Basaveshwar Engineering College (Autonomous)
[TEQIP Lead Institute, Govt. Aided Institution, AICTE Recognized, Affiliated to VTU Belgaum]
Bagalkot-587103, Karnataka, India.
Department of Electrical and Electronics Engineering

Basaveshwar Engineering College (Autonomous) Bagalkot

Department of Electrical and Electronics Engineering

Scheme of Teaching & Evaluation and detailed Syllabus

for B.E Electrical and Electronics Engineering for batch admitted in 2018-19

(based on Joint Board Meeting held on 04.06.2018 and09-05-2020)

Semester-5 **CAY 2021-22 [175 credits. 2019-20 admitted batch]**

Sl.	Sub Code	Subject	C	Hrs/ Week			Exam Marks		
				L	T	P	CIE	SEE	Total
01	UEE551C	Field Theory	3	2	2	0	50	50	100
02	UEE552C	Digital Signal Processing	3	2	2	0	50	50	100
03	UEE553C	Control Systems	3	2	2	0	50	50	100
04	UEE554C	Generation Transmission and Distribution	3	3	0	0	50	50	100
05	UEE5XXE	Dept. Elective – 1	3	3	0	0	50	50	100
06	UEE5XXE	Dept. Elective – 2	3	3	0	0	50	50	100
07	UEE561L	Digital Signal Processing Laboratory	1	0	0	2	50	50	100
08	UEE562L	Control System Laboratory	1	0	0	2	50	50	100
09	UEE563L	Analog and Digital Laboratory	1	0	0	2	50	50	100
10	UHS002N	Advanced Quantitative Aptitude and Soft Skills	1	2	0	0	50	50	100
Total			22	17	6	6	500	500	1000

List of Elective Subjects

Electrical Machine Design	Electrical Engineering Materials
Testing and Commissioning of Electrical Equipment	Micro Electro Mechanical Systems
Advanced Power Electronics	Reactive Power management
Fundamentals of Solar Thermal ECS	

Question paper pattern for Theory SEE:

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than 4 subdivisions.
3. Any five full questions are to be answered choosing at least one from eachunit

Laboratory Assessments for SEE:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
2. Allocation of 50 marks for CIE Performance and journal write-up: Marks for each experiment = 30 marks / No. of proposed experiments. One Practical test for 20 marks, (5 write up, 10 conduction, calculation, results etc., 5 viva-voce).
3. Allocation of 50 marks for SEE: 25% write up, 50% conduction, calculation, results etc., 25% viva-voce

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Digital Signal Processing

SubjectCode:UEE552C **Credits:03**
Contact Hours:03(3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Ch1.Discrete Fourier Transform (10h)

Introduction, Definition, and derivation of DFT and IDFT , Properties-linearity, shift, Symmetry etc., circular convolution, periodic convolution, use of tabular arrays, circular arrays, Stock Ham's methods, Linear convolution-two finite duration sequences, One finite and one infinite duration –overlap add method

Unit-II

Ch2.Fast Fourier Transform Algorithms (6h)

Introduction, decimation in time algorithm (DIT-FFT, DIT-IFFT), First decomposition, Continuation of decomposition, number of computations, number of multiplications, Computational efficiency,

Ch3.Design of FIR Digital filters(4h)

Introduction, Windowing, rectangular, Hamming window.

Unit-III

Ch4.Design of IIR Digital filters(10h)

Introduction, all pole analog filters- Butterworth and Chebyshev, Design of analog filters, Bilinear Transformation, Design of digital Butterworth and Chebyshev filters, Frequency transformations

Unit-IV

Ch5.Realization of Digital Systems(7h)

Introduction, block diagrams and SFG's, Realization of IIR systems- direct form, cascade form, Parallel form, Realization of FIR systems- direct form, cascade form, Linear phase realizations

Ch6.DSP Processors TMS320(3h)

Architecture and electrical applications (block diagram approach)

References:

1. Digital Signal Processing Principle,algorithms and applications 4th edition by Proakis, Pearson Education 2012
2. Digital Signal Processing by Sanjith K. Mithra Edition, 2013
3. Digital Signal Processing by Oppenheim, Pearson Education / PHI, 2015
4. Digital Signal Processing by Salivatanam, A Vallavaraj, Gnanapriya , TMH 2011
5. Digital Signal Processing by Ifeachor Emmauel, Pearson Education, 2nd edition 2010

Course outcomes:

After completion of the course, the students shall be able to:

1. Student should be able to recall DFT, IDFT, and basic properties of DSP
2. Student should be able to classify the FFT algorithms, filters, and design methods

3. Student should be able to derive DFT properties, FFT algorithms, filter equations, and convolution output
4. Student should be able to assess the output of system by linear & circular convolution, Stockhams method, and FFT algoritms
5. Student should be able to implement/realize the discrete LTI system in direct form I & II, cascade and parallel forms
6. Student should be able to design a filter for the given specifications.

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Control System

Subject Code: UEE553C **Credits: 03**
Contact Hours: 03 (3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

01 Introduction and Transfer function of Systems: L- 06 Hrs

Classification of control systems, open loop and closed loop systems, effects of feedback, Mathematical models of physical systems; definition of transfer function, Mechanical systems, Translational systems, Rotational systems, Electrical systems, Analogous systems.

02 Block Diagrams and Signal Flow Graphs: L- 05Hrs

Block diagrams (BD), Reduction of BD, Signal Flow graphs (SFG), Drawing block diagram and SFG of simple networks Mason's gain formula, Converting BD into SFG.

Unit-II

03 Time Response of Feed Back Control Systems: L-06 Hrs

Standard test signals, Unit step response of First and second order systems, time response specifications, and Time response specifications of second order systems, steady state errors and error constants.

04 Stability Analysis: L- 03 Hrs

Concepts of stability, Necessary conditions for Stability, Routh's stability criterion.

Unit-III

05 Root–Locus Techniques L-03 Hrs

Root locus concepts, Construction of root loci.

06 Introduction to State Variable Analysis: **L- 06 Hrs**

Concepts of state, state variables and state model, state models for linear continuous time systems, conversion of state model to transfer function and transfer function to state model, solution of state equations,

Unit-IV

07 Frequency Domain Analysis: L- 07 Hrs

Introduction, frequency domain specifications, correlation between time and frequency response. Method to draw bode plot, phase margin, gain margin, stability considerations,

08 Nyquist stability criterion. L- 03 Hrs

References:

1. 'Norman S Nise' “Control System Engineering ” McGraw Hill,
2. Benjamin C Kuo, “Automatic Control System”, VII- Edition, PHI, 2010.
3. Richard C. Dorf Robert H Bishop “Modern Control Systems “,VII- Edition, Addison

Wesley.

Course outcomes:

After completion of the course, the students shall be able to:

1. Illustrate the control System concept and its types.
2. Analyze the transfer function modeling of systems and its parameters
3. Explain the concept of time response and order of the system.
4. State the various concept of stability.
5. Compare and contrast the various frequency response plots.
6. Apply the State space modeling and solution of state equations

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Generation Transmission and Distribution

Subject Code: UEE554C **Credits: 03**
Contact Hours: 04 (4L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Electrical Power generation: 03 Hrs

Hydro Power Generation: Site selection, Line diagram representation, Classification, Merits and Demerits.

Thermal Power Generation: Site selection, Line diagram representation, Classification, Merits and Demerits.

Nuclear Power Generation: Site selection, Line diagram representation, Classification, Merits and Demerits.

Basic Aspects of Power Generation: 07 Hrs

Introduction, Load curve and load duration curve. Terms commonly used in system operation: Load factor, Diversity factor, Demand factor, plant capacity factor, plant utilization factor, Installed capacity, reserve capacity, Cold reserve, hot reserve, Spinning reserve, firm power. Effect of diversity factor on cost of generation. Interconnection of power stations, transfer of power. Economic Loading of interconnected stations.

Unit-II

AC Transmission Systems: 08 Hrs

Typical AC transmission system, Advantages of high voltage transmission. Comparison of conductor material in overhead lines: 3 phase 3 wire system, 3 phase 4 wire system. Components of overhead transmission line: Conductors, Line supports, Insulators – Types, Potential distribution over suspension insulator string, String efficiency, Methods of improving string efficiency. Corona – Factors affecting corona, Imp terms, Methods of reducing corona. Sag in overhead lines- Calculation of sag for equal and unequal supports, Effect of wind and ice loading on sag.

Electrical Parameters of Overhead Transmission Lines: 02 Hrs

Constants of Transmission line. Inductance of single phase two wire line, Capacitance of single phase two wire line.

Unit-III

Performance of Transmission Lines: 05 Hrs

Classification of overhead Transmission line. Short Transmission line, Medium Transmission line – End condenser method, Nominal T method, Nominal π method, Long Transmission line. Generalised circuit constants (ABCD) of a transmission line.

Underground Cables: 05 Hrs

Construction of underground cables, Insulating materials for underground cables, Laying of underground cables. Insulation resistance of single core cable, Capacitance of single core cable, Dielectric stress in a single core cable. Grading of cables: Capacitance grading, Intersheath grading.

Unit-IV

Distribution Systems: 04 Hrs

Classification of distribution systems. Overhead Vs Underground distribution system. Connection schemes of distribution system. Requirements of a distribution system.

DC Distribution: 04 Hrs

Types of DC distributors, DC distributor fed at one end- Concentrated loading, Uniform loading. DC distributor fed at both ends - Concentrated loading.

AC Distribution: 02 Hrs

AC distribution calculation, Methods of solving AC distribution issues.

References:

1. Soni, Gupta and Bhatnagar, "Power System Engineering", 5th edition, Dhanapat Rai and Co.(P) Ltd. Publishers, New Delhi,2016.
2. Mehta V K and Rohit Mehta, " Principals of Power Systems", 4th edition, S Chand and Company Ltd, Publishers, New Delhi,2015.
3. Gupta J B, "Transmission and Distribution of Electrical power", 9th edition, Sanjeev jumarKataria Publishers, New Delhi,2012.
4. WadhwaCL,"Generation,DistributionandUtilizationofElectricalPower",3rd edition,New age International (p) Ltd., New Delhi, 2012.

Course outcomes:

After completion of the course,

1. Students shall be able to **list and define** various parameters and features of Electrical power generation, transmission and distribution.
2. Students shall be able to **explain** different mechanical and electrical parameters related to Electrical power generation, transmission and distribution.
3. Students shall be able to **relate/articulate** the concepts and theories related to electrical parameters of Electrical power generation, transmission and distribution.
4. Students shall be able to **compare and contrast** the features of Electrical power generation, transmission and distribution.
5. Students shall be able to **evaluate/calculate** various parameters related to Electrical power generation, transmission and distribution.
6. Students shall be able to **discuss/choose/test** issues relating to Electrical power generation, transmission and distribution.

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ELECTRICAL MACHINE DESIGN

Subject Code: UEE5XXE **Credits: 03**
Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Principles of Electrical Machine Design: L-04 Hours

Introduction to design of electrical machines, limitations. Different types of materials and insulators used in electrical machines.

Design of DC Machines: L-06 Hours

Output equation, choice of specific loadings and number of poles, design of main dimensions, armature slot dimensions, commutators, brushes, and magnetic circuit – estimation of ampere turns, yoke, pole and field windings (shunt, series and inter poles).

Unit-II

Design of Transformers (Single phase and three phase): L-10 Hours

Output equation for single phase and three phase transformer, choice of specific loadings, expression for volts/turn , determination of main dimensions of the core, types of windings and estimation of number of turns and cross sectional area of Primary and secondary coils, estimation of no load current , expression for leakage reactance. Design of tank and cooling tube.

Unit-III

Design of Induction Motors : L-10 Hours

Output equation, choice of specific loadings, main dimensions of three phase induction motor, stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end ring, relation between bar and end ring currents. Estimation of no load current, leakage reactance.

Unit-IV

Design of Synchronous Machines : L-10 Hours

Output equation, choice of specific loadings, short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole synchronous machine. Design of rotor of salient pole synchronous machines, magnetic circuits, dimensions of the pole body, field winding, and rotor of non salient pole machine.

References:

1. Sawhney A. K, “A Course in Electrical Machine Design”, Dhanpat Rai, XVII Edition, 2006.Reactive Power Management, D. Tagare, TMH, 1st Edition, 2004.
2. Mittle, V.N., “Design of Electrical Machine Design”, Standard, 1983.
3. Aggarwal, R.K, “Principles of Electrical Machine Design”, IV Edition, Kataria Publishers, 1992.

Course outcomes:

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

1. Students should be able to identify, list and define different types of materials, parts, insulators, and the terms associated to Electrical machines and design terms
2. Students should be able to classify and explain the Choice of specific loadings of DC, Induction & synchronous machines and transformer
3. Students should be able to derive the expressions and prove the given criterion considering the limitations of the materials

4. Students should be able to calculate the dimension of the machine, number of ampere turns, for a given specific loading
5. Students should be able to estimate the number of slots, number of conductors, turns considering the feature of material & its limitations and the power factor
6. Students should be able to design the machine for a given application considering all the parameters, maximum specific loading, current, voltage, magnetizing current, voltage drop and other parameters of the machine and transformer design

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Testing and Commissioning of Electrical Equipment
(Elective)

Subject Code: UEE553E **Credits: 03**
Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Transformers : **L-10 Hrs**

Specifications: Power and distribution transformers as per BS standards. Installation: Location, site, selection, foundation details (like bolts size, their number, etc), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection

Commissioning tests: Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Bucholz& other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test, Installation and commissioning of transformer, causes and troubles and failures in power Transformer and maintenance of transformer.

Unit-II

Synchronous Machines: **L-10Hrs**

Specifications: As per BIS standards.

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

Commissioning Tests: Insulation, Resistance measurement of armature & field windings, waveform & telephone interference tests, line charging capacitance.

Performance tests: Various tests to estimate the performance of generator operations, slip test, short circuit test, sudden 3 phase short circuit tests, i vibration test and Abnormal conditions and protection

Unit-III

Induction Motors: **L-10 Hrs**

Specifications: for different types of motors, Duty, I.P. protection. i Installation: Location of the motors (including the foundation details) & its control apparatus, shaft & alignment for various coupling. Fitting of pulleys & coupling, drying of windings.

Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing.

Electrical tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test

Trouble causes and remedies and protection of induction motor and maintenance of motors.

Unit-IV

Switch Gear and Protective Devices: **L-09 Hrs**

Standards, types, specification, Installation, commissioning tests, type &i routine tests, possible troubles, causes and corrective actions for circuit breakers and maintenance of circuit breakers.

Specifications of VTs, Specifications of CTs, Testing of Current i Transformer and Voltage transformer.

References

1. Testing & Commissioning Of Electrical Equipment -S. Rao, KhannaPublishers.2004
2. Testing & Commissioning Of Electrical Equipment -B .V. S. Rao, Media Promoters and Publication Pvt., Ltd.
3. Testing & Commissioning Of Electrical Equipment- Ramesh L. Chakrasali

Course Outcomes

Students should be able to

1. Identify the different electrical equipment and define all the terms associated with their tests, specifications and standards
2. Explain the procedures and precautions for conduction of different tests
3. Test commission and install any electrical equipment considering all the guidelines specified by India and foreign countries
4. Prepare a maintenance schedule of different equipment and machines
5. Familiar about electrical safety regulations and rules during maintenance.
6. Trouble shooting chart for various electrical equipment, machines and domestic appliance

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Advanced Power Electronics

Subject Code: UEE55XE **Credits: 03**
Contact Hours: 04 (4L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

01. Introduction to Power Electronics: **05hr**
    Introduction, Applications, switching characteristics of Thyristor, MOSFET,IGBT, GTO, IGCT and MCT
02. Controlled Rectifiers: **05hr**
    Single phase and Three phase full wave controlled rectifier with RL, RLE load, Effect of source and load inductance of single phase bridge controlled converter

Unit-II

03. Inverters: **05hr**
    Detailed study of three phase inverter of 120^0 and 180^0. PWM techniques for single phase and three phase inverter, Space Vector PWM technique for three phase inverter
04. Multilevel Inverter: **05hr**
    Introduction, concept of multilevel inverter, flying capacitor, diode clamped and Cascaded H-Bridge multilevel converter and its application

Unit-III

05. Multiphase Matrix Converter Topologies: **05hr**
    Three-Phase Input with three phase Out Put Matrix converter, Three phase input with Five-Phase Output Matrix Converter, Sinusodial Carrier based PWM techniques
06. AC-Link Universal Power Converter: **05hr**
    Introduction, Hard Switching ac-Link Universal Power Converter, Soft Switching ac-Link Universal Power Converter

Unit-IV

07. Power Electronics for Wind Energy Conversion Systems:**05hr**
    Introduction, Wind Power Conversion: - Control Variables for Wind Turbines, Wind Turbine Concepts. Power Converters for Wind Turbines: - Two-Level Power Converter, Multilevel Power Converter, Multi-cell Converter. Controls and Grid Requirements for Modern Wind Turbines
08. Power Electronics for Photo Voltaic System: **05hr**
    Introduction, Power Curves and Maximum Power Point of PV Systems: Electrical Model of a PV Cell, Photovoltaic Module I–V and P–V curve, MPP under Partial Shading. Grid-Connected PV System, Control of Grid-Connected PV System: Maximum Power Point Tracking Control Methods (Perturb and Observe, Incremental conductance Method, Fractional Open circuit method and Fractional Short Circuit Method)

Reference Books:

1. Rashid .M. H "Power Electronics Hand book", Academic press,2001.
2. Haitham Abu-Rub, Mariusz Malinowski "Power Electronics for Renewable Energy systems, Transportation and Industrial Applications, by, Wiley publishers 2014.
3. Chakaraborty,SimonsandM.GKramer"PowerElectronicforRenewableEnergyand Distributed Energy System" WE (Ed), 2013.

Course Outcomes:

After completion of the course, the students shall be able to:

1. Recall, list and define the various semiconductor switches employed in power electronics circuits
2. Students able to describe the operation and switching characteristics of switches and operation of various advance power converter.
3. Derive the expressions of performance parameters for various power converters connected to R and R L loads.
4. Analyze and compare the behavior of power converters controlled by sine triangle and SVPWM.
5. Design various components for Multi level inverter, matrix converter and universal power converter connected to R, R-L load and renewable energy sources
6. Assess the performance of advance converter connected to renewable energy sources (PV and Wind turbine).

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REACTIVE POWER MANAGEMENT

Subject Code: UEE5XXE **Credits: 03**
Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Introduction: L-10 Hours

Importance of reactive power control in electrical power system, objectives of load compensation, ideal compensator, load compensation specific of a compensator, power factor correction and voltage regulation in single phase system, reactive power bias.

Unit-II

Basic requirement in AC power transmission: **L-10 Hours**

Factor affecting stability and voltage, uncompensated Transmission line: performance equations and performance requirement of lines, voltage profile, voltage-power characteristics, load ability characteristics.

Transmission line compensation: types passive/active compensators, series/shunt compensation and compensation by sectioning.

Unit-III

Harmonics: L-10 Hours

Characteristics and un characteristics harmonics, sources, troubles caused by harmonics on electrical equipment, means of reducing harmonics, types of harmonic filters, DC filters IEEE 519-1992 guidelines telephone interferences.

Unit-IV

Reactive power co-ordination : L-10 Hours

Reactive power management and planning, utility objectives, practices, transmission benefits, reactive power dispatch & equipment impact, reactive power forecasting, reactive power control by DSM, power pooling.

References

4. Reactive power control in electric power systems, T. J. E. Miller, John Wiley & Sons NY 2009
5. Reactive Power Management, D. Tagare, TMH, 1st Edition, 2004.
6. Power System Stability and Control. Kundur, TMH, 9th reprint, 2007.
7. Power System Voltage Stability, Carson. W. Taylor, McGraw-Hill, Inc.

Course outcomes:

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

- Student should be able to identify the basics of Reactive power management.
- Student should be able to explain about the reactive power compensator.
- Student should be able to apply the RPM concept in field.
- Student should be able to define the basic requirement in AC power transmission, factor affecting stability and voltage.
- Student should be able to explain about the harmonics on the system and types of harmonic filters.
- Student should be able to express about the reactive power co- ordination.

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Electrical Engineering Materials

Subject Code: UEE55XE **Credits: 03**
Contact Hours: 04 (4L-0T-0P) **Assessment: CIE 50 and SEE 50**

UNIT – I

Conductivity Of Metals: 05 Hours

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, equation of motion of an electron, the current carried by electrons, mobility, energy levels of the molecule, emission of electrons from metals, effect of temperature on the electrical conductivity of metals, electrical conducting materials, electrical contact materials, non-linear conductors, thermal conductivity of metals, thermo electric effect.

Insulating Materials: 05 Hours

materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and Bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

UNIT – II

Materials for special applications: 05 Hours

Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, and sintered alloys for breaker and switch contacts

Modern Techniques For Materials Studies: 05 Hours

Optical microscopy, Electron microscopy, Photo electron spectroscopy, Atomic absorption spectroscopy, magnetic resonance, nuclear magnetic resonance, electron spin resonance and ferromagnetic resonance.

UNIT – III

Magnetic Materials: 06 Hours

Introduction Properties and Application of Piezoelectric materials, Eletrostrictive materials, Ferromagnetic materials, Magnetostrictive materials, Shape memory alloys, Electro archeological fluids, Magneto archeological fluids, Smart hydro gels

Ceramics: 03 Hours

Properties, application to conductors, insulators & capacitors Plastics, rubber

UNIT – IV

Amorphous Materials: 05 Hours

Crystalline versus Amorphous solids, glass formation, Techniques of preparation, Structural models of Amorphous materials, properties of met glasses

Wind Turbine Blades materials: 05 Hours

Composites materials for wind turbine blades, Fibers, Carbon fibers, Aramid, Basalt, Matrix, Thermosets, Thermoplastics

Reference Books:

1. An Introduction to Electrical Engineering- Indulkar C.S. &Thiruvengadam. S Chand & Company; 4th Edn. 2004 edition (1 December 2006)
2. Materials Science for Electrical and Electronic Engineers, Ian P. Jones, Oxford University Press, Indian Edition, 2007
3. Electrical Properties of Materials, L.Solymar, D.Walsh, 8th Indian Edition- Oxford

University Press Seventh Edition.
4. MEMS and MOEMS Technology and Applications, P.Rai-Choudhury (Editor), PHI, 2009.
5. Introduction to Electronic Properties and Materials, DavidJiles, CRC Press, 2nd Edition.

Course outcomes:

1. An ability to apply basic concept and principles of electrical materials.
2. Formulate to solve engineering problems.
3. Concept of solar cell materials helps in designing.
4. An ability to identify a materials and its structure.
5. To gain the knowledge of properties and engineering application of ceramics and amorphous materials.

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Digital Signal Processing Laboratory

Subject Code: UEE561L **Credit: 01**
Contact Hours: 02 (0L-0T-2P) **Assessment: CIE 50 and SEE 50**

List of Experiments:

1. Generation of Unit step, ramp, exponential and sinusoidal signals
2. Convolution of two signals
3. To determine power and energy of the signals
4. To determine impulse response given y(n) and x(n)
5. To determine DTFT of given sequence
6. Circular convolution of two given sequences
7. Computation of N – point DFT of a given sequence and to plot magnitude and phase
8. Linear convolution of two sequence using DFT and IDFT
9. Circular convolution of two sequences using DFT and IDFT
10. Design and implementation of FIR and IIR fitter to meet given specifications.
11. Study of DSP starter kits (DSK)
12. Linear convolution Using DSK
13. Circular Convolution using DSK
14. Computation of N point DFT using DSK

Course outcomes:

After the completion of the course, the student will be able to :-

1. Students should be able to generate universal discrete signals of signal systems & digital signal processing using MATLAB/CCStudio
2. Students should be able to write/model the programme for signal processing experiments in MATLAB/CCStudio
3. Students should be able to compare & contrast results of conducted signal processing experiments with theoretical calculations

Laboratory Assessments:

1) Each Laboratory is evaluated for 100 marks (50 CIE and 50 SEE)
2) Allocation of 50 marks for CIE
    - Performance and journal write-up: Marks for each experiment = 30 Marks.
    - One practical test for 20 Marks (5 marks write up, 10 marks conduction, calculation, Results etc.., 5 marks viva – voce).
3) Allocation of 50 marks for SEE. 25% write-up, 50% conduction, calculation, results etc., 25% Viva – Voce..

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Control Systems Laboratory

Subject Code: UEE562L **Credit: 01**
Contact Hours: 02 Hrs **Assessment: CIE 50 and SEE 50**

1. Determine time domain response of second order systems for step input and obtain performance parameters.
2. **a)** Experiment to draw the speed – torque characteristic of a A.C. servomotor.
   b) Experiment to draw the speed torque characteristic of a D.C. servomotor.
3. Design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.
4. Study the synchro-transmitter and receiver and obtain output vs input characteristics.
5. Determine experimentally the frequency response of a second -order system and evaluation of frequency domain specifications.
6. Design RC lag compensating network for the given specifications. viz., the maximum phase lag and the frequency at which it occurs, and obtains its frequency response.
7. Experiment to draw the frequency response characteristic of a given lag- lead compensating network.
8. Design a PID controller and study its effect on steady state error.
9. Plot the root locus diagram of an open loop transfer function and determine range of gain 'k' for stability. Using MATLAB software
10. Plot a Bode diagram of an open loop transfer function. Using MATLAB software
11. Draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system. Using MATLAB software.

Course outcomes:

After the completion of the course, the student will be able to :-

1. Execute the frequency response and time response analysis of a second order control system through conduction.
2. Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot. Using MATLAB
3. Design Lag, Lead, Lead-Lag compensators and verify experimental results through conduction.
4. Analyze and verify experimental results of a toque- speed characteristic of DC and AC servomotors.
5. Analyze the effect of P, PI, PD and PID controllers on a control system.

Laboratory Assessments:

1) Each Laboratory is evaluated for 100 marks (50 CIE and 50 SEE)
2) Allocation of 50 marks for CIE
   - Performance and journal write-up: Marks for each experiment = 30 Marks.
   - One practical test for 20 Marks (5 marks write up, 10 marks conduction, calculation, Results etc.., 5 marks viva – voce).
3) Allocation of 50 marks for SEE. 25% write-up, 50% conduction, calculation, results etc., 25% Viva – Voce..

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Department of Electrical and Electronics Engineering

Analog and Digital Electronics Laboratory

Subject Code: UEE563L **Credit: 01**
Contact Hours: 02 (0L-0T-2P) **Assessment: CIE 50 and SEE 50**

List of Experiments:

1. Design and testing of diode clipping and clamping circuits.
2. Design of fixed bias and voltage divider bias circuits for BJT.
3. Design of RC coupled single stage BJT amplifier and determination of the gain, frequency response, input and output impedances.
4. Calculation of hybrid parameters of a CE transistor amplifier
5. Simplification, realization of Boolean expressions using logic gates /Universal gates.
   (i) Realization of Full adders and Full Subtractors using logic gates
   (ii) Realization of parallel adder/subtractors using 7483 chip
6. Realization of Binary to Gray Code conversion and vice versa.
7. MUX / DEMUX-use of 74153, 74139 for arithmetic circuits and code converters
8. Realization of One/Two bit comparator and study of 7485 magnitude comparator.
9. Truth table verification of Flip- Flops (i) JK Master slave (ii) T type and (iii) D type
10. Realization of 3 bit counters and MOD- N counter design (7490, 74193).
11. Shift left; Shift Right; SIPO, SISO, PIPO, PISO, operations using 74S95.
12. Ring counter and Johnson counter.

Course outcomes:

After the completion of the course, the student will be able to :-

1. Student should be able to select appropriate components and write the requirement table based on experiment
2. Student should be able to write the procedure, simplify the expressions using K-map and realize the circuit
3. Student should be able to rig-up the circuit and verify output

Laboratory Assessments:

4) Each Laboratory is evaluated for 100 marks (50 CIE and 50 SEE)
5) Allocation of 50 marks for CIE
   - Performance and journal write-up: Marks for each experiment = 30 Marks.
   - One practical test for 20 Marks (5 marks write up, 10 marks conduction, calculation, Results etc.., 5 marks viva – voce).
6) Allocation of 50 marks for SEE. 25% write-up, 50% conduction, calculation, results etc., 25% Viva – Voce..

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BVVS

Department of Electrical and Electronics Engineering

Semester-6 **CAY 2021-22 [175 credits. 2019-20 admitted batch]**

Sl.	Sub Code	Subject	C	Hrs/ Week			Exam Marks		
				L	T	P	CIE	SEE	Total
01	UEE651C	Power System Analysis and Stability	3	2	2	0	50	50	100
02	UEE652C	Microcontrollers	3	3	0	0	50	50	100
03	UEE653H	Management and Entrepreneurship	3	3	0	0	50	50	100
04	UEE6XXE	Dept. Elective – 3	3	3	0	0	50	50	100
05	UEE6XXN	Open Elective – 1	3	3	0	0	50	50	100
06	UEE661L	Microcontrollers and IoT Laboratory	1	0	0	2	50	50	100
07	UEE662L	Electrical Auto CAD and MiPower Laboratory	1	0	0	2	50	50	100
08	UEE665P	Mini Project	2	0	0	4	50	50	100
09	UCS659L	Advanced C Programming Laboratory (mandatory)	2	0	2	2	50	50	100
10	UHS003N	Career Planning and Professional Skills	1	2	0	0	50	50	100
Total			22	16	4	10	500	500	1000

List of Elective Subjects

Modern Control Theory	VLSI Design and Applications
Electrical safety in Industrial plants	Battery Management
Electrical Power Utilization and Drives	Energy Efficient Motors
Fundamentals of Wind Energy Conversion Systems	Computer aided electrical drawing
List of Open Electives Subjects @ 6th Sem	
MATLABORATORY for Engineers	Renewable Energy Resources

Question paper pattern for Theory SEE:

4. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
5. Each question should not have more than 4 subdivisions.
6. Any five full questions are to be answered choosing at least one from eachunit

Laboratory Assessments for SEE:

4. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
5. Allocation of 50 marks for CIE Performance and journal write-up: Marks for each experiment = 30 marks / No. of proposed experiments. One Practical test for 20 marks, (5 write up, 10 conduction, calculation, results etc., 5 viva-voce).
6. Allocation of 50 marks for SEE: 25% write up, 50% conduction, calculation, results etc., 25% viva-voce

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Department of Electrical and Electronics Engineering

Power System Analysis and Stability

SubjectCode:UEE651C **Credits:03**
Contact Hours:03(2L - 2T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Power System Representation: (4L-4T Hours)

Standard symbols of power system components, Single line diagram, Per unit system, Per unit impedance of 3 phase components, Change of base, Per unit impedance diagram, Advantages of per unit system calculations, Formation of Y- bus by inspection method-Numerical Problems

Symmetrical Three Phase Faults: (4L-4T Hours)

3 - phase short circuit at the terminals of unloaded generator, Sub transient, Transient and Steady state reactance, Transients on a transmission line, Short circuit currents and Reactance of synchronous machines on load and no load, Short circuit MVA-Numerical Problems

Unit-II

Symmetrical Components: (3L-3T Hours)

Definition of sequence components for 3-Phase unbalanced power systems, Operator "a" and its properties, Expressions for sequence components, Phase shift of symmetrical components in star delta transformer bank-Numerical Problems

Sequence Networks:(3L-3T Hours)

3- Ph power in terms of sequence components, voltage drop due to sequence currents, sequence impedance and sequence networks of power system elements (Alternator, Transformer and Transmission line), positive, negative and zero sequence networks of power system elements-Numerical Problems

Unit-III

Unsymmetrical Fault at the Terminals Unloaded Generator:(3L-3T Hours)

L-G, L-L, L-L-G fault with and without fault impedance at the terminals of unloaded generator- derivation for connection of sequence network and fault currents-Numerical Problems

Unsymmetrical Faults on Power Systems:(3L-3T Hours)

L-G, L-L, L-L-G faults on unloaded power systems, Open conductor faults in power system-Numerical Problems

Unit-IV

Stability Analysis: (3L-3T Hours)

Classification of Power System Stability, Steady Rotor dynamics, Swing equation, Power angle equation for salient and non salient pole synchronous machines-Numerical Problems

Equal Area Criterion:(3L-3T Hours)

Equal area criterion – Stability analysis for sudden change in mechanical input power, 3-ph fault on Generator terminals and on transmission line, Expression for critical clearing angle, Methods to improve stability of power system-Numerical Problems

References:

1. K. Uma Rao, "Computer Techniques and Models in Power Systems", 1st Edition, I. K. International publishing house, 2014.

2. Nagarath and Kothari, “Modern Power System Analysis”, 3rd Edition, TMH, 2009.
3. W.D. Stevenson, “Elements of Power Systems Analysis”, 4th Edition, Mc.Graw Hill Publishers, 2013.
4. HadiSaadat, “Power System Analysis”, TMH, Publishers, 4th Edition 2015.
5. V Neelakantan, "Power System Analysis & Stability”, Shiva Publishers, 2017

Course outcomes:

After completion of the course, the students shall be able to:

1. Students shall be able to recall the procedure for drawing the reactance diagrams of power system network and advantages of per unit system representation
2. Students shall be able to illustrate the significance of fault analysis, sequence components and power system stability studies
3. Students shall be able to derive mathematical expressions for fault currents and rotor angle under different disturbance conditions
4. Students shall be able to make use of per unit system and sequence components to carry out symmetrical and unsymmetrical fault analysis
5. Students shall be able to decide the stability of the power system and fault analysis methodology for different fault conditions
6. Students shall be able to construct positive, negative and zero sequence reactance diagrams and power angle curves for various fault conditions

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Department of Electrical and Electronics Engineering

Microcontrollers

SubjectCode:UEE652C **Credits:03**
Contact Hours:03(3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Ch1. Microprocessors and Microcontrollers (4h):

Basics hex numbers, Hexadecimal addition, Block diagram of Computer, bus and Types of buses, memory address, Introduction of Microprocessors and Microcontrollers 8051, Features, Block diagram, pin diagram, program model, Architecture, PSW, PC, SP, Memory

Ch2. 8051 Assembly Language Programming (2h):

Introduction to assembly language programming,
assembling and running a program, The program counter and ROM space,
data types and directives.

Ch3. Addressing Modes(4h):

Introduction, Addressing modes,
External Data Moves, Code Memory Read Only Data Moves, Indexed Addressing Mode, Programs, PUSH and POP Opcodes, programs, Data exchanges. Programs

Unit-II

Ch4. Logical and Arithmetic Operations (5h):

Introduction, Arithmetic instructions, incrementing and decrementing,
Addition, subtraction, multiplication and division, decimal arithmetic,
Byte level Logical instructions, Bit level logical instructions, Rotate and swap instructions, Programs

Ch5. Jump and Call Instructions (5h):

The jump and call program range, jump and call instructions,
machine cycle and time delays generation
Programs

Unit-III

Ch6. 8051 I/O and Timer Programming (6h)

Introduction, I/O programming, I/O Bit Manipulation Programming.
Timers, programming timers 0 and 1 in 8051 assembly.
Counter programming,

Ch7. 8051 Serial Port and Interrupt Programming (4h):

Basics of serial communication, 8051 connections to RS-232,
Serial port programming in 8051 assembly, Introduction to interrupts,

Unit-IV

Ch8. 8051 Interfacing and Applications (5h):

Interfacing 8051 to LCD, parallel ADC0809, serial ADC MAX1112, DAC, Stepper motor

Ch9. Programming in C for 8051(4h)

Introduction, Programming in C for 8051: data types, Programs on time delays, I/O programming,

References:

1. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications" 3rd edition, Cengage, 2007.

2. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd edition, Pearson, 2012.
3. Myke Predko, "Programming and Customizing the 8051 Microcontroller", TMH, 1999, 15th Reprint, 2008
4. Dr.Ramani Kalpathi and Ganesh Raja; "Microcontroller and its applications", 1st revised edition Sanguine Technical publishers, Bangalore-2007.
5. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and system Design", Pearson Education, 2011.
6. Dr.K. Uma Rao and Dr. Andhe Pallavi, "8051 Microcontroller Architecture, Programming and Applications", Sanguine Technical Publishers Bangalore, 2010.

Course outcomes:

After completion of the course, the students shall be able to:

1. List the features of microcontroller, peripherals and define addressing modes
2. Illustrate architecture of microcontroller, functions of registers & pins, addressing modes, directives, programming instructions, interrupts and peripheral devices
3. Identify the instructions/addressing modes, codes for selecting the register banks/timer registers and to make use of appropriate instructions for programs & delay calculation
4. Create, inspect &debug the assembly language instructions/program and re-correct code & assess number of bytes
5. Formulate the flowchart & assembly level /8051C programme for given application
6. Design and construct the interfacing circuit and develop programme with microcontroller 8051 for given application

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Department of Electrical and Electronics Engineering

Modern Control Theory (Elective)

Subject Code: UEE654E **Credits: 03**
Contact Hours: 03 (3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

01 State Variable Analysis and Design: **L- 05 Hrs**
Introduction, state space representation using physical variable, phase variable and canonical variables.

02 Derivation of transfer function from state model: **L-04 Hrs**
Diagonalization, Eigen values, Eigen vectors, Solution of state equations.

Unit-II

03 Solution State Transition Matrix: **L-05Hrs**

Solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley- Hamilton method, concept of controllability and observability methods.

04 Pole Placement Techniques: **L-05Hrs**
Stability improvements by state feedback, necessary and sufficient condition for arbitrary pole place placement

Unit-III

05 Design of Controllers: **L-05Hrs**
Introduction and Design of Proportional (P), Integral (I), Differential (D), PI, PD and PID..

06 Design of Compensators: **L-05Hrs**
Lead compensator, Lag compensator and Lag-lead compensator using frequency domain.

Unit-IV

07 Non-Linear Systems: **L-05 Hrs**
Introduction behavior of non linear system common physical non-linearly - saturation, friction, backlash, dead zone, relay multivariable non linearity. Phase plane method singular points stability of nonlinear system.

08 Liapunov Stability Criteria: **L-05 Hrs**
Liapunov function, direct method of Liapunov and the linear system, Hurwitz criterion and Liapunov's direct method, construction of Liapunov functions for non linear system by Krasvskii's method.

References:

1. Benjamin C. Kuo and Farid Golnaraghi, "Automatic Control Systems", VIII- edition, John Wiley and Sons, 2003.
2. Nagoor Kani, "Advanced Control Theory" 2Edition RBA Publications 2014.
3. Parvatikar K, "Modern control Theory" 1Edition, PRISM Publications, 2016.

Course outcomes:

After completion of the course, the students shall be able to:

1. Students should be able to identify state variables, controllers, and compensators for linear and non linear systems.
2. Students should be able to describe/illustrate state space, pole placement technique and different types of nonlinear systems
3. Students should be able to compute eigen values & vectors in state equation and controllability & observability.
4. Students should be able to analyze stability improvements by state feedback, state observer and Liapunov criteria.
5. Students should be able to compare and contrast multiple methods to implement a function in different domains.
6. Students should be able to design the PID controller, compensators and state regulator observer using system parameters.

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Electrical Power Utilization and Drives

Subject Code: UEE65XE **Credits: 03**
Contact Hours: 03 (3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Electric heating: 10 Hrs

Introduction, Concept of electric heating, Advantages, Modes of heat transfer, Classification of electric heating, Requirements/ properties/Characteristic of a good heating element. Design of heating element, Resistance furnace/Oven, Temperature controlofresistancefurnace.Electricarcfurnace(i)Directarcfurnace(ii)Indirectarc furnace. Induction heating/Furnace: (i) Core type induction furnace – direct & indirect (ii) Coreless induction furnace (iii) High frequency eddy current heating, Dielectric heating.

Unit-II

Tariff : 02 Hrs

Introduction, Definition and significance, Objectives of tariff, Factors governing tariff, Features of good tariff or desirable characteristic of tariff, Types of tariff

Introduction to Electric Drives: 08 Hrs

Concept of electric drive, advantages and classification. Dynamics of motor load combination. Speed torque convention/Multi quadrant operation. Equivalent drive parameters-(i) rotational load (ii) Translational load. Components of load torque: Static torque, Viscous torque, Coulomb torque, Windage torque. Steady state stability: Criterion for steady state stability. Load equalization, Calculation of time and energy loss in transient operation.

Unit-III

DC motor and Induction Motor drives: 06 Hrs

DC motor drives: Speed Torque Characteristics of DC motor: DC shunt motor- Speed control, DC series motor- Speed control. Motoring and electric braking of DC shunt motor, Motoring and electric braking of DC series motor.

Induction Motor drives: Principle of operation, Equivalent circuit, Speed Torque Characteristics of Induction motor. Braking of Induction motor – Regenerative, Plugging, Dynamic braking.

Heating and rating of motors: 04 Hrs

Heating effects, heating and cooling curves. Loading conditions and classes of duty. Determination of power rating of electric motors for different applications.

Unit-IV

Electric Traction: 10Hrs

Introduction, Ideal traction system, advantages and Disadvantages of electric traction. Systems of track electrification, Types of railway services. Speed time curves of train movement- Creast speed, Average speed, Schedule speed. Simplified speed time curves. Mechanism of train movement- adhesive weight and co-efficient of adhesion. Tractive effort for propulsion of train. Power output from driving axles, Energy output from driving axles, Specific energy output, Energy Consumption.

References:

1. Garg G C, “Utilization of electrical power and electric drives”, Khanna Publishers, 9th edition,2012
2. S K Pillai, “A first course on electric drives”, Wiley Eastern Ltd., 2nd Edition,2006.

3. De N K, Sen P K, "Electric Drives", 15th edition, PHI,2012.
4. Wadhwa C L, "Generation, Distribution and Utilization of Electrical Power", 3rd edition, New age International(p) Ltd., New Delhi,2012.
5. Gupta J B, "Utilization of electrical power and electric traction", 10th edition, S K Kataria and sons,2012.
6. Dubey G K, " Fundamentals of electric drives", 2nd edition, Narosa publishingHouse,2010.

Course outcomes:

After completion of the course,

1. Students shall be able to **list and define** various parameters and features of electric heating, tariff, electric drives andtraction.
2. Students shall be able to **explain** various concepts and theory related to electric heating, tariff, electric drives andtraction.
3. Students shall be able to **relate/articulate** the concepts and theories related to electric heating, tariff, electric drives andtraction.
4. Students shall be able to **compare and contrast** the features of electric heating, tariff, electric drives andtraction.
5. Students shall be able to **evaluate/calculate** various parameters related to electric heating, tariff, electric drives andtraction.
6. Students shall be able to **discuss/choose/test** issues relating to electric heating, tariff, electric drives and traction.

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VLSI DESIGN

Subject Code: UEE6XXE **Credits: 03**
Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Introduction to MOS Technology: L-05 Hours

Introduction to integrated circuit technology, Metal oxide semiconductor and related VLSI technology, Basic MOS transistors, enhancement mode transistor action, depletion mode transistor, nMOS fabrication, CMOS fabrication, BiCMOS technology. Basic

Electrical Properties of MOS and BiCMOS Circuits: L-05 Hours

Drain to source current verses Voltage characteristics, threshold voltage, trans-conductance, nMOS inverter, determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, MOS transistor circuit model, BiCMOS inverters.

Unit-II

MOS and BiCMOS Circuit Design Process: L-10 Hours

MOS layers stick diagrams, nMOS design style, CMOS design style, designs rules and layout, and lambda based design rules. Basic Circuit Concept: sheet resistance, area capacitance calculation, delay unit, inverter delay, driving large capacitive loads, super buffers, wiring capacitance.

Unit-III

Subsystem Design and Layout: L-10 Hours

architectural issues, gate (restoring) logic, examples of structure ddesign (combinational logic)- a parity generator, Bus arbitration logic for n-line bus, multiplexers. Subsystem Design Process: General consideration, design process- 4 bit arithmetic processor.

Unit-IV

Semiconductor memories: L-10 Hours

Introduction, Dynamic random access memory, static randomaccess memory, nonvolatile memory, flash memory, Ferro electric random access memory.

References

1. Douglas A. Pucknell, Kamran Eshraghian, “Basic VLSI Design”, 3rdEdition, PHI.
2. Sung Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits, Analysis and Design”, 3rd Edition, Tata McGraw Hill.
3. S. M. Sze, “VLSI Technology”, 2ndEdition, Tata McGraw Hill.

Course Outcomes

At the end of this course,

- Students shall be able to learn details of basics of MOS transistors and digital chip design process
- Students shall be able to understand MOS and BiCMOS Circuit Design Process
- Students shall be able to understand semiconductor memories.
- Students shall be able to Knowledge of stick diagram
- Students shall be able to excel in design of digital integrated circuits
- Students shall be able to understand Electrical Properties of MOS and BiCMOS

Battery Management System

Subject Code: UEE6XXE **Credits: 03**

Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Battery-Management-System Requirements: L-09 Hours

Introduction and BMS functionality. Requirements: Sensing, High-voltage contactor control, Isolation sensing and thermal control, Protection and interface, State-of-charge estimation and Energy & power estimation.

Unit-II

Battery State Estimation: L-10 Hours

Preliminary definitions, approaches to estimate state of charge, Review of probability, Overview of vector random (stochastic) processes, Sequential-probabilistic-inference solution, The six-step process, Deriving the linear Kalman filter, Visualizing the Kalman filter, MATLAB code for the Kalman filter steps, Practical considerations, The extended Kalman filter (EKF),

Unit-III

Battery Health Estimation: L-10 Hours

Introduction, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Sensitivity of voltage to ESR and total capacity, A Kalman filter framework for estimating parameters, EKF for parameter estimation, Simultaneous state and parameter estimation, Robustness and speed, The problem with least-squares capacity estimates, Derivation of weighted ordinary least squares, Derivation of weighted total least squares, Goodness of the model fit and confidence intervals, Simplified method with proportional confidence on xi and yi.

Unit-IV

Cell Balancing: L-10 Hours

Causes (and not causes) of imbalance, Design choices when implementing balancing, Circuits for balancing (1): Passive, Circuits for balancing (2): Active, capacitive, Circuits for balancing (3): Active, inductive and dc-dc, How quickly must I balance a pack? And results of balancing simulations.

Voltage-Based Power-Limit Estimation: Problem definition, Voltage-based rate limits, using simple cell model, Voltage-based rate limits, using comprehensive cell model, Bisection search and Power-limits estimation example.

References

1. A.R. JHA, Next-Generation Batteries and Fuel Cells for Commercial, Military, and Space Applications, CRC Press, 2012.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric, Springer, 2013.
3. Gregory L. Plett, Battery Management Systems, Volume 1: Battery Modeling , Artech House September 2015

Prerequisites

Students should have basic knowledge of

- Battery technologies and principle of operation

Course Outcomes

At the end of this course

1. Students should be able to identify, list and define all the terms associated with battery terminologies, Electric vehicles and different filters and methods of optimal control
2. Students should be able to explain the types of battery tests and methods employed to determine SoC and SoH
3. Students should be able to solve numerical problems on fundamental aspects of a rechargeable battery, performance parameters & specifications, battery cell voltage equalization
4. Students should be able to compare and contrast the types of battery state of charge & health estimation methods and control methods for optimal performance of battery
5. Students should be able to conduct tests, observe and draw the inference based on the test results on existing batteries.
6. Students should be able to develop innovative technologies and battery management system for energy conservation

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Department of Electrical and Electronics Engineering

Microcontrollers and IoT Laboratory

Subject Code: UEE661L **Credits:01**

Contact Hours:02(0L - 0T - 2P) **Assessment: CIE 50 and SEE 50**

Part A - Assembly Language Programming

1	Addition of two 8 bit numbers, 16 bit numbers, array of 8 bit numbers, average of an array
2	Subtarction of two 8 bit numbers, 16 bit numbers
3	BCD Addition- two digit numbers, 4 digit numbers
4	Multiplication, Division
5	Arranging an array of number in ascending/descending order
6	To find maximum/minimum number of an array
7	Block of data transfer- Internal RAM, Internal RAM to external RAM
8	To find number of positive and negative numbers in an array
9	Code Coversion-BCD to Hex, Hex to BCD
10	Counters-Binary, BCD

Part B-IOT Programming

1	Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2	To interface LED/Buzzer with Arduino Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds
3	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6	To interface DISPLAY with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth
8	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when I'/'O' is received from smartphone using Bluetooth.
9	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud
10	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud
11	To install MySQL database on Raspberry Pi and perform basic SQL queries.
12	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker
13	Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14	Write a program to create TCP server on Arduino Raspberry Pi and respond with humidity data to TCP client when requested.
15	Write a program to create UDP server on Arduino Raspberry Pi and respond with humidity data to UDP client when requested.

AutoCAD lab

Subject Code: UEE662L **Credits:01**

Contact Hours:02(0L - 0T - 2P) **Assessment: CIE 50 and SEE 50**

Part A - Assembly Language Programming

1	Draw Commands- Mirror, Move, copy, offset, rotate, fillet, trim
2	Wiring layout of residential and workshop plan
3	Single Layer 24 Conductor 4 pole progressive Winding with sequence diagram
4	Double Layer 24 Conductor 4 pole DC lap Winding with sequence diagram
5	Double Layer 26 Conductor 4 pole DC lap Winding with sequence diagram
6	12 slots 24 conductors 3 phase full pitch star connected AC winding
7	Assembly of pole, core and field coil for a isometric pole, core and field coil of a DC machine
8	Assembly of single phase 500 kVA core type transformer
9	Assembly of 50 kW DC generator for a given dimension
10	Rotor of 25 kVA alternator assembly
11	Stator of 25 kVA alternator assembly
12	Rotor of 3 phase induction motor assembly

References

1. A.K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & Co. (P) Limited (2016), ISBN-10: 8177001019, ISBN-13: 978-8177001013
2. V. N. Mittle & Arvind Mitttle, Design of Electrical Machines, standard publishers distributors
3. S. F. Devalapur, Electrical Drafting, Eastern Book Promoters

Prerequisites:

Students should have basic knowledge of engineering physics and Electrical Machines constructional and operational details

Course Outcomes:

At the end of this course

1. Draw layout of residential and workshop plan using commands
2. Write identify the commands and icons on the Auto CAD software
3. Draw the Windings, assembly of machine parts

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Department of Electrical and Electronics Engineering

Open Elective

Renewable Energy Sources

Subject Code: UEE5XXN **Credits: 03**
Contact Hours: 03 (3L-0T-0P) **Assessment: CIE 50 and SEE 50**

Unit-I

Introduction to Energy Sources: **02Hrs**

Classification of Energy Resources; Conventional Energy Resources – Availability and their limitations; Non-Conventional Energy Resources– Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources.

Solar Energy Basics: **04Hrs**

Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (only theory); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

Solar Thermal Systems: **04Hrs**

Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, Concentrating dish type; Solar driers, Solar Still.

Unit-II

Solar Electric Systems: **05Hrs**

Solar Thermal Electric Power Generation – Solar Pond and Concentrating Solar Collector (parabolic trough, parabolic dish, Central Tower Collector). Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, module, panel and array. Solar PV Systems – Street lighting, Domestic lighting and Solar Water pumping systems.

Wind Energy: **05Hrs**

Wind and its Properties, History of Wind Energy. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of a WECS, Derivation for Power in the wind, Advantages and Disadvantages of WECS

Unit-III

Biomass Energy: **05Hrs**

Introduction, Photosynthesis process, Biomass conversion technologies; Biomass Gasification – Principle and Working of Gasifiers, Biogas - production of biogas, factors affectingbiogasgeneration,typesofbiogasplants–KVICandJanatamodel.

Geothermal Energy: **05Hrs**

Introduction, Geothermal resources (brief description); Advantages and disadvantages; Applications of Geothermal Energy

Unit-IV

Energy from Ocean: **06Hrs**

Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitation of TPP.

Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Advantages and Limitation of OTEC.

Emerging Technologies: **04Hrs**

Fuel Cell, Wave Energy. (Principle of Energy generation using block diagrams, advantages and limitations).

References:

1. Khan, B. H., Non-Conventional Energy Resources, TMH, New Delhi, 2006.
2. Rai, G. D., Non-Conventional Sources of Energy, IV- Edition, Khanna Publishers, New Delhi, 2007
3. Mukherjee, D., and Chakrabarti, S., Fundamentals of Renewable Energy Systems, New Age International Publishers,2005.
4. Tiwari,G.N.,and Ghosal,M.K.,Renewable Energy Sources: Basic Principles and Applications, Alpha Science International, Ltd., New Delhi, 2006.

Course outcomes:

After completion of the course,

1. **Lst and define** various parameters and features of solar, wind, biomass, geothermal and ocean energy conversion systems.
2. **Explain** various concepts and theory related to solar, wind, biomass, geothermal and ocean energy conversion systems
3. **Relate/articulate** the concepts and theories related to solar, wind, biomass, geothermal and ocean energy conversion systems
4. **Compare and contrast** the features of solar, wind, biomass, geothermal and ocean energy conversion systems
5. **Evaluate/calculate** various parameters related to solar, wind, biomass, geothermal and ocean energy conversion systems
6. Discuss/choose/test issues relating to solar, wind, biomass, geothermal and ocean energy conversion systems