Objective:

- To classify different materials from Electrical Engineering application point of view.
- To understand various properties and characteristics of different classes of materials.
- To select materials for applications in various electrical equipment.
- To impart knowledge of Nano-technology, battery and solar cell materials.
- To develop ability to test different classes of materials as per IS.

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

- Categorize and classify different materials from Electrical Engineering applications point of view.
- Explain and summarize various properties and characteristics of different classes of materials.
- Choose materials for application in various electrical equipment.
- Explain and describe knowledge of nanotechnology, batteries and solar cell materials.
- Test different classes of materials as per IS.

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

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), ClausiusMossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta (δ).

Unit 01 B] : Optical Properties of Materials: (2 Hrs)

Comparison between materials used for Photo-Conductive, Photo-Electric Emissive and Photo-Voltaic cell. Different materials used for plastic, organic and thin-film solar cells (Mono-Crystalline, Poly-Crystalline). Introduction to fiber optics, materials used and its applications.

Unit 02 A] : Insulating Materials, Properties & Applications: (6Hrs)

Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Amorphous materials Polymers, Ceramics, Enamels. Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF₆. Insulating Materials for Power & Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

Unit 02 B] : 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 03 : Magnetic Materials: (8Hrs)

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, Curie-Weiss law, 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, Magnetic Recording Materials, Compact Discs. Introduction to laser and magnetic strip technology.

Unit 04 : Conducting Materials: (8Hrs)

General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High & Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Canthal, Silver & Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Materials used for Lamp Filaments, Transmission Lines, Electrical Carbon Materials, Materials for Super-capacitors. Material used for Solders, Metals & Alloys for different types of Fuses, Thermal Bimetal & Thermocouple. Introduction to Superconductivity and Super Conductors.

Unit 05 A] : Nanotechnology: (6Hrs)

Introduction, Concepts of Energy bands & 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.

Unit 05 B] : Batteries: (2 Hrs)

Materials used for Batteries: Lead Acid, Lithium-ion, Sodium-Sulphur, Nickel-Cadmium, Zero Emission Battery Research Activity (ZEBRA) Batteries. Batteries used in Electric Vehicle (EV) and Electric Hybrid Vehicle (EHV).

Unit 06 : Testing of Materials: (8Hrs)

Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.

1. Measurement of Dielectric Loss Tangent ($\tan \delta$) 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.
5. Measurement of Flux Density by Gauss-meter.

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 Lab /TW Assessment

There is **no Term Work** for the subject. But continuous assessment 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.

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).

List of Experiments: (Any **eight experiments** from the list below).

1. To measure dielectric strength of solid insulating materials.
2. To measure dielectric strength of liquid insulating materials.
3. To measure dielectric strength of gaseous insulating materials using Sphere Gap-Unit.
4. To obtain Hysteresis Loop of the Ferro-Magnetic Material.
5. To understand the principle of thermocouple & to obtain characteristics of different thermocouples.
6. To measure Insulation Resistance & 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 ($\tan \delta$) of solid/liquid dielectric materials.
11. Measurement of Flux Density by Gauss-meter.

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

Text Books:

- [T1] S. P. Seth, “A Course in Electrical Engineering Materials”, DhanpatRai and Sons publication.
- [T2] “Electrical Engineering Materials”, T.T.T.I, Madras.
- [T3] K. B. Raina& S. K. Bhattacharya, “Electrical Engineering Materials”, S. K. Kataria& Sons.
- [T4] P.K. Palanisamy, “Material Science for Electrical Engineering”, SciTech Pub. (India) Pvt. Ltd., Chennai.
- [T5] Charles P. Poole, Jr. Frank & J. Ownes, “Introduction to Nanotechnology”, Wiley Student Edition.
- [T6] Ronald M. Dell and David A.J. Rand, “Understanding Batteries”, Royal Society of Chemistry, 2001 Publication.

Reference Books:

- [R1] D. M. Tagare, “Electrical Power Capacitors-Design & Manufacture”, Tata McGraw Hill Publication.
- [R2] S. P. Chalotra& B. K. Bhatt, “Electrical Engineering Materials”, Khanna Publishers, Nath Market.
- [R3] C. S. Indulkar& S. Thiruvengadam, “Electrical Engineering Materials”, S. Chand & Com. Ltd.
- [R4] Kamraju& Naidu, “High Voltage Engineering”, Tata McGraw Hill Publication.
- [R5] James F. Shackelford & M. K. Muralidhara, “Introduction to Material Science for Engineering”, Sixth Edition by Pearson Education.
- [R6] “Insulation Technology Course Material of IEEMA Ratner”, Pearson Education.
- [R7] Traugott Fischer, “Materials Science for Engineering Students”, Elsevier publications.
- [R8] Rakosh Das Begamudre, “Energy Conversion Systems”, New Age International Publishers.
- [R9] David Linden, “Handbook of Battery and Fuel Cells”, McGraw Hill, 1984, Publication.
- [R10] Chetan Singh Solanki, “Solar Photovoltaic: Fundamentals, Technologies and Applications”, Prentice Hall of India Publication.
- [R11] R. P. Deshpande, “Ultra capacitors – future of energy storage”, McGraw Hill, Publication.
- [R12] Linden and Reddy, “Handbook of Batteries”, New York McGraw Hill, 2002, Publication.
- [R13] R. P. Khare, “Fiber optics and Optoelectronics”, Oxford University publication.

Unit	Text Books	Reference Books
1	T1, T3	R1, R3, R8, R10, R13
2	T1, T4	R1, R3
3	T1, T2	R2, R3, R5
4	T1, T2	R1, R3, R6
5	T5, T6	R7, R9, R11, R12
6	T1	R4

203143: Analog And Digital Electronics

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
Practical : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Practical : 50 Marks
		Term Work : 25 Marks

Prerequisite:

- Basics of numbering system.
- Basics of diodes and BJT.

Course Objective:

- To demonstrate the concept of numbering system & Boolean's algebra reduction using K map.
- To design and analyze sequential and combinational circuits.
- To develop the concept of basics of operational Amplifier and its applications.
- To introduction to BJT and diode rectifier.

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

- Understand conversion of number system, perform binary arithmetic and reduce Boolean expressions by K- Map.
- Demonstrate basics of various types of Flip flops, design registers and counter.
- Analyze parameter of Op-amp and its applications.
- Apply the knowledge of Op-amp as wave form generators & filters.
- Use BJT as amplifier with various configurations.
- Analysis of uncontrolled rectifier.

Unit 01 : Number system & Boolean's Algebra: (8 Hrs)

Numbering systems-binary, octal, decimal and hexadecimal and their conversion, codes-BCD, Grey and excess3, Binary arithmetic: - addition and subtraction by 1's and 2's compliment. Booleans algebra, De-Morgan's theory etc. K-map: - structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map.

Unit 02 : Combinational & Sequential circuits: (9 Hrs)

Concept of Combinational & Sequential circuits, Flip flops – R-S, Clocked S-R, D latches, Edge Triggered D flip-flops, Edge triggered JK flip flops, JK Master - slave flip flop, Register- Buffer registers, shift registers, controlled shift registers, ring counter, Counters – asynchronous Counters, synchronous counter, up - down counter , twisted ring counters, N –moduleCounters.

Unit 03 : Operational Amplifier & Applications: (8 Hrs)

Op-Amp: Block diagrams of 741, ideal and practical parameters, open loop and close loop configuration of Op-Amp. Applications of Op- Amp- Comparator, Schmitt trigger, zero crossing detectors, V-I and I-V converters, Instrumentation amplifier, peak detector.

Unit 04 : Waveform generators, Filters & Regulators: (8 Hrs)

Waveform generation using Op-amp - sine, square, saw tooth and triangular generator, Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using ICs 78xx, 79xx, LM 317

Unit 05 : BJT & Applications: (8 Hrs)

BJT amplifier: Introduction, Class A amplifier, AC-DC load line analysis, Single stage and Multistage BJT amplifier, direct coupled, RC coupled and transformer coupled, Darlington pair, Push-Pull amplifier and differential amplifier FET-construction, Parameters, Characteristics.

Unit 06 : Diode & Precision Rectifiers: (7 Hrs)

Diode rectifier: Introduction, 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. Comparison of single phase half wave and full wave rectifiers,

Precision rectifiers: Half wave and Full wave. Comparison of diode and precision rectifier.

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 (3 to 5)
- List of components required with their specifications , data sheets of ICs used

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, data sheets of ICs used.

Guidelines for Lab /TW Assessment

- There should be continuous assessment of the TW.
- 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.

List of Experiments:

Total **ten** experiments are to be conducted out of following experiments:

First seven experiments are compulsory.

1. Study of ring counter and twisted ring counter.
2. Study of up - down counters (IC 74192/74193) and N- modulo counter. (IC 7490/7493).
- 3*. Study of Op-amp as Schmitt trigger.
4. Study of Instrumentation amplifier using three Op-amp, CMR measurement
- 5*. Study of Op-amp as sine, and triangular wave generator.
- 6*. Study of IC-555 applications- astable, monostablemultivibrator.
- 7*. Study of Single Phase Full-wave bridge rectifier with RL load.

Any three experiments are to be conducted of following experiments:

1. Study of Three Phase Full-wave Rectifier with R load.
- 2*. Study of active filters- Low pass and high pass filters.
3. Transistor amplifiers: frequency response of BJT, multistage BJT amplifier.
- 4*. Study of Single Phase Half-Wave Rectifier.
5. Study of op-amp as a ZCD & Comparator
6. Study of various flip-flops and verification of truth table.
7. Study and verify shift register operation (IC 7495).

** These experiments should be performed on general purpose PCB/ Breadboard.*

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.

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.

Unit	Text Books	Reference Books
1	T1, T2	R1
2	T1, T2, T3	R2
3	T4, T5	R3, R4
4	T4, T5	R3, R4
5	T5, T6	R5
6	T7	R6

203144: Electrical Measurements and Instrumentation

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Practical : 50 Marks
		Term Work : 25 Marks

Course Objective:

- To provide the knowledge of system of units, classification and essentials of measuring instruments.
- To get the knowledge about the construction & operation of various electrical & non electrical measuring instruments.
- To apply the knowledge to identify the measuring instruments & make use of it for quantifying measurements of electrical parameters.

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

- Understand various characteristics of measuring instruments, their classification and range extension technique.
- Classify resistance, apply measurement techniques for measurement of resistance, inductance.
- Explain construction, working principle and use of dynamometer type wattmeter for measurement of power under balance and unbalance condition.
- Explain Construction, working principle of 1-phase and 3-phase induction, static energy meter and calibration procedures.
- Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications.
- Measurement of various physical parameters using transducers.

Unit 01 : (9 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) (attraction and repulsion), and Permanent Magnet Moving Coil (PMMC), block diagram and operation of digital ammeter & voltmeter.

B. Range Extension: PMMC ammeters and voltmeters using shunts, multipliers. Universal shunt, universal multiplier. Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT over shunt and multipliers for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02 : (8 Hrs)

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

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

Unit 03 : (8 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. Power analyzer, Multi meter.

Unit 04 : (7 Hrs)
Measurement of Energy: Construction, working principle, torque equation, errors and adjustments of single phase conventional (induction type) energy meter. Calibration of energy meter. Block diagram and operation of electronic energy meter. Three phase energy meter, TOD meter.

Unit 05 : (8 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 & numerical. 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 : (8 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, application, null voltage, 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 etc.; their construction, working, advantages and disadvantages.

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 & 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.

List of Experiments:

Compulsory Experiments: (06) Six.

1. Demonstration of working parts of various types of meter by opening the instrument & explanation of symbols & notations used on instruments.
2. Extension of instrument range: ammeter, voltmeter, watt meter using CT & PT.
3. Measurement of active & reactive power in three phase circuit using two wattmeter methods (balanced & unbalanced loads).
4. Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two way switch.
5. Calibration of single phase static energy meter at different power factors.
6. Measurement of voltage, current, time period, frequency & phase angle using CRO.

Any four experiments are to be conducted of following experiments:

1. Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.
2. Measurement of power in three phase, four wire system using three CTs & two wattmeter.
3. Calibration of single phase wattmeter at different power factors.
4. i) Measurement of resistance by ammeter voltmeter method.
ii) Measurement of low resistance using Kelvin's double bridge.
5. Measurement of inductance using Anderson's bridge/ Maxwell's bridge.

6. Displacement measurement by LVDT.
7. Electrical methods for measurement of liquid level.

Industrial Visit (If Any): 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.

Text Books:

- [T1] A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation” DhanpatRai& 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” by, PHI Publication.

Unit	Text Books	Reference Books
1	T1,T2,T3,T4	R1,R2,R3,R4
2	T1,T2	R1,R4
3	T1,T2	R1,R2
4	T1,T2	R1,R2
5	T1,T2,T3,T4	R2,R3,R4
6	T1,T2,T3	R2,R3

203151: Soft Skills

Teaching Scheme
PR : 02 Hrs/ Week

Credits
PR: 01

Examination Scheme [Marks]
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, etiquettes 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 :-

- DoSWOT analysis.
- Develop presentation and take part in group discussion.
- Understand and Implement etiquettes in workplace and in society at large.
- Work in team with team spirit.
- 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 Etiquettes: (2 Hrs)

Corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting: Understand the importance of professional behavior at the work place, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquettes (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

*** Perform any 8 exercises out of above 11 with exercise no. 11 as compulsory.**

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 minutesearch)
- 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. McGrath, “Basic Managerial Skills for all”, Eastern Economy Edition, Prentice hall India.
- [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, ISBN-139780743409384.

- [R7] Wayne Dyer, “Change Your Thoughts, Change Your Life”, Hay House India, ISBN-139788189988050.
- [R8] Stephen Covey, “Habits of Highly Effective People”, Pocket Books, ISBN-139781416502494.
- [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] SharuRanganekar, “Wonderland of Indian Manageress”, Vikas Publishing Houses, ISBN-13 9788125942603.
- [R14] Shiv Khera, “You can win”, Macmillan, ISBN-139789350591932.
- [R15] Gopaldaswamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”.

203154:Audit Course I

Solar Thermal Systems

Course Name: Solar Thermal Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:

Lectures: 2 h per week

Field Visit: 4 h

Examination Schemes: Audit (P/F)

Written and MCQ

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 firsthand 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

- Differentiate between types of solar Concentrators
- Apply software tool for solar concentrators
- 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

References:

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

203145: Power System I

Teaching Scheme
Th : 04 Hrs/ Week

Credits
Th/Tut: 04

Examination Scheme [Marks]
In Sem (Online) : 50 Marks
End Sem : 50 Marks

Prerequisite:

- Power Generation.
- Various insulating materials and properties.
- Knowledge of fundamental of electrical circuit components.

Course Objective:

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

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

- Recognize different patterns of load curve, calculate different factors associated with it and tariff structure for LT and HT consumers.
- Aware of features, ratings, application of different electrical equipment in power station and selection of overhead line insulators.
- Analyze and apply the knowledge of electrical and mechanical design of transmission lines.
- Identify and analyze the performance of transmission lines.

Unit 01 : Structure of Electrical Power Systems and tariff: (8 Hrs)

- 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, Interconnected grid system. Fitting of available generating stations into the area load duration curve.
- B) Tariff :** Introduction of Tariff, Tariff setting principles, desirable characteristics of Tariff, various consumer categories and implemented tariffs such as two part, three part, Time of Day tariff for H.T. & L.T. industrial and commercial consumers along with current electricity charges, Introduction to Availability Based Tariff (ABT), Interruptible tariff, Incentives and penalties applied to various consumers.

Unit 02 : Major Electrical Equipment's in Power Stations and Overhead line insulators : (8 Hrs)

- A) Major Electrical Equipment's in Power Stations :** 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, transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays, current transformers, Potential transformers, Lightning arresters, Earthingswitches, isolators, carrier current equipment (P.L.C.C.), Control panels, battery rooms, metering and other control room equipment in generating stations.

- B) Overhead Line Insulators:** Types of insulators & their applications such as pin type, suspension type, strain type, Silicon Rubber insulators, post insulators, Shackle insulators, bushings, voltage distribution along string of suspension insulators, string efficiency, equalization of potential across each unit, method of improving string efficiency, insulator failure.

Unit 03 : Mechanical Design of Overhead Lines and Underground

Cables:

(8 Hrs)

- A) Mechanical Design of Overhead Lines:** Main components of overhead lines, Line supports, conductor spacing, length of span, calculation of sag for equal and unequal supports and effect of ice and wind loadings.
- B) Underground Cables:** Classification, Construction of cable, XLPE cables, insulation resistance, dielectric stress in single core cable, capacitance of single core and three core cable, cables used for HVDC transmission. Grading of cables, inter sheath grading, capacitance grading.

Unit 04 : Resistance and Inductance of Transmission Line:

(9 Hrs)

Resistance of transmission line, skin effect and its effects, proximity effect, internal & external flux linkages of single conductor, inductance of single phase two wire line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of G.M.R. and G.M.D, necessity of transposition, inductance of three phase double circuit line with symmetrical and unsymmetrical spacing, inductance of bundled conductors.

Unit 05 : Capacitance of Transmission Line:

(7 Hrs)

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, capacitance of three phase line with symmetrical and unsymmetrical spacing, capacitance of double circuit three phase line with symmetrical and unsymmetrical spacing.

Unit 06 : Performance of Transmission Lines:

(8 Hrs)

Classification of lines based on length and voltage levels such as short, medium and long lines. Performance of short transmission line with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Pi' and 'Nominal Tee' circuits using R, L and C parameters. Ferranti effect, Representation of 'Tee' and 'Pi' models of lines as two port networks, evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of Efficiency & regulation of short & medium lines.

Industrial visit: Minimum one visit to HV substations is recommended.

Text Books:

- [T1] J. B. Gupta, "Transmission and Distribution", S. K. Kataria & Sons, New Delhi.
- [T2] V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication
- [T3] J. B. Gupta, "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] “Know your Power – citizen’s primer” – Prayas energy group

References:

www.mahadiscom.in
www.mercindia.org.in

203146: Electrical Machines I

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Practical : 50 Marks
		Term Work : 25 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 test & analyze the performance of machine.
- To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.

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

- Apply energy conversion principles to different machines.
- Select machine for specific applications.
- Test the various machine for performance calculation.

Unit 01 : Transformers: (8 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. Open circuit and short circuit tests, determination of equivalent circuit parameters from the test data and determination of voltage regulation and efficiency. Autotransformers, their ratings and applications. Comparison with two winding transformer with respect to saving of copper and size.

Unit 02 : Transformers: (8 Hrs)

Polarity test. Parallel operation of single phase transformers, conditions to be satisfied, load sharing 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: (8 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: (8 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, straight line commutation, commutation with variable current density, under and over commutation, causes of bad commutation and remedies, inter poles, compensating windings. (Descriptive treatment only)

Unit 05 : Three Phase Induction Motor: (8 Hrs)

Production of rotating mmf by 3-phase balanced voltage fed to a symmetrical 3-phase winding. Construction: Stator, Squirrel cage & wound rotors. 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: (8 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; stator resistance starter, auto transformer starter, star delta starter and rotor resistance starter. D.O.L. starter and soft starting, with their relevant torque and current relations. Comparison of various starters. , testing of three phase induction motor as per IS 325 & IS 4029.

Guidelines for Instructor's Manual

- Prepare 4/5 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges and whether moving coil or moving iron etc.
 - **Theory:** Brief theory explaining the experiment
 - **Circuit / connection diagram** or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
 - **Procedure:** Write down step by step procedure to perform the experiment.
 - **Observation table:**
 - **Sample calculation:** For obs. number ---
 - **Result table:**
 - **Nature of graph:**
 - **Conclusion:**
 - **Comments if any:**
 - **Questions / Answers:** Write minimum 5/ 6 questions / answers based on each experiment.

Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
7. Use black or blue ink pen for writing.

Guidelines for Laboratory Conduction

1. Check whether the MCB / ELCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked within week.

Guidelines for Lab /TW Assessment

1. Do the continuous assessment. The experiment performed in a particular week, should be checked within same week or at the most in next week.
2. While assessment, teacher should put the remark by writing word "Complete" and not simply "C". Put the signature along with date at the end of experiment and in the index.
3. Assign 10 marks for each experiment as per following format
Timely completion = 03 marks
Neat and clean writing = 02 marks
Depth of understanding = 03 marks
Regular attendance = 02 marks
4. Maintain continuous assessment sheet. At the end of semester, convert these marks out of as prescribed in syllabus structure and display on the notice board.

List of Experiments:

Compulsory Experiments:

1. O.C. and S.C. test on single phase Transformer.
2. Polarity test on single phase and three phase transformer
3. Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedances.

Any five experiments are to be conducted of following experiments:

1. Speed control of D.C. Shunt motor and study of starters.
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. Load test on 3-phase induction motor.
6. No load & blocked-rotor test on 3-phase induction motor :
 - a) Determination of parameters of equivalent circuit.
 - b) Plotting of circle diagram.
7. Calculation of motor performance from (a) & (b) above.
8. Determination of sequence impedance of the transformer
9. To study Sumpner's test.
10. Measurements of non-sinusoidal current waveform of transformer at no load
Swinburne Test on DC shunt Motor.

Industrial Visit:

- Minimum One visit to above machines manufacturing industry (mentioned in syllabus) is recommended.
- Assignment based on IS 2026.

Text Books:

- [T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
- [T2] Ashfaq Husain, "Electrical Machines", DhanpatRai& 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", Tata McGraw 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] SmarajitGhosh, "Electrical Machines", Pearson Education, New Delhi.
- [R6] Charles I Hubert, "Electrical Machines Theory, Application, & Control", Pearson Education, New Delhi, Second Edition.

203147: Network Analysis

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Term Work : 50 Marks

Prerequisite:

- Terminology of electrical networks, Laplace transforms linear differential equations.

Course Objective:

- To develop the strong foundation for Electrical Networks.
- To develop analytical qualities in Electrical circuits by application of various theorems.
- To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach.
- To apply knowledge of 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 :-

- Developing strong basics for network theory.
- Develop the problem solving technique for networks by application of theorems.
- Understand the behavior of the network by analyzing its transient response.
- Apply their knowledge of network theory for designing special circuits like filters.

Unit 01 : Basics of Network: (8 Hrs)

Source transformation: voltage and current sources, mesh analysis, nodal analysis, Concept of super node and super mesh, coupled circuits and dot conventions. Concept of network graphs (incidence, tie set and cut set matrix), Concept of duality and dual networks.

Unit 02 : Network Theorems: (8 Hrs)

Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity theorem, Millman theorems applied to both ac/dc circuits.

Unit 03 : Analysis of Transient Response in Circuits-Classical Method: (8 Hrs)

Initial and Final Condition of network, General and Particular Solution, time constant. Transient response of R-L, R-C and R-L-C network in time domain.

Unit 04 : Analysis of Transient Response in Circuits: Laplace Transform Approach: (8 Hrs)

Standard test inputs: Step, Ramp, Impulse, Their Laplace transform, Representation of R,L,C in S domain, transformed network, Application of Laplace transform to solve series and parallel R-L, R-C and R-L-C circuits (Source free, Source driven).

Unit 05 : Two Port Network and Network Functions: (8 Hrs)

Two port parameters: Z, Y, H and Transmission parameters Network Functions for 1 and 2 port, calculation of network functions, Poles and zeros of network functions, Restrictions on poles and zeros, Time-domain behavior from the pole and zero location, Necessary conditions for stable driving point function and Transfer function.

Unit 06 : Filters:**(8 Hrs)**

Classification of filters: Low pass, High Pass, Band pass, Band stop, Symmetrical networks : characteristic impedance , propagation constant, Design of constant K- low pass and constant K- high pass filters using symmetrical networks.

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 formulae 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 on their own.
- Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Lab /TW Assessment

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.

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 PSPICE/MATLAB 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. Frequency response of constant K- low pass filters
11. Frequency response of constant K- high pass filters.

Text Books:

- [T1] M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India Private Limited, Third Edition,
- [T2] D Roy Choudhary, "Network and Systems", New age international publishers.
- [T3] Abhijit Chakroborty, "Circuit Theory", Dhanpat Rai and Company, 7th edition.
- [T4] Ravish R Singh, "Network Analysis and synthesis", McGraw Hill education (India) Pvt. Ltd, 3rd edition 2015.

Reference Books:

- [R1] William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGraw Hill Publication.
- [R2] N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.
- [R3] G. K. Mittal, "Network Analysis and Synthesis", Khanna Publication.

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

203148: Numerical Methods and Computer Programming

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 05	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
Tutorial : 01 Hr/ Week		Practical : 50 Marks
		Term Work : 25 Marks

Prerequisite:

- Differentiation and integration of a single real variable, ordinary differential equations.
- Fundamentals of Programming languages.
- Linear Algebra.

Course Objective:

- To emphasize the need of computational techniques and analyze errors involved in the computation.
- To provide sound knowledge of various numerical methods.
- 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.
- To impart skills to develop programs using C language.

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

- Develop algorithms and implement programs using C language for various numerical methods.
- Demonstrate types of errors in computation and their causes of occurrence.
- Identify various types of equations and apply appropriate numerical method to solve different equations.
- Apply different numerical methods for interpolation, differentiation and numerical integration.
- Apply and compare various numerical methods to solve first and second order ODE.
- Apply and compare various numerical methods to solve linear simultaneous equations.

Unit 01 : Basics of C Language: (8 Hrs)

Revision: Basics of 'C' language - Data types, Operators and its precedence. Control statements: 'if-else' and nested 'if-else', 'for, while and do-while'.

Arrays: Introduction, one and two dimensional arrays.

Functions: Types of functions User Defined Functions - declaration and prototypes, Local and Global variables.

Pointers: Introduction, declaring and initializing pointers.

Unit 02 : Numerical Methods , Errors and Concept of root of equation: (8 Hrs)

A) Basic principle of numerical methods. 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.

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

- Unit 03 : Solution of Transcendental and polynomial equation and Curve Fitting: (8 Hrs)**
- A) **Solution of Transcendental and polynomial equation:** Bisection, Secant, Regula-Falsi, Chebyshev and Newton-Raphson methods, Newton-Raphson method for two variables.
- B) **Curve Fitting** using least square approximation – First order and second order.
- Unit 04 : Interpolation and Numerical Differentiation: (8 Hrs)**
- A) **Interpolation:** Difference operators, Introduction to interpolation - Newton's forward, backward interpolation formulae, Stirling's and Bessel's central difference formulae, Newton's divided difference formula, Lagrange's interpolation.
- B) **Numerical Differentiation** using Newton's forward and backward interpolation formulae.
- Unit 05 : Solution of Ordinary Differential Equation(ODE) and Numerical Integration: (8 Hrs)**
- A) **Solution of First order Ordinary Differential Equation (ODE)** using Taylor's series method, Euler's, Modified Euler's methods. Runge-Kutta second and fourth order methods. **Solution of Second order ODE** using 4th order Runge-Kutta method.
- B) **Numerical Integration:** Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single and double integrals.
- Unit 06 : Solution of linear simultaneous equation: (8 Hrs)**
- A) **Solution of simultaneous equation:** Direct methods - Gauss and Gauss-Jordan elimination methods, concept of pivoting – partial and complete. Iterative methods – Jacobi and Gauss Seidel methods.
- B) **Matrix Inversion** using Jordan method and Eigen values using Power method.

Guidelines for Instructor's Manual

Practical Sessions -

The Instructor's Manual should contain following related to every program –

- Theory related to the method.
- Algorithm and Flowchart of the method.
- One or two solved numerical.
- Brief description of the few C commands used in the program.
- Seven - eight questions based on method and related C commands.
- Printout of C program and output.

Tutorial Sessions -

The Instructor's Manual should contain following related to every Tutorial –

- Algorithm, flowchart and program related to the tutorial C assignments.
- One – two solved numerical related to every method in the tutorial.

Guidelines for Student's Lab Journal

Practical Sessions -

The Student's Lab Journal should be a hand written containing following related to every experiment –

- Theory related to the method.
- Algorithm and Flowchart of the method.
- One solved numerical.
- Brief description of the few C commands used in the program.
- Questions & Answers based on method and related C commands.
- Printout of C program and output.

Tutorial Sessions –

The Student's Tutorial Notebook should contain following related to every Tutorial –

- Algorithm, flowchart and program related to the tutorial C assignments.
- At least one solved numerical related to every method in the tutorial.

Guidelines for Lab /TW Assessment

- There should be continuous assessment of the TW.
- TW assessment should be based on – understanding of the method, proficiency in C programming, involvement during lab sessions, neatness in journals and timely submission.
- Students performance in tutorial sessions should also be evaluated and considered for final TW assessment with due weightage.

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.

List of Experiments:

Term work shall consist of minimum **EIGHT** computer programs in C language with flowcharts and results.

1. Solution of a polynomial equation using Birge-Vieta method.
2. Solution of a transcendental equation using Bisection or Regula-Falsi method.
3. Solution of two variable non-linear equation using N-R method.
4. Program for interpolation using Newton's forward or backward interpolation.
5. Program for interpolation using Lagrange's or Newton's Divided difference interpolation.
6. First order curve fitting using Least square approximation.
7. Solution of simultaneous equation using Gauss Seidel or Jacobi method.
8. Solution of simultaneous equation using Gauss elimination or Jordon method.
9. To find largest Eigen value using Power method.

10. Solution of Numerical Integration using Simpson's (1/3) rd or (3/8) thrule.
11. Solution of first order ODE using 4th order RK method or Modified Euler method.

List of Tutorials:

***** Tutorials should be based on following methods.**

1. Minimum 6 'C' programs based on decision making, for, while, and do-while loops, one and two dimensional arrays and user defined functions.
2. Sturm's Theorem and BirgeVieta method.
3. RegulaFalsi method, Newton Raphson method and Second order Least Square Approximation method.
4. Any two methods of interpolation with equal interval and all methods for unequal interval.
5. One direct and one iterative method for solution of linear simultaneous equations.
6. 4th order R-K method for first order ODE and 2nd order ODE and Simpson's rule for single and double integrals.

***** A Tutorial can be extended for more than one week to include all the mentioned methods.**

Text Books:

- [T1] M. K. Jain, S.R.K. Iyengar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Publications.
- [T2] T. Veerarajan and T. Ramchandran, "Numerical Methods with Programs in C and C++", Tata McGraw Hill Publication.
- [T3] P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis", Krishna Prakashan Media Ltd, Meerut.
- [T4] Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences", Khanna Publishers.
- [T5] E. Balagurusamy, "Programming in ANSI C", Tata McGraw Hill Publication.
- [T6] E. Balagurusamy, "Numerical Methods", Tata McGraw Hill 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] YashwantKanetkar, "Let us C", BPB Publications.
- [R4] S.S. Sastry, "Introductory methods of Numerical Analysis", PHI Learning Private Ltd.
- [R5] P. Thangaraj, "Computer oriented Numerical Methods", PHI Learning Private Ltd.

Unit	Text Books	Reference Books
1	T5	R3
2	T6,T1,T3	R4,R2 ,R5
3	T2,T3,T4	R2 ,R1,R5
4	T2,T3,T4	R2,R1,R5
5	T2,T3,T4	R2,R1,R5
6	T2,T3,T4	R2,R1,R5

203149: Fundamentals of Microcontroller and Applications

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Oral : 50 Marks

Prerequisite:

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

Course Objective:

- To understand the differences between microcontrollers and microprocessors learn microcontroller architecture & describe the features of a typical microcontroller.
- To use the 8051 addressing modes and instruction set and apply this knowledge to perform programs - arithmetic & logic operations, data & control transfer operations, input & output operations.
- To define the protocol for serial communication and understand the microcontroller development systems.
- To build and test a microcontroller based system; interface the system to switches, keypads, displays, A/D and D/A converters.
- To provide students with the concepts and techniques required in designing computer hardware interfaces embedded software for microcontrollers and measurement of various analog parameters.

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

- Differentiate between microprocessor and microcontroller.
- Describe the architecture and features of various types of microcontroller.
- Demonstrate programming proficiency using the various addressing modes and all types of instructions of the target microcontroller.
- Program using the capabilities of the stack, the program counter the internal and external memory, timer and interrupts and show how these are used to execute a programme.
- Write assemble assembly language programs on PC and download and run their program on the training boards.
- Design electrical circuitry to the Microcontroller I/O ports in order to interface with external devices.
- Write assembly language programs and download the machine code that will provide solutions real-world control problems such as fluid level control, temperature control, and batch processes.

Unit 01 : (8 Hrs)

Introduction to concept of microcontroller, comparison of Microprocessor and microcontroller, Comparison of all 8 bit microcontrollers, Intel 8051 microcontroller architecture, Pin diagram, Memory organization of 8051, special function registers, Internal structure of I/O ports, operation of I/O ports. Interfacing of 8051 with external memory.

Unit 02 : (8 Hrs)

Addressing modes of 8051, Instruction set of 8051, Stack and Stack Related instruction, Data exchange, byte level logical operations, bit level logical operations, rotate and swap operations, instruction affecting flags, incrementing, decrementing, arithmetic operations, jump and recall instruction, Call and return subroutines.

Unit 03 : (8 Hrs)
Assembly language programming of 8051. Counters and timers in 8051, timer modes and its programming.

Unit 04 : (8 Hrs)
Interrupts- timer flag interrupt, serial port interrupt, external interrupts, software generated, interrupt control and interrupt programming. Serial communication and its programming. Serial data input, output, Serial data modes, interfacing of 8051 with PC through RS232.

Unit 05 : (8 Hrs)
Microcontroller development tools- study of simulator, emulator, assemblers, programmers, cross assembler for microcontrollers. Study, interfacing and programming of PPI 8255 - mode 0, 1, BSR mode. Interfacing of 8051 with 8255 for expanding of I/O. Programming and Interfacing of 8051 with 8 bit ADC (0809) and DAC (0808).

Unit 06 : (8 Hrs)
Part A: (Theoretical Treatment only)
Measurement of parameters such as matrix (4 x 4) Keyboard pressure, temperature, flow, level, voltage, current, power (KW), power factor and frequency using 8051.
Part B: Interfacing and Programming
Interfacing of 8051 with single key, LED, Relay, voltage, current, speed control of dc motors, Stepper motor control (speed /position).

Guidelines for Instructor's Manual

1. Commands to be followed in order to operate the 8051 micro controller kit.
2. Architecture of 8051 micro controller kit-Functional block diagram & its explanation.
3. Pin Diagram of 8051 micro controller with 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 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 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. Staff member has to check the result of all the groups after the execution of the program.

List of Experiments:

Compulsory Experiments:

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for arithmetic operation of 8 bit numbers.
3. Assembly Language Program for finding largest number and smallest number from a given array of 8 bit numbers.
4. Assembly Language program to arrange 8 bit numbers stored in array in ascending order and descending order.
5. Assembly Language Program for data conversion.
6. Assembly Language Program for use of Timer/Counter for various applications.

Any six experiments are to be conducted of following experiments:

1. Implementation of Serial Communication by using 8051 serial ports.
2. Programming using cross assembler.
3. Blinking display of LED's interfaced with 8051 through 8255.
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 relay with 8051.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of matrix keyboard/ 7 segment display with 8051

Text Books:

- [T1] V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
- [T2] Muhammad Ali Mazidi, J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearsons Publishers.
- [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.

Reference Books:

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

NOTE: - Text books given covers total syllabus.

203155: Audit Course II

(A) Solar Photovoltaic Systems

Course Name: Solar Photovoltaic Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:

Theory: 02Hrs/ Week

Practical: 2 h x 3

Examination Schemes: Audit (P/F)

Written and MCQ

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 do design of Solar PV system for small and large installations
- Will be able to 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 modeling 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

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

203155: Audit Course II

(B) Course Name: Installation & Maintenance of Electrical appliances

Prerequisite: Completion of FE/DEE or equivalent

Teaching Scheme:

Theory / Practical: 02Hrs/ Week

Examination Schemes: Audit (P/F)

Written and MCQ

Term paper

Field Visit: 4 h

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