Solapur University, Solapur

Faculty of Electrical Engineering
Structure of T.E. (Electrical Engineering)
w.e.f. 2014-15

T.E. (Electrical Engineering) Part –I

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	TH	TW	POE	OE	Total
1.	Power System Analysis	4	--	2	6	100	25	--	25	150
2.	Engineering Economics and Industrial Management	4	1	--	5	100	25	--	--	125
3.	Electromagnetic Engineering	4	1	--	5	100	25	--	--	125
4.	Electrical Machine-III	4	--	2	6	100	25	50	--	175
5.	Control Systems-I	4	--	2	6	100	25	--	25	150
6.	Electrical Workshop	--	--	2	2	--	25	--	--	25
7	Self learning module I	--	--	-	-	50	--	--	--	50
	Total	**20**	**02**	**08**	**30**	**550**	**150**	**50**	**50**	**800**

T.E. (Electrical Engineering) Part –II

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	TH	TW	POE	OE	Total
1.	Control System-II	4	--	2	6	100	25	--	--	125
2.	Electrical Machine Design	4	--	2	6	100	25	--	25	150
3.	Power Electronics	4	--	2	6	100	25	50	--	175
4.	Signals & Systems	3	1	--	4	100	25	--	--	125
5.	Microprocessor and Microcontrollers	4	--	2	6	100	25	--	--	125
6.	Mini Hardware Project *(Project Based Learning)*	--	--	2	2	--	50	--	--	50
7.	Self learning module II	-	--	-	-	50	--	--	--	50
	Total	**19**	**01**	**10**	**30**	**550**	**175**	**50**	**25**	**800**

Note –

- Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining students exceeds 7, then a new batch shall be formed.
- Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I
- Appropriate Elective I & II Subjects may be added when required.
- Student shall select one Self Learning Module at T.E. Part I and T.E. Part II each from Technical and Humanities and Social Sciences Group with at least one Self Learning Module from the Humanities and Social Sciences Group
- Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programs of faculty of Engineering and Technology.
- Department shall appoint the subject coordinator for self learning subject at T.E. Part I and T.E. Part II , and students should submit minimum 4 assignments to the subject coordinator for evaluation.
- Project group for T.E.(Electrical) Part I Mini Project shall not be of more than **four** students
- Project group for B.E. (Electrical) Part I and Part II shall not be of more than **four** students.
- Term work assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

DETAILED SYLLABUS

FOR

T.E. ELECTRICAL

ENGINEERING

PART - I

Solapur University, Solapur

TE Electrical Semester-I

POWER SYSTEM ANALYSIS

Teaching Scheme	**Examination**
Scheme Theory: - 4 Hrs/Week	**Theory -** 100Marks
Practical: - 2 Hrs/Week	**Term-Work-**25Marks
	OE: 25Marks

Course Objectives

- To understand the representation of complex 3-phase power system in to a single line diagram and representation of into a single line diagram & representation of equivalent circuit models for various power system equipments.
- To gain complete knowledge about load flow analysis by various methods for various power system networks.
- To understand the complete behavior of this power system network & power system equipments by stability analysis under various conditions.
- To understand the different faults of the power system by fault analysis.

Course Outcome

- Students will be able to understand the complete knowledge for representing the power system network.
- Students will be able to know the complete load flow analysis in order to get the various losses.
- Students will be able to implement the knowledge to design for improve eth epower system operation.
- Students will be able to understand the various faults & analysis of faults.

SECTION-I

UNIT 1: REPRESENTATION OF POWER SYSTEM COMPONENTS (06Hrs)

Circuit models of Transmission line, Synchronous machines, Transformers and Loads, Single line diagram, reactance / impedance diagram, per unit system, per unit impedance diagram of power system

UNIT 2: NETWORK MATRICES . (06Hrs)

Introduction, Formation of Y_{BUS} by method of inspection (including transformer off-nominal tap setting) and method of singular transformation, Formation of Bus Impedance

matrix by step by step building algorithm (without mutual coupling elements), Formation of Modified Bus Impedance matrix

UNIT 3: LOAD FLOW STUDIES (08Hrs)

Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses Acceleration of convergence; Newton Raphson's Method –Algorithm and flow chart for NR method in polar coordinates, Algorithm and flow chart for Fast Decoupled load flow method, Comparison of Load Flow Methods

(numerical problems of different methods for one iteration only)

UNIT 4: SYMMETRICAL FAULTS ANALYSIS (06Hrs).

Analysis of Synchronous machines and Power system, Transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines with and without load, selection of circuit breaker rating

SECTION-II

UNIT 5: SYMMETRICAL COMPONENTS (08Hrs)

Introduction, analysis of unbalanced load against balanced Three phase supply, neutral shift. Resolution of unbalanced phasors into their symmetrical components, Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components**,** Analysis of balanced and unbalanced loads against unbalanced 3 phase supply, Sequence impedances and networks of power system elements (alternator, transformer and transmission line) Sequence networks of power systems

UNIT 6: UNSYMMETRICAL FAULTS (08Hrs)

L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance, Unsymmetrical faults on a power system with and without fault impedance, Open conductor faults in power system

UNIT 7: STABILITY STUDIES (05Hrs)

Introduction**, Rotor** dynamics and the swing equation, Steady state and transient stability, Equal area criterion for transient stability evaluation and its applications, critical clearing angle, critical clearing time

UNIT 8: LIGHTENING AND TRAVELLING WAVES (05Hrs)

Lightening

Lightening phenomenon, mechanism of lightning stroke, shape of lightning voltage wave, over voltages due to lightening, lighting protection problem, Protection against surges, Lightning arrestors and protective characteristics

Traveling Waves

Traveling Waves on Transmission lines, wave equation, reflection and refraction of waves, typical cases of line terminations, attenuation

TEXT BOOKS:

1. **Elements of Power System Analysis**, W.D.Stevenson, TMH,4th Edition

2. **Modern Power System Analysis**,.I. J. Nagrath and D.P.Kothari- TMH, 3rd Edition,2003.

3. Symmetrical Components and Short Circuit Studies, Dr.P.N.Reddy, Khanna Publishers

4. **Computer Methods in Power System Analysis,** Stag, G. W., and EI-Abiad, A. H.- McGraw Hill International Student Edition. 1968

Reference Books:

1. **Power System Analysis**, Hadi Sadat, TMH,2nd Edition.
2. **Power system Analysis**, R.Bergen, and Vijay Vittal, Pearson publications, 2nd edition, 2006.
3. **Computer Aided Power system analysis**, G.L., Kusic, PHI.Indian Edition, 2010 .
4. **Power System Analysis**,W.D.Stevenson & Grainger,TMH, First Edition, 2003.
5. **Advanced Power System Analysis and Dynamics**, Singh, L. P,New Age International (P) Ltd, New Delhi, 2001. 6.**Computer Aided Power System Operations and Analysis**"- Dhar, R. N, TMH, 1984.

Term work:

Term-work shall consist of at least 4 simulations covering from but not restricted to the following:

1. Y Bus formation for power systems with and without mutual coupling, by singular transformation
2. Y Bus formation for power systems
    - with and without mutual coupling, by inspection method
    - with and with mutual coupling, by singular transformation
    - with and with mutual coupling, by inspection method

3. Determination of bus currents, bus power and line flow for a specified system voltage (Bus) Profile
4. Formation of Z-bus (without mutual coupling) using Z-bus building Algorithm .
5. To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinity bus through a pair of identical transmission lines under 3-phase fault on one of the lines for variation of inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.
6. Write a program to perform load using Gauss- Seidel method (only p q bus)
7. To determine fault currents and voltages in a single transmission line system with star-delta transformers at a specified location for LG, LLG.
9. Load flow analysis using Gauss Siedel method, NR method, Fast decoupled method for both PQ and PV buses.

Solapur University, Solapur

T.E Electrical Semester-I

Engineering Economics & Industrial Management (New)

Teaching Scheme	Examination Scheme
Theory: - 4 Hrs/Week	**Theory -** 100Marks
Tutorial: 1Hr/Week	**Term-Work-** 25Marks

Course Objectives: The students should know the economical aspects & Industrial management related to the course of the electrical engineering which will be useful while doing the job in the industries or doing own business.

Course Outcome: After studying the subject students will know all the economical aspects & managerial skills required in industries & they will be more competent while doing the job in the industries.

SECTION I

UNIT 1: Basics Economics **(10Hrs)**

Micro & macro economics ,trade cycle, payback period, value engineering, ABC analysis , Make or buy decision ,Economic order quantity, cost control, cost ratio, cost reduction

UNIT 2: Business Organization **(10Hrs)**

Forms/Types of business organization – proprieriorship, Partnership, Private and Public Limited, Joint stock Company, Organisation structure & Characteristics – Line and staff Organisations.

UNIT 3: Indian Economy **(06Hrs)**

Infrastructure of Indian Economy, Power sector & agricultural sector, science & technological developments, present & future electrical energy requirements in India.

Section II (Industrial Management)

UNIT 4: Management (12Hrs)

Functions of management, planning, organizing, staffing, directing, controlling.

Project planning-Implementation, monitoring and control, PERT & CPM methods for project implementation, methods of reducing project costs, management Information systems (MIS)

UNIT 5: Small scale industries & entrepreneurship (10Hrs)

Definitions & roll of small sectors, Advantages of SSI,Industrial policy, Self employment for engineers, steps for setting and starting SSI.

Entrepreneurship – growth, functions and facilities for entrepreneurship development given by the government.

UNIT6: Industrial safety & related industrial acts

(04Hrs).

Rules & advantages of industrial safety, Indian factory act, and Indian electricity act 2003 and 2011.

Text Books:

1. Industrial organization and engineering economics by T.R.Banga, S.C.Sharma (Khanna Publishers)
2. Indian Economy By,Ruddar Datt and KPM Sundharum (S.C.Chand publishers)
3. Industrial Engineering and management by, O.P.Khanna (Dhanapatrai Publications) 2008 edition

Reference books

E/e-file/all syllabus and structure/engineering syllabus final/T.E.electrical syllabus/TE part-I

- **There are total six assignments to be written by the students in the class.(3 Assignments per section) & two case studies(1 case study per section) which carries 25 marks for the term work.**

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Solapur University, Solapur

T.E Electrical Semester-I

Electromagnetic Engineering

Teaching Scheme	**Examination Scheme**
Theory: - 4 Hrs/Week	**Theory-**100Marks
Tutorial: - 1 Hrs/Week	**Term-Work- 2**5Marks

Course Objectives

1) To develop conceptual & analytical understanding of electromagnetism.
2) To acquire knowledge of electricity and magnetism from various electrical laws.

Course Outcome

Analyze electric & magnetic fields with the help of vector analysis & integral calculus.

SECTION I

UNIT 1: Vector Analysis: (08 Hrs)

Scalars & vectors, vector algebra, vector components & vectors, vector field, Dot & cross products, Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co-ordinate System, Introduction to line, Surface and Volume Integrals, Definition of Curl, Divergence and Gradient , Coulomb's Law in Vector Form, Definition of Electric Field Intensity,

UNIT 2: Static Electric Fields: (10 Hrs)

Electric field due to continuous charge distribution, Electric Field due to line charge & sheet charge, Gauss Law – Applications, point form; Divergence theorem, Electric Scalar Potential, Relationship between potential and electric field, Electric Flux Density , Energy & potential energy expended in moving a point charge in an electric field, Line integral, potential difference & potential, potential gradient, potential field of a point charge & system of a charges, dipole, energy density in electrostatic field

UNIT 3: Electric Fields in Materials : (08 Hrs)

Electric current, Current density, point form of ohm's law, continuity equation for current, Poisson's and Laplace's equation, Uniqueness, Electric Polarization, Nature of dielectric materials- Definition of Capacitance, calculation of Capacitance of various geometries,

Electrostatic energy and energy density, Boundary conditions for electric fields, Product solution of Poisson's & Laplace equations

SECTION-II

UNIT 4: Static Magnetic Fields: (10 Hrs)

The Biot-Savart Law in vector form, Magnetic Field intensity due to a finite and infinite wire carrying a current, Magnetic field intensity on the axis of a circular and rectangular loop carrying a current , Ampere's circuital law and simple applications, Magnetic flux density, Curl Stokes theorem, Lorentz force equation for a moving charge and applications, Force on a wire carrying a current placed in a magnetic field ,Torque on a loop carrying a current , Magnetic moment, Magnetic Vector Potential

UNIT 5: Electric and Magnetic Fields in Materials : (08 Hrs)

Definition of Inductance, Inductance of loops and solenoids, Definition of mutual inductance – simple examples, Energy density in magnetic fields, Nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, Energy in a inductor & energy density

UNIT 6: Time Varying Fields: (08 Hrs).

Maxwell's Equation for static fields & time varying fields, Maxwell's Equations from Faraday's Law, ampere's law & Gauss law; Displacement current, Ampere's circuital law in integral form, Modified form of Ampere's circuital law, Maxwell's equations for harmonically varying fields

Text books:

1. W. Hayt., "*Engineering electromagnetic*", McGraw Hill, 4th edition, 1987.
2. Edminister,"*Schaum's series in electromagnetic*" McGraw Hill publications, 3rd edition, 1986.

Reference Books:

1. M.N.O.Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press, Third edition.
2. Corson and lerrain, "*Electromagnetic*", CBS publications, 2nd edition, 1986.
3. David K. cheng, "*Field and electromagnetic*", Addison Wesley, 2nd edition, 1999.

Term work:

Term-work shall consist of at least 6 tutorials/ assignments/ simulation covering the syllabus

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Solapur University, Solapur

T.E Electrical Semester-I
Electrical Machines-III

Teaching Scheme
Theory: - 4 Hrs/Week
Practical: - 2 Hrs/Week

Examination Scheme
Theory - 100Marks
Term-Work - 25Marks
POE: 50Marks

Course Objectives

1) To get detailed knowledge of construction, operating principles of Synchronous machines and special purpose machines.

2) To find equivalent circuit parameters and performance parameters for synchronous machines

Course Outcome

1) Students will be able to analyze performance of synchronous machines and special purpose machines

2) Students will be able to identify applications of synchronous machines and special purpose machines in industries & power sector.

SECTION I

UNIT 1: SYNCHRONOUS MACHINES (08Hrs)

Basic principle of operation, construction of salient & non-salient pole Synchronous machines, methods of excitation, Armature windings, winding factors, EMF equation, harmonics in voltage wave form, Armature reaction, synchronous impedance, leakage reactance, Alternator ON load, phasor diagram of salient and non salient type alternator, losses and efficiency.

UNIT 2: VOLTAGE REGULATION (10Hrs)

Effect of armature resistance, open circuit and short circuit test, voltage regulation by EMF, MMF, ZPF & ASA method, Short circuit ratio and its importance, Two reaction theory-direct and quadrature axis reactances, Slip test and regulation, power developed by synchronous machines

UNIT 3: PARALLEL OPERATION OF ALTERNATORS (08Hrs)

Synchronizing of alternators, synchronizing current, power, torque, effect of reactance effect of change of excitation and mechanical input, alternators connected to infinite bus bars, parallel operation of alternators, load sharing, methods of synchronizations, power flow equations including armature resistance

SECTION-II

UNIT 4: SYNCHRONOUS MOTOR (10Hrs)

Construction, Principle of operation, Methods of starting synchronous motors, motor ON load with constant excitation, phasor diagrams, effect of change in load, effect of change in excitation, V and inverted V curves, torque and torque angle, power developed, Synchronous condenser, hunting and damping, Applications

UNIT 5: SPECIAL PURPOSE MACHINES (PART 1) (7Hrs)

Stepper motor and its types- VR stepper motor, Multi stack VR stepper motor, PM stepper motor, Hybrid stepper motor, Permanent magnet DC motor, low inertia DC motor

UNIT 6: SPECIAL PURPOSE MACHINES (PART 2) (7Hrs)

Permanent magnet synchronous motor, switched reluctance motor, comparison between VRSM and SRM, DC and AC Servomotors, Universal motor, hysteresis motor

Text Books:

4. P.S Bhimbra, “Electrical machinery”, Khanna Publishers
5. BL theraja, “A Text Book of Electrical Technology”, S chand and co
6. Vk Mehta,rohit Mehta, Principles of Electrical Machines”, S chand
7. Jb gupta, “Theory & Performance Of Electrical Machines”, S. K. Kataria & Sons,

Reference Books:

1. M. G. Say, "Performance & Design of Alternating Current machines", CBS publishers, 3rd Edition,2002.
2. A.E Clayton & N.N.Hancock, "The Performance & Design of DC machines", CBS Publication 3rd Edition,2004.
3. Ashfaq Hussain, "Electrical Machines", Dhanpat Rai Publications.

Term work:

Minimum **eight** of the following list of experiments should be performed in the laboratory:

1. Determination of Voltage regulation of an alternator by EMF method.
2. Determination of Voltage regulation of an alternator by MMF method
3. Determination of Voltage regulation of an alternator by ZPF method.
4. Determination of X_d and X_q by Slip test
5. Performance of synchronous generator connected to infinite bus, under constant
   power and variable excitation & vice - versa.
6. Determination of V and Inverted V curves of a synchronous motor.
7. Determination of efficiency of synchronous motor by indirect loading
8. Determination of efficiency of synchronous motor by direct loading
9. Determination of load sharing by parallel operation
10. Determination of efficiency of Alternator by direct loading

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Solapur University, Solapur

T.E Electrical Semester-I
Control Systems-I

Teaching Scheme	Examination Scheme
Theory: - 4 Hrs/Week	**Theory** -100Marks
Practical: - 2 Hrs/Week	**Term-Work-**25Marks
	OE - 25 Marks

Course Objectives

1) To enhance the analytical ability of the students in facing the challenges posed by growing trends in control systems
2) To enhance the describing ability of the students to represent the control system mathematically.
3) To enhance the describing ability of the students to analyze the system in time and frequency domain.

Course Outcome

1) Students will be able to analyze and represent the control system mathematically.
2) Students will be able to analyze the control system in Time and frequency Domain.

SECTION I

UNIT 1: Introduction to Control System **(5 hrs)**

Definition, basic components & classification of general control system, Open loop & Close loop control systems, advantages & disadvantages, examples, Positive & negative feedback, Transfer Function of open loop and closed loop control system.

UNIT 2: Mathematical Models of Physical Systems **(8 hrs)**

Introduction, Differential equations of physical systems & solutions for these differential equations, Transfer Function of electrical and mechanical (Translational and Rotational) systems, electrical analogy of mechanical systems (F-V & F-I), Transfer Function of AC & DC Servomotor.

UNIT 3: Reduction of Multiple Systems **(10 hrs)**

Reduction of multiple systems & feedback characteristic, Block diagram, Signal flow Graph (SFG), Conversion of Block diagram to SFG. Mason's Gain formula and its application for

SFG, Definition of sensitivity, effect of feedback on system parameter variation, system dynamics & disturbance signal.

SECTION-II

UNIT 4: Time-Response Analysis (10 hrs)

Standard test signals, poles, zeros & system response, response of first order and second order systems to unit step input, Time response specifications, Steady state errors & definitions of error constants kp, kv and ka, P, PI, PD and PID Controller.

Unit 5: Stability & Root Locus Techniques (7 hrs)

Concept of stability & necessary condition, Root-Harwitz criterion with special cases, location of roots in s-plane, concept of root locus diagram, properties and rules for construction of root locus, Determination of stability from root locus.

UNIT 6: Frequency Response Analysis (7 hrs)

Introduction to frequency response of system, Frequency domain specifications, Correlation between Time domain and Frequency domain, polar plot & bode plot for frequency function. Minimum phase function, gain margin & phase margin, determination of stability using Bode Plot.

Text Books:

1. I. J. Nagrath, M. Gopal "Control System Engineering", 5th Edition. New Age International Publishers.
2. Control System Engineering by R Anandanatrajan, P Ramesh Babu, 2nd Edition, Scitech
3. Benjamin C. Kuo, "Automatic Control Engineering", Prentice Hall of India Pvt. Ltd.
4. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
5. Control system principles and design, M. Gopal, TMH publication, 3rd edition, 2008

Reference Books:

1. Feedback Control Systems, C. L. Phillips, R. D. Harbor PHI publication, 1988
2. Richard C.Dorf, Robert H. Bishop," Modern Control Systems", eleventh edition.
3. Control systems by Smarajit Ghosh, Pearson Education 2nd Edition

Term work:

Term work consists of minimum 8 experiments of following

1) To verify potentiometer as transducer and error detector.

2) To verify Synchro as transducer.

3) To verify Synchro as error detector.

4) AC position control system.

5) DC position control system.

6) Time response of first order system.

7) Step response of second order system using R, L and C.

8) To study the effect of P, PI & PID Controller on a 2^{nd} order system.

9) Transient response specifications of second order system using MATLAB.

10) Root locus using MATLAB.

11) Bode plot using MATLAB.

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Solapur University, Solapur

T.E Electrical Semester-I
Electrical workshop

Teaching Scheme	**Examination Scheme**
Practical: - 2 Hrs/Week	**Term-Work-**25Marks

Electrical workshop

To perform and record any six of following experiments

1. Soldering and desoldering.
2. Understanding Different types of power supply, function generator, DSO, CRO.
3. Understanding Different types of meters such as analog multimeter, clamp meter, tri vector meter , power quality analyser , RLC meters etc.
4. Understanding of different types of switchgears such as MCCB, MCB, ELCB, Isolators, HRC fuses
5. Understanding of different types of switches such as SPST, SPDT, DPST,DPDT, TPST, TPDT
6. Types of wiring, Industrial, domestic wiring and panel wiring etc.
7. Study and performing of motor winding.
8. Troubleshooting in electronic circuits.
9. PCB making.
10. Measurement of insulation resistance and earth resistance.
11. Installation of plate , pipe and grid earthing.

DETAILED SYLLABUS

FOR

T.E. ELECTRICAL

ENGINEERING

PART - I I

Solapur University, Solapur

T.E Electrical Semester-II
Control Systems-II

Teaching Scheme	Examination Scheme
Theory: - 4 Hrs/Week	**Theory** - 100Marks
Practical: - 2 Hrs/Week	**Term-Work-** 5Marks

Course Objectives

1) To enhance the analytical ability of the students in facing the challenges posed by growing trends in designing the control systems in time and frequency domain.
2) To enhance the ability of the students to analyze and design the control system in modern control approach.
3) To enhance the ability of the students to understand nonlinear control systems.
4) To enhance the ability of the students to analyze the Discrete Time Control Systems.

Course Outcome

1) Students will be able to design the controller in time and frequency domain.
2) Students will be able to analyze and design the control system in modern approach.
3) Students will be able to analyze the nonlinear control systems.
4) Students will be able to analyze the Discrete Time Control Systems.

SECTION I

UNIT 1: Design of compensator using Root Locus (8 hrs)

Introduction of design problem, Approach & preliminary considerations, Realization of basic compensators, Design of lead, lag & lag-lead compensators.

UNIT 2: Design of compensator using Frequency response (6 hrs)

Transient response through gain adjustment, lag compensation, lead compensation, lag-lead compensation using Bode Plot.

UNIT 3: State-Space Analysis (10 hrs)

Concept of state, state variable & state model, state-space representation of transfer function of electrical and mechanical systems, state transition matrix, its properties, Solution of homogeneous and non-homogeneous state equation, Controllability & Observability.

SECTION-II

UNIT 4: State Space Design **(8 hrs)**

Introduction, Design of Pole placement, Necessary and sufficient condition for arbitrary pole placement, Determination of K using transformation Matrix, Direct Substitution and Ackermann's Formula, State Observer, Full state observers , Effects of addition of the observer on a closed loop system. TF of the observer based controller Design of Control System with observers.

Unit 5: Non-linear Control Systems **(8 hrs)**

Introduction, common non-linearities in control system, Phase plane method. Singular points, Stability of Nonlinear Systems, construction of phase trajectories by analytical and graphical methods, Definition & derivation of Describing Functions for different non linearities.

UNIT 6: Discrete-time Control System **(8 hrs)**

Basic elements of discrete data control system and its advantages over the continuous time system, Pulse Transfer Function of cascade elements, closed loop systems and digital controller, Z-transform analysis of Discrete-Time Control Systems, Mapping between s-plane & z-plane, stability analysis of closed loop systems in z-plane using Juri's Test, Bilinear Transformation and Root Locus.

Text Books:

6. I. J. Nagrath, M. Gopal "Control System Engineering", 5th Edition. New Age International Publishers.
7. Control System Engineering by R Anandanatrajan, P Ramesh Babu, 2nd Edition, Scitech
8. Discrete-time Control Systems by K Ogata, Prentice Hall India, 2nd Ed
9. Digital Control Systems by B.C. Kuo, Saunders college Publishing, 2nd Ed

Reference Books:

1. Benjamin C. Kuo, "Automatic Control Engineering", Prentice Hall of India Pvt. Ltd.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988
4. Control system principles and design, M. Gopal, TMH publication, 3rd edition, 2008
5. Feedback Control Systems, C. L. Phillips, R. D. Harbor PHI publication, 1988

Term work:

Minimum **eight** programs should be performed in the laboratory based on the entire syllabus.

Solapur University, Solapur

T.E Electrical Semester-II

Electrical Machines Design

Teaching Scheme	Examination Scheme
Theory: - 4 Hrs/Week	**Theory -** 100Marks
Practical: - 2 Hrs/Week	**Term-Work -** 25Marks
	OE: 25Marks

Course Objectives

To get detailed knowledge of design of Transformers, DC machines, Induction motors and synchronous machines.

Course Outcome

Students will be able to analyze design of Transformers, DC machines, Induction motors and synchronous machines.

SECTION-I

UNIT 1: Introduction: (4Hrs)

Principles of design, design factors, specifications, limitations, modern trends in design of electrical machines.

UNIT 2: Design of transformers: (10Hrs)

Types, classification & specifications, output equation, design of core, selection of design constants, design of yoke, design of window, and design of windings, tank design with and without cooling tubes.

UNIT 3: General concept of design of rotating machines: (4Hrs)

Output equations of DC and AC machines, factors affecting size of rotating machines, Choice of specific loadings, separation of main dimensions.

UNIT 4: Design of DC machines: (6Hrs)

Selection of no of poles, core length, air gap, design of armature of field system.

SECTION-II

UNIT 5: Design of three phase induction motors: (10Hrs)

Output equation, main dimensions, stator design, stator winding, stator core, stator slot design, selection of stator slots, air gap length, rotor design, selection of rotor slots, rotor bars/windings calculation, design of end ring, design of wound rotor, no of rotor turns, area of rotor conductors, rotor tooth density, design of rotor core.

UNIT 6: Design of single phase induction motor: (7Hrs)

Output equation, specific loadings, main dimensions, design of stator, no of stator slots, size ,stator teeth, stator core, air gap length, design of rotor, no of rotor slots, area of rotor bars, area of end rings, rotor teeth, rotor core.

UNIT 7: Design of synchronous machines: (7Hrs)

Output equation, specific loadings, design of salient pole machines-main dimensions, length of air gap, armature design, design of turbo alternator main dimensions, length of air gap, stator design, rotor design.

Text Books:

10. A.K Sawhney, “A course in Electrical machine design”, Dhanpat Rai & Sons.
11. Mittle V.N and Mittle A, “Design of Electrical machines”, Standard publications and distributors
12. R.K Agarwal, “Principles of Electrical machine design” , S K Kataria & Sons.

Reference Books:

8. M.G.Say, “Performance & design of A.C machines”, CBS Publishers & Distributors
9. A.E.Clayton, “Performance & design of D.C machines”, CBS Publishers & Distributors

Term work:

Term work shall consist of at least 4 Drawing sheets and 2 Tutorials / Programming assignments covering the syllabus.

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Solapur University, Solapur
T.E Electrical Semester-II
Power Electronics

Teaching Scheme
Theory: - 4Hrs/Week
Practical: - 2Hrs/Week

Examination Scheme
Theory - 100Marks
Term-Work -25Marks
POE-50Marks

Course Objectives

1) To understand the various power electronic devices and various circuits.
2) To enhance the analytical ability of the students in facing the challenges posed by growing trends in designing the control systems of electrical machine and power system applications.

Course Outcome

1) Students will be able to analyze and design the power electronic circuits.
3) Students will be able to analyze and design the control circuits for electrical machine and power system applications.

SECTION I

Unit 1 Switching devices: (12Hrs)

Principle of operation of SCR, Static & Dynamic characteristics, Turn on Methods, Firing circuits (using R, R-C, UJT), Commutation Circuits (class A to F), Protection circuits of SCR (over voltage, over current, dv/dt & di/dt).

Principle of operation, characteristics, rating and applications of Triac, Diac, GTO, MOSFET, IGBT and Power BJT, need for gate drive circuits.

Unit 2 Controlled Rectifiers (13Hrs)

Introduction, Half wave controlled rectifiers with R, R-L load with and without freewheeling diode, Full Wave controlled rectifiers (Half controlled & Fully controlled) with R, R-L load with and without freewheeling diode (effect of source inductance not included), Three phase half controlled & Fully controlled rectifiers with R load only, Applications of single and three phase controlled rectifiers.

Numerical based on calculation of output voltage.

SECTION- II

Unit 3 Inverters (08Hrs)

Introduction, Principle of operation, Performance parameters, Single phase half and full bridge Inverters, 3 phase bridge Inverters(120^0 and 180^0 conduction mode) with R & R-L load, , Voltage control methods of 1 phase inverters, Harmonic reduction techniques, Applications, Numericals with R load only.

Unit 4 DC to DC converters:

(05Hrs)

Comparison between linear and switched mode regulators, DC-DC switched mode regulators – Buck, Boost, Buck-Boost, (CCM mode only), Applications, Numericals included.

Unit 5 AC Voltage Controllers: (10 Hrs)

Introduction of AC Voltage Controllers, Principle of On-Off Control, Principle of Phase Control, Single Phase bidirectional control with R & R-L load, Applications. Numericals included

Unit 6 Applications of power electronics: (04Hrs)

Speed control of dc motor, HVDC transmission (block diagram and basic principle), Role of power electronics converters in integration of renewable energy sources into grid, active filters (block diagram and basic principle).

Text Books:

1. M.H.Rashid, “Power Electronics” Prentice-Hall of India
2. Ned Mohan, Undeland, Robbins, “Power Electronics”John Wiley Publication
3. “ Thyristors & their applications” Ramamurthy
4. Alok Jain, “Power Electronics & its Applications”Penram International Publishing (India) Pvt. Ltd.
5. Vedam Subramanyam, “Power Electronics” New Age International

Reference Book:

1. Landers “Power Electronics”, McGraw Hill
2. M.D. Singh, K.B. Khanchandani, “Power Electronics” Tata McGraw Hill
3. P.C.Sen, “Modern Power Electronics” --- Wheeler Publication

Term work:

Minimum **Six** experiments and **two** simulations should be performed in the laboratory:

List of experiment is as follows:

1. VI Characteristic of SCR
2. Characteristic of any one high switching frequency devices
3. Firing circuit of SCR
4. Commutation circuit of SCR
5. Experiment based on controlled rectifiers
6. Experiment based on inverters
7. Experiment based on DC to DC converter
8. Experiment based on AC voltage controller
9. Light dimmer circuit using triac
10. Speed control of motors.

List of simulations is as follows:

1. Simulations based on AC to DC converter
2. Simulations based on DC to DC converter
3. Simulations based on DC to AC converter

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T.E. Electrical Semester-II
SIGNALS & SYSTEMS

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week	**Theory -** 100Marks
Tutorial: - 1 Hr/Week	**Term-Work-** 25Marks

Course Objectives

1. To enhance the analytical ability of the students in facing the challenges posed by growing trends in communication, control and signal processing areas.
2. To develop ability among students for problem formulation, system design and solving skills.

Course Outcome

1. Students will be able to analyze the system in Time and Frequency domain through its respective tools.
2. Students will demonstrate knowledge of complex number, Fourier series and ability to design electrical and electronics systems analyze and interpret data.

SECTION I

UNIT 1: Introduction to Signals and Systems: (08 Hrs)

Definition of signals and systems; Classification of signals: Continuous time and discrete time, even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power; Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and folding; Elementary signals: exponential, sine, step, impulse and its properties, ramp, rectangular, triangular, signum, sinc; Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT 2: Linear Time-Invariant Systems: (08 Hrs)

Introduction; The Representation of Signals in Terms of impulse; Discrete-Time LTI Systems; The Convolution Integral; Properties of Linear Time-Invariant Systems; LTI System realization; Block-diagram Representations of LTI Systems Described by Differential Equations; Singularity functions.

UNIT 3: System Analysis in Frequency Domain using Fourier Transform: (8 Hrs)

Definition and necessity of CT and DT Fourier series and Fourier transforms; CT Fourier series (Trigonometric and Exponential); Dirichlet's condition; CT Fourier transform and its properties; Limitations of FT and need of LT and ZT.

SECTION-II

UNIT 4: The Z-Transform: (6 Hrs)

Introduction; The Z-Transform; The Region of Convergence for the Z-Transform; The Inverse z-Transform; Application & Characteristics of LTI System Using Z Transform.)

UNIT 5: Discrete Fourier Transform: (6 Hrs)

Properties of discrete time Fourier transform (DTFT), relation between DTFT and Fourier Transform, Introduction to DFT and its properties, FFT (RADIX 2 DIF, DIT).

Text Books:

13. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.
14. A.V. Oppenheim and A. S. Wilsky , "Signal and Systems", Pearson Education

Reference Books:

10. M. J. Roberts and Govind Sharma, "Fundamentals of Signals and Systems",2nd edition,Mc Graw Hill,2010
11. Lathi B. P., "Signal & Systems", Oxford University press, 2nd Ed. 1998
12. Salivahan S., "Digital Signal Processing", TMH Publication, 2001.
13. A. Nagoor Kani, "Signals and Systems", McGraw Hill
14. P. Ramesh Babu & R. Anandanatarajan, "Signals and Systems", 4/e- SciTech

Tutorial Assignments:

Tutorials must be conducted batch wise. Batch size should not be more than 20 students. The main objective of this tutorial is to focus on the outcomes defined in the theory syllabus by solving minimum five assignments based on the entire syllabus from among but not restricted to the following.

1. Sketch and write defining mathematical expression for the following signals in CT and DT.

a) Unit Step. b) Unit Impulse. c) Unit Ramp.

d) Rectangular. e) Triangular. f) Sine/Cosine.

g) Exponential. h) Signum. i) Sinc.

2. Classify and find the respective value for the given signals.

   a) Periodic / Non Periodic b) Energy / Power /Neither

3. Take any two CT and DT signals and perform the following operation Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and folding.
4. Express any two system mathematical expressions in input output relation form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time invariant, Invertible.
5. State and prove the properties of CT Fourier Transform and also demonstrate the interplay between the time and frequency domain.
6. State and prove the properties of Z Transform and take any two examples of each on Z-Transform & Inverse Z-Transform.
7. State and prove the properties of Discrete Fourier Transform and compare DFT & FFT Algorithms.

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T.E. Electrical Semester-II
MICROPROCESSOR AND MICROCONTROLLER

Teaching Scheme	Examination Scheme
Theory: - 4 Hrs/Week	**Theory** - 100Marks
Practical: - 2 Hr/Week	**Term-Work**- 25Marks

Course Objectives

1. To study the architecture and addressing modes of 8085.
2. To study the architecture and addressing modes of 8051 and to write assembly language programs of 8051.

Course Outcome

1. To impart knowledge on the architecture and basic concepts of microprocessor and microcontroller.
2. To create the memory and IO interfacing techniques with 8051.
3. To write assembly language program in microcontroller 8051 for various applications.

SECTION I

UNIT 1: Architecture of Intel 8085: (6 Hrs)

Architecture of Intel 8085 microprocessor, functional PIN diagram, ALU, Instruction register-decoder, Timing and control, general purpose registers, Data & Address bus.

UNIT 2: 8051 Microcontroller: (10 Hrs)

Comparison of microprocessor & microcontroller, Overview of 8051 family, Architecture of 8051, Functional pin description, Memory organization, Special Function Registers and various resources of 8051

UNIT 3: Assembly language programming: (8 Hrs)

Addressing modes, Instruction set and Assembly language programming.

SECTION-II

UNIT 4: Hardware overview: (8 Hrs)

Study of port structure, interrupt structure, timers, counters and their programming.

UNIT 5: 8051 Interfacing: (16 Hrs)

Semiconductor memory, memory address decoding, interfacing with External ROM , 8051 data memory space, accessing External data memory in 8051. Interfacing of LCD, Matrix keyboard, ADC 0809, DAC 0808, RTC DS12887, 8255.

UNIT 6: Electrical Applications of 8051: (4 Hrs)

Power factor control Relay, Temp indicator & controller, stepper motor and DC motor control.

Text Books:

1. Muhammad Ali Mazidi, "The 8051 Microcontroller and embedded systems", Pearson Education.
2. Ramesh S. Gaonkar ,"Microprocessor – Architecture, Programming and Applications with the 8085", Penram International Publisher , Fifth Edition,2006.
3. Ray.A.K. & Bhurchandi.K.M, "Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing", Tata Mc Graw Hill, 2006.

Reference Books:

1. Kenneth Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", 2nd Edition, Penram International.
2. Douglas V.Hall, "Microprocessors and Interfacing: Programming and Hardware", second edition, Tata Mc Graw Hill, 2006.
3. Peter Abel, "IBM PC Assembly language and programming", fifth edition, Pearson education / Prentice Hall of India Pvt.Ltd, 2007.
4. Device datasheet- ATMEL, DALLAS.
5. 8051 Manual (Intel).

Term Work:

Term-work shall consist of at least 6 tutorials/ assignments/ simulation covering the syllabus.

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T.E. Electrical Semester-II
MINI HARDWARE PROJECT

Teaching Scheme	Examination Scheme
Practical: - 2 Hr/Week	**Term-Work- 50**Marks

Mini hardware project

Note: Students groups should study and fabricate at least one mini hardware project such as but not restricted to the following

- Power supply
- Circuit using various types of transducer.
- Circuit using various sensors
- Circuit using various electronic and mechanical limit switches.
- Model project of electrical system.
- Circuit based on microprocessor application.
- Constructing and testing of simple power electronic circuit.
- Circuit based on PLC.

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T.E Electrical Semester-II

Self-Learning Module-II

Module –I: Safety Engineering & Disaster Management

UNIT I: Safety Philosophy and principles of Accident prevention

Introduction, accident, injury, unsafe act, unsafe condition, reportable accidents, need for safety, break down of accidents, hazardous industries.

Theories & Principle of accidents Casualty, cost of accident, computation of cost, utility of cost data. Accident reporting & Investigation Identification of the key facts, corrective actions, classification of facts Indian regulation

UNIT II: Safety Management:

Division of responsibility, Location of Safety function, size of safety department, qualification for safety specialist, safety committee – structure and functions

UNIT III: Safe Working Condition and Their Development **:**

SOP for various Electrical equipment, Incidental safety devices and methods, statutory of provisions related to safeguarding of Machinery and working condition

UNIT IV: Nature of disasters**:**

Nature of disasters – natural and other disasters, Earthquakes, floods, draught, cyclones, fire and other environmental disasters

UNIT V:

Behaviour of structures in disaster prone areas, Disaster zoning, Hazard assessment, Environmental Impact Assessment

UNIT VI:

Methods of mitigating damage during disasters, disaster preparedness

Text books:

1. Safety and Accident Prevention in Chemical Operation – H.H. Faweett and Wood
2. Personal Protective Equipment – NSC Bombay.
3. Design of Earthquake Resistant Buildings – Minoru Wakabayashi (McGraw Hill Publication)

4. Dynamics of Structures: Theory and Application to Earthquake Engineering (2nd edition) – Anil K Chopra(Pearson Education Publication).

Reference Books:

1. Fundamentals of Vibrations – Anderson, R.A. (Mc Millan) IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
2. Earth quake engineering damage assessment and structural design – S.F. Borg
3. Disasters and development – Cuny F (Oxford University Press Publication)
4. Fire Prevention Hand Book – Derek James

Module –II: Intellectual Property Rights

Unit-I: Basic Concepts of Intellectual Property:

Introduction to intellectual property rights, laws and its Scope, Trade Related Aspects of Intellectual Property Rights

Unit-II: Patents:

Introduction to patent law and condition for patentability, Procedure for obtaining patents, Rights of a patentee, Patent infringements, Biotechnology patents and patents on computer programs, Patents from an international perspective

Unit-III Trademark and 'geographical Indications:

Statutory authorities and registration procedure, Rights conferred by registration, Licensing, assignment and transfer of trademark rights, Trademark infringement, Geographical Indication of Goods & Appellations of Origin

Unit-IV Copyright:

Registration procedure and copyright authorities, Assignment and transfer of copyright, copyright infringement and exceptions to infringement, Software copyright

Unit-V

Introduction to the law on Industrial Designs, Registration and piracy, International perspective, Introduction to the law on semiconductor layout design, Registration, commercial exploitation and infringement

Text Books:

1. Vinod V Sople ,Managing Intellectual Property, – PHI

2. Kumar K ,Cyber law, intellectual property and e-commerce security, Dominent Publication and distribution,

New Delhi.

Reference Books:

1. Inventors Guide to Trademarks and Patents- Craig Fellenstein, Rachel Ralson- Pearson Education.

2. Intellectual Property –David Bainbridge, Longman

Module –III: Value Engineering

UNIT – I Basic Concepts

Meaning of the term value, basic kind, reasons for poor value, value addition, origin and history, Benefits, relevance in Indian scenario

UNIT – II Techniques

Different techniques, organizing value engineering study, value engineering and quality

UNIT – III Job Plan

Different phases, General phase, Information phase, Functional Phase, Creation Phase, Evaluation Phase, Investigation Phase, Implementation Phase, Audit

UNIT – IV Selection of evaluation of VE Projects

Project selection, method selection, value standard, application of methodology

UNIT – V Value Engineering Program

VE operations in maintenance and repair activities, VE Cost, life cycle, cost model, training for VE, general value engineering, case studies

TEXT BOOKS

1. Value Engineering – S.S. Iyer – New Age International Publishers, New Delhi

2. Industrial Engineering & Management – O.P. Khanna – Dhanpat Rai & Sons

REFERENCES

1. Techniques of Value Analysis and Engineering – L.D. Miles – McGraw Hill, New York

2. Value Engineering, A Systematic Approach – A.E. Mudge – McGraw Hill, New York

3. Compendium on Value Engineering – H.G. Tufty – Indo American Society