

Government College of Engineering, Karad
Third Year (Sem. – V) B. Tech. Electrical Engineering
EE3501: Elements of Power System

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | -- | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : DC and AC Circuits, DC /AC Machines and Transformers

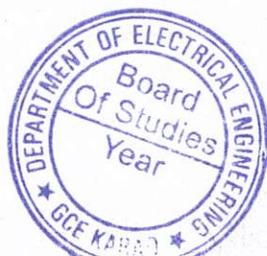
Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Summarize evolution and structure of power system. |
| CO2 | Develop per phase impedance and reactance diagrams for a symmetrical three-phase system. |
| CO3 | Determine the parameters and performance of transmission lines. |
| CO4 | Identify economic aspects of power generation. |

| | Course Contents | CO | Hours |
|---------------|--|------------|-----------|
| Unit 1 | Introduction and Mechanical aspects of Power System Evolution of Power System and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Types of supporting structures, types of insulators, corona, sag and its calculation | CO1 | 08 |
| Unit 2 | Power System Components and Per Unit System Introduction to Power system elements. Corona, its causes and effects, Single phase representation of balanced three phase systems, Per-unit system, Per unit representation of transformer, methods of voltage control. Changing the base of Per-unit quantities, Node equations, Single-line diagram, Impedance and Reactance diagram | CO2 | 06 |
| Unit 3 | Series Impedance of Transmission Lines Types of Conductors, Resistance, Inductance of conductor due to internal flux, Flux linkages between two points external to an isolated conductor, Inductance of a single phase two wire line ,Flux linkages of one conductor in a group, Inductance of a three phase lines with equilateral spacing, Inductance of a three phase lines with Unsymmetrical spacing. | CO3 | 08 |
| Unit 4 | Capacitance of Transmission Lines Electric field of a long straight conductor , Potential difference between two points due to a charge, Capacitance of two wire line, Capacitance of a three phase line with equilateral spacing, Capacitance of a three phase line with unsymmetrical spacing, Effect of earth on the capacitance of three phase transmission lines. | CO3 | 06 |
| Unit 5 | Current and Voltage relations of Transmission Line Representation of Lines, short Transmission line, medium –length line, long transmission line: Solution of differential equations, long transmission line: Interpretation of the equation, Power flow through a transmission lines. Causes and effects of low power factor, shunt capacitors, calculation of p.f. correction. | CO3 | 06 |
| Unit 6 | Economic Aspects of Power Generation Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, Utilization and plant use factors. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs. Desirable Characteristics of a Tariff Method. Tariff Methods: Flat Rate, Block-Rate, two-part, three –part and power factor tariff methods | CO4 | 06 |

Text Books

| | |
|----|---|
| 1. | J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994. (Unit 3,4,5) |
| 2. | D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2011 (Unit 1-6) |



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| Reference Books | |
|-----------------|---|
| 1. | J. D. Glover and M. Sarma, Power System Analysis and Design, 3rd Edition, Brooks/ Cole Publishing, 2002 |
| 2. | Ashfaq Husain, "Electrical Power System", CBS, 5 th edition, 2007 (Unit 1,6) |
| 3. | Weedy B M, Cory B J, John, "Electric Power Systems", Wiley Publication, 2012 |
| 4. | Hadi Sadat, "Power System Analysis", McGraw Hill International, 2001. |
| Useful Links | |
| 1. | https://nptel.ac.in/courses/108/105/108105067/ Power System Analysis, IIT Kharagpur |
| 2. | https://nptel.ac.in/courses/108/102/108102047/ Power System Generation, Transmission and Distribution (Encapsulated from earlier Video), IIT Delhi |
| 3. | https://onlinecourses.nptel.ac.in/noc22_ee17/preview Power System Engineering, IIT Kharagpur |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 1 | 1 | 1 | 1 | - | 1 | 1 | 2 | - | 2 | 1 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 1 | - | 1 | - | 2 | - | 2 | 1 | 1 |
| CO 3 | 3 | 3 | 3 | 2 | 1 | - | 1 | - | 2 | - | 1 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | - | 2 | 2 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | 5 | - |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | - | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Government College of Engineering, Karad
Third Year (Sem – V) B. Tech. Electrical Engineering
EE3502: Control System Analysis

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | - | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Signals and system, DC-AC Circuits

Course Outcomes (CO): Students will be able to

- | | |
|------------|---|
| CO1 | Model and represent the physical systems mathematically. |
| CO2 | Analyse and formulate the given system in time domain. |
| CO3 | Analyse and formulate the given system in frequency domain. |
| CO4 | Estimate the parameters of given continuous time system using state space approach. |

| Course Contents | | CO | Hours |
|-----------------|--|------------|-----------|
| Unit 1 | Modelling and representation of Control System and Transfer Function : Laplace transform review, Transfer function of electrical system, Block diagram representation and reduction, types of feedback systems, signal flow graph, Mason's gain rule, SFG | CO1 | 06 |
| Unit 2 | Control System Components: Error detectors, Potentiometer, Synchros, optical rotary encoders, DC and AC Servomotors, stepper motor, gear trains, AC and DC tacho-generators, Transfer function and applications of these. | CO1 | 06 |
| Unit 3 | Time Response Analysis: Response of first and second order system, general second order system, response with additional pole and zeros, steady state error for unity feedback system, static error constants and systems type, steady state error specifications, Concept of stability for linear systems, Absolute and relative stability, Routh stability criterion and its application in special cases. | CO2 | 08 |
| Unit 4 | Root Locus: Definition of root locus, Rules for plotting root loci, Root contour, stability analysis using root locus, effect of addition of pole and zero. | CO2 | 06 |
| Unit 5 | Frequency Domain Techniques: Frequency domain specification, Correlation between time and Frequency domain specifications, stability analysis from polar plot and Nyquist plot. Bode plot, stability, gain margin, phase margin by bode plot, Effect of gain variation and addition of poles and zeros on Bode plot, transfer function from Bode plot. | CO3 | 08 |
| Unit 6 | State variable Analysis: Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole placement by state feedback | CO4 | 08 |

Text Books

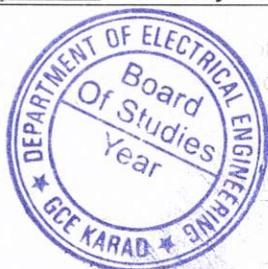
1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt Ltd, 5th edition.(Unit 1-6)
2. I.J. Nagrath and M. Gopal, "Control System Engineering", New age International publication, 5th Edition, 2014 (Unit 1,2,4,5)
3. Norman S. Nise, "Control System Engineering", John Willey and Sons, 6th Edition, 2015.

Reference Books

1. M. Gopal, "Control Systems-Principles and Design", Tata McGraw-Hill Education Pvt. Ltd, 4th edition, 2014.
2. Benjamin C. Kuo, "Automatic Control System", Prentice Hall of India Pvt Ltd, Wiley publication, 9th edition, 2017.
3. A. Anand kumar, "Control Systems", PHI Learnings, 2nd Edition, 2014

Useful Links

1. <https://nptel.ac.in/courses/108/106/108106098/> Control engineering, IIT Madras, IITEST Shibpur
2. https://onlinecourses.nptel.ac.in/noc20_ee90/preview Control systems, IIT Madras



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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 3 | 1 | - | - | 2 | 2 | 1 | 2 | 3 | - |
| CO 2 | 3 | 3 | 1 | 3 | 2 | - | - | 2 | 2 | 1 | 2 | 3 | 1 |
| CO 3 | 3 | 3 | 1 | 3 | 2 | - | - | 2 | 2 | 1 | 2 | 3 | 1 |
| CO 4 | 3 | 3 | 2 | 3 | 3 | - | - | 2 | 2 | 2 | 3 | 3 | 1 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | - | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 10 |
| Evaluate | 5 | 5 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Government College of Engineering, Karad
Third Year (Sem – V) B. Tech. Electrical Engineering
EE3503: Microcontroller

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite: Basics of analog and digital electronics.

Course Outcomes (CO): Students will be able to

- | | |
|------------|---|
| CO1 | Summarize microcontroller architecture and recognize assembly language programming. |
| CO2 | Implement interfacing of microcontroller and its applications. |
| CO3 | Analyse Programmable Logic Controllers. |
| CO4 | Elaborate the advance microcontrollers. |

| Course Contents | | CO | Hours |
|-----------------|---|-------------|-----------|
| Unit 1 | Microcontroller Architecture: Introduction to microcontroller, features of microcontroller, block diagram, architecture of 8051, pin configuration, 40 pin dip 8051, I/O ports, serial ports, timer/counter, and interrupt structure. | CO 1 | 06 |
| Unit 2 | Assembly Language Programming of 8051: Description of instructions, assembly directives, assembly software program with algorithm of 8051, use of assembler and C. | CO 1 | 06 |
| Unit 3 | Interfacing: Interfacing of 8051 with LCD, LED, ADC, DAC, 7 segments displays. | CO 2 | 08 |
| Unit 4 | Applications of 8051: Switch, push button, relay, automatic power factor controller, DC motor, stepper motor, temperature sensor. | CO 2 | 08 |
| Unit 5 | Programmable Logic Controllers (PLCs) : Introduction to PLC, Building blocks of PLC, PLC programming Languages, Creating Ladder diagram for real time task, applications of PLC. | CO 3 | 06 |
| Unit 6 | Advance Microcontrollers: 1. PIC: PIC 16 microcontroller, block diagram, MCU configuration, peripherals, serial interface. 2. ARM: ARM Architecture, instruction set and assembly language program. | CO 4 | 06 |

Text Books

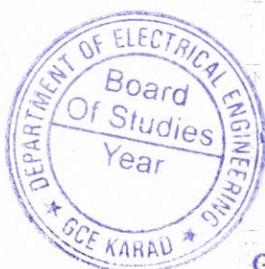
- V Udayshankara, M.S. MallikarjunaSwamy, "8051 Microcontroller: Hardware, software and application ", McGraw Hill eighth edition 2014.(Unit 1-4)
- Jadhav. V. R, Khanna publishers, Programmable Logic Controllerl, New Delhi, ISBN: 9788174092281, 2008 (Unit 5)
- Panachakel Jerrin Thomas, "A Textbook on Microcontroller Based System Design using 8051 and ARM ", Lambert publication,2015(Unit 6)

Reference Books

- Satish Shah, "8051 Microcontrollers: MCS51 family and its variants", Oxford University Press.
- Subrata Ghoshal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", Pearson Education, 2002
- K Uma Rao, Andhe Pallavi, "The 8051 Microcontrollers: Architecture, Programming and Applications", Pearson Education,2010

Useful Links

- https://onlinecourses.nptel.ac.in/noc22_ee12/preview_Microprocessors And Microcontrollers, IIT Kharagpur
- https://onlinecourses.swayam2.ac.in/ntr24_ed02/preview_PLC and Microcontroller , National Institute of Technical Teachers Training and Research, Chandigarh
- <https://www.classcentral.com/course/youtube-8051-microcontroller-lecture-series-53060>




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 2 | - | - | - | 2 | 2 | 2 | 2 | 1 | - |
| CO 2 | 3 | 3 | 1 | 2 | 2 | - | - | 2 | 2 | 2 | 2 | 1 | 2 |
| CO 3 | 3 | 3 | 1 | 2 | 3 | - | - | 2 | 2 | 1 | 2 | 2 | 1 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 1 | 2 | 2 | 1 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | 5 | - | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 10 |
| Evaluate | - | 5 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Third Year (Sem – V) B. Tech. Electrical Engineering

EE3514: Automation and Control (Elective-I)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite: Control System Analysis, Control System Designs

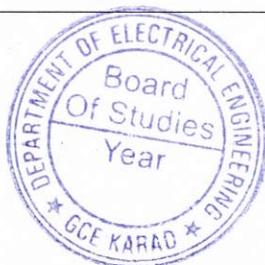
Course Outcomes (CO): Students will be able to

- CO1** Summarize the fundamental principles of Industrial Automation
- CO2** Apply the concepts of fundamentals of logic for various processes of automation.
- CO3** Analyse and formulate the requirements of appropriate ladder programs to provide solutions using PLCs.
- CO4** Develop architecture of SCADA and explain the importance of SCADA in critical infrastructure.

| Course Contents | | CO | Hours |
|-----------------|--|------------|-----------|
| Unit 1 | Introduction to Industrial Automation and Control: Fundamentals of Industrial Automation Systems, Definition and Goals of Automation, Needs and role of Automation, Evolution of Automation, Types of processes, comparison, evolution of PLC, Types of Automation. | CO1 | 05 |
| Unit 2 | Fundamentals of Logic: Building blocks of PLC: CPU, Memory organization, Input-output modules, Special I/O modules, power supply. Fixed and Modular PLC and their types, Redundancy in PLC module. | CO2 | 07 |
| Unit 3 | PLC Programming: Factors to consider in selecting PLC, General PLC Programming Procedure, PLC programming Languages, Creating Ladder diagram for real time task, mnemonics programming code | CO2 | 09 |
| Unit 4 | PLC Function and its applications: Simple programming examples using ladder logic: language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions. PLC based application: Motor sequence control, Traffic light Control, elevator control, tank level control, conveyer system, stepper motor control, reactor control | CO3 | 09 |
| Unit 5 | Introduction To SCADA System Introduction to SCADA, typical SCADA architecture/block diagram, benefits of SCADA. Various editors of SCADA, Interfacing SCADA system with PLC: Typical connection diagram, Desirable Properties of SCADA system, Features, advantages and disadvantages of SCADA. Steps in creation SCADA screen for simple objects (defining tags and items) with PLC ladder program using OPC | CO4 | 06 |
| Unit 6 | SCADA system in Industries and its Applications Open system connection (OSI) Model, TCP/IP protocol DNP3 Protocol, IEC61850 layered architecture, control and information of protocol SCADA application for substation automation. | CO4 | 06 |

Text Books

1. Jadhav. V. R, Khanna publishers, Programmable Logic Controller, New Delhi, ISBN: 9788174092281, 2008(Unit 1,2,3,4)
2. Petruzell. F. D, Tata — McGraw Hill India, Programmable logic controllers, New Delhi, Fourth edition, ISBN: 9780071067386, 2010 (Unit 1,2,3,4,6)
3. John W. Webb, Ronald A. Reis, programmable logic controllers: principles and application: Prentice Hall of India, 2010.(unit 6)




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| Reference Books | |
|-----------------|--|
| 1. | G. Thomson/Delmar learning, Introduction to Programmable logic controllers, Dunning. New Delhi, 2001 |
| 2. | Stenerson, Jon, PHI learning, Industrial automation and process controll, New Delhi ISBN:9780130618900, 2003 |
| 3. | Luis A. Bryan, Industrial Text Co. publication, Programmable Controllers Theory and Implementation, 1997 |
| 4. | Mini S. Thomas John Douglas, McDonald, CRC Press, Concept of SCADA System and its Evolution(Unit 5,6) |
| Useful Links | |
| 1. | https://nptel.ac.in/courses/108/105/108105062/ Industrial Automation and Control, IIT Kharagpur |
| 2. | https://onlinecourses.swayam2.ac.in/nou24_ee02/preview Industrial Automation and Drives, Chhattisgarh Swami Vivekanand Technical University, Bhilai |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 1 | 1 | 1 | 1 | - | 1 | 2 | 1 | 1 | 1 | 2 | - |
| CO 2 | 3 | 1 | 1 | 1 | 2 | 2 | - | 2 | 1 | 2 | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 2 | 2 | 3 | 2 | - | 3 | 1 | 3 | 2 | 2 | 1 |
| CO 4 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | 5 | - | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | - | 5 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Third Year (Sem. – V) B. Tech. Electrical Engineering
EE3524: Electrical Circuit Analysis (Elective I)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | -- | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : DC and AC circuits

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Apply network theorems for the analysis of electrical circuits |
| CO2 | Obtain the transient and steady-state response of electrical circuits |
| CO3 | Analyze circuits in the sinusoidal steady-state |
| CO4 | Analyze two port circuit behavior |

| | Course Contents | CO | Hours |
|---------------|--|------------|-----------|
| Unit 1 | Analysis of DC Circuit: Types of sources, Dependent and Independent sources, source transformation, star/delta transformation, Ladder network, Node and Mesh Analysis. | CO1 | 04 |
| Unit 2 | Network Theorems Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. | CO1 | 10 |
| Unit 3 | Solution of First and Second order networks Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient response. | CO2 | 06 |
| Unit 4 | Sinusoidal steady state analysis AC circuit analysis, Mutually coupled circuits, Dot Convention in coupled circuits, Ideal Transformer. | CO3 | 06 |
| Unit 5 | Electrical Circuit Analysis Using Laplace Transforms Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. | CO2 | 06 |
| Unit 6 | Two Port Network and Network Functions Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters. Driving point and transfer functions and their characteristics. | CO4 | 06 |

Text Books

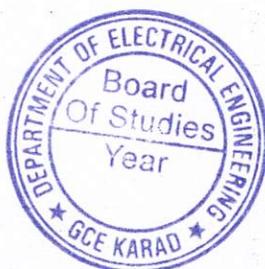
1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2016 (Unit 1-6)
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications.

Reference Books

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 1959
2. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", Mc Graw Hill Education.

Useful Links

1. <https://nptel.ac.in/courses/108/104/108104139/> Basic Electric Circuits, IIT Kanpur
2. <https://nptel.ac.in/courses/108105479> A Basic Course on Electric and Magnetic Circuits, IIT Kharagpur




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 1 | - | - | - | - | - | - | - | 3 | 3 | 1 |
| CO 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | 1 |
| CO 4 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 | 1 |

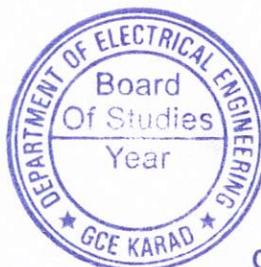
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | - | - | 10 |
| Apply | 6 | 6 | 10 |
| Analyse | 6 | 6 | 20 |
| Evaluate | 8 | 8 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Third Year (Sem – V) B. Tech. Electrical Engineering
EE3534: High Power Converters (Elective-I)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | - | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Power Electronics

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Differentiate characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical and various PWM techniques. |
| CO2 | Analyse the working of multi pulse rectifiers. |
| CO3 | Analyse the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI. |
| CO4 | Analyse the various applications of multilevel converters. |

| Course Contents | | CO | Hours |
|-----------------|---|------------|----------|
| Unit 1 | Basics of Power semiconductor Devices: High-Power Semiconductor Devices, Diodes, SCR, GTO, GCT; IGBT. Operation of series connected devices: main cause of unbalance, voltage equalizations for GCTs, IGBTs | CO1 | 6 |
| Unit 2 | Multipulse Rectification: Multi-pulse Diode and SCR Rectifiers, Definition of THD and PF, THD and PF of six-pulse diode rectifier, 12, 18, 24- pulse series-type and separate-type diode rectifiers, Six-pulse and 12-pulse SCR rectifier, Effect of line and leakage inductances, and Phase-Shifting Transformers, Harmonic current cancellation | CO2 | 8 |
| Unit 3 | Multilevel Inverter with H Bridge Topology: Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages. | CO3 | 8 |
| Unit 4 | Diode Clamped Multilevel Inverters: Introduction, Converter structure and Functional Description, Modulation of Multilevel converters, Voltage balance Control, Effectiveness Boundary of voltage balancing in DCMC converters, Performance results Multilevel Flying Capacitor Inverters: Introduction, Flying Capacitor topology, Modulation scheme for the FCMC, Dynamic voltage balance of FCMC. | CO3 | 6 |
| Unit 5 | PWM Techniques for Inverters: PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes Staircase Modulation, Trapezoidal modulation, selective harmonic elimination, Space Vector Modulation. | CO1 | 8 |
| Unit 6 | Applications of multilevel converters: High Power Industrial Drives, Solar PV Grid Integration, High Voltage DC Transmission (HVDC), UPS and Variable Frequency Drives (VFDs). | CO4 | 6 |

Text Books

| | |
|----|--|
| 1. | N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989. (Unit 2,3) |
| 2. | M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994(Unit 1, 2,,5) |
| 3. | BinWu, Mehdi Narimani, "High Power Converters and AC drives", IEEE press 2017, 2nd Edition. Unit(1-6) |

Reference Books

| | |
|----|--|
| 1. | B. K .Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986 |
| 2. | Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla, "Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 20171st Edition |
| 3. | Thomas A. Lipo, "Pulse Width Modulation for Power Converters: Principles and Practice", D.Grahame Holmes, |



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| | |
|---------------------|---|
| | John Wiley & Sons, Oct-2003. |
| Useful Links | |
| 1. | https://onlinecourses.nptel.ac.in/noc22_ee16/preview High Power Multilevel Converters - Analysis, design and operational issues, IIT Delhi |
| 2. | https://www.edx.org/learn/electrical-engineering/the-georgia-institute-of-technology-multilevel-converters-for-medium-high-power-applications |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | - | 2 | 3 | 1 |
| CO 2 | 3 | 2 | 3 | 1 | 2 | 3 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 3 | 3 | 2 | 3 | 1 | 2 | 3 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 4 | 2 | 2 | 2 | 1 | 3 | 1 | 2 | 2 | 2 | - | 1 | 2 | 2 |

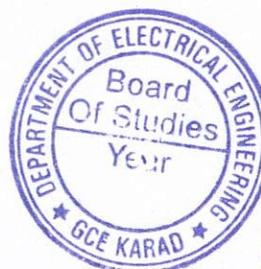
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy) '1

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | 5 | 5 | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | - | - | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Third Year (Sem – V) B. Tech. Electrical Engineering

EE3544: Renewable Energy Systems (Elective-I)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Basic Mechanical Engineering & Basic Electrical Engineering, Environmental science

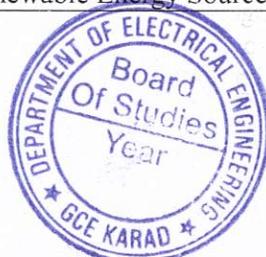
Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Describe need, importance, and scope of renewable energy resources for sustainable future. |
| CO2 | Interpret working of solar and wind power generation and its utilization. |
| CO3 | Develop and deploy renewable energy sources on much wider scale. |
| CO4 | Implement improved-technologies for harnessing fossil fuels. |

| Course Contents | | CO | Hours |
|-----------------|--|------------|-----------|
| Unit 1 | Introduction to Renewable Energy System: Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources. | CO1 | 04 |
| Unit 2 | Solar PV and Thermal systems: Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar Photovoltaic systems: Basic Principle of SPV conversion, Types of PV Systems, Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications. | CO2 | 10 |
| Unit 3 | Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and darrius types. Applications of wind energy | CO2 | 08 |
| Unit 4 | Biomass Energy: Introduction, biomass categories, biofuels. Introduction to biomass conversion technologies: gasification, bio-refinery and bio-diesel, Biogas generation, basic biogas plants-fixed dome type, floating gasholder type. Utilization of biogas, Energy plantation, Alternative liquid fuels: ethanol and methanol. Ethanol production | CO3 | 07 |
| Unit 5 | Geothermal Energy: Geothermal fields, estimates of geothermal power. Basic geothermal steam power plant, binary fluid geothermal power plant and geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy. Applications of geothermal energy. Geothermal energy in India. | CO3 | 07 |
| Unit 6 | Other Energy Sources: Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Energy Storage system: Battery, Fuel cell: Principle of working, various types, construction and applications, Battery management systems. | CO4 | 06 |

Text Books

1. B. H. Khan, "Non-Conventional Energy Resources", , The McGraw Hill, 2017(Unit 1-6)
2. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill., 2009
3. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning



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Pvt.Ltd, New Delhi, 2013.

Reference Books

1. Chetan Singh Solanki, "Solar Photovoltaics: fundamentals, Technologies and Applications", Prentice Hall of India. 2015
2. K. M. Mittal, "Non-Conventional Energy Systems", A H Wheeler Publishing Co Ltd, 1999
3. G.D. Rai, "Non-conventional Energy sources", Khanna Publishers, 1998

Useful Links

1. <https://nptel.ac.in/courses/127103236> Sustainable Power Generation Systems, IIT Guwahati
2. <https://nptel.ac.in/courses/103103206> Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems, IIT Guwahati

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | 2 | 1 | 2 |
| CO 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | 2 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | 2 | 2 | 3 |

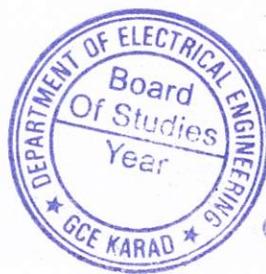
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | 5 | 5 | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 10 |
| Evaluate | - | - | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Government College of Engineering, Karad
Third Year (Sem – V) B. Tech. Electrical Engineering
EE3505: Basic Power System (MDM-03)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | - | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite: Basic knowledge of electrical concepts.

Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Illustrate generation of electricity and energy storage methods. |
| CO2 | Analyse the different parameters of transmission line. |
| CO3 | Discuss the economic aspects of power system. |
| CO4 | Analysis of components of power grid. |

| Course Contents | | CO | Hours |
|-----------------|--|-------|-------|
| Unit 1 | Generation of Electrical Power India's electricity scenario, working of steam power plant, hydro power plant and wind power plant, turbines, generator, pump. | (CO1) | (06) |
| Unit 2 | Renewable Energy System Basic concepts- solar energy, solar thermal systems, solar photovoltaic systems, biomass energy, geothermal energy, ocean energy and small hydro resources, emerging technologies, Integration of renewable energy system. | (CO1) | (06) |
| Unit 3 | Power transmission and distribution Difference of AC and DC transmission, AC power system single line diagram, power factor, Step-up, step-down, auto transformer. | CO2 | (08) |
| Unit 4 | Economic Aspects of Power Generation Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, Utilization and plant use factors. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs. Concept of tariff, Desirable Characteristics of a Tariff, Types of the tariff. | CO3 | (08) |
| Unit 5 | Energy Storage Introduction, necessity of energy storage, specifications of energy storage devices, energy storage methods. | (CO1) | (06) |
| Unit 6 | Power Grid Introduction to power grid, electricity generation, electric power transmission, electricity distribution, need of grid, challenges of the grid, regional power grids in India. | (CO4) | (06) |

Text Books

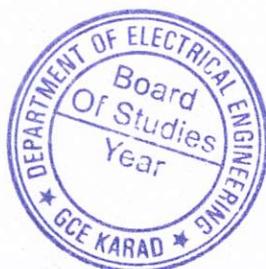
1. V.K. Mehata and Rohit Mehata “ Principles of power system” S. Chand publications, 2005 (unit 1-6)
2. B.H.Khan, “non-conventional energy resources”, McGraw Hill International, third edition, 2017(unit 2)

Reference Books

1. J. D. Glover and M. Sarma, Power System Analysis and Design, 3rd Edition, Brooks/ Cole Publishing, 2002
2. Weedy B M, Cory B J, John, Electric Power Systems, Wiley Publication
3. Hadi Sadat, Power System Analysis, McGraw Hill International, fifth edition, 2001

Useful Links

1. <https://nptel.ac.in/courses/108/105/108105067/> Power System Analysis, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/102/108102047/> Power System Generation, Transmission and Distribution (Encapsulated from earlier Video), IIT Delhi
3. https://onlinecourses.nptel.ac.in/noc22_ee17/preview Power System Engineering, IIT Kharagpur



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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | - | 2 | 2 | 1 |
| CO 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | - | 2 | 2 | 1 |
| CO 3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO 4 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | - | 2 | 3 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

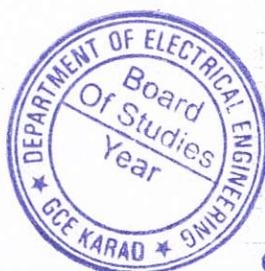
Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | 5 | 5 | 10 |
| Understand | 5 | 5 | 20 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 10 |
| Evaluate | - | - | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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|---|--|--------------------|---------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | |
| EE3518 : Optimization Techniques (Open Elective-III) | | | |
| Teaching Scheme | | Examination Scheme | |
| Lectures | 02 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 02 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |
| Prerequisite : Engineering Mathematics, Programming Skills | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Apply linear and nonlinear optimization techniques to solve complex engineering problems with constraints, design variables, and objectives. | | |
| CO2 | Solve LPPs using Simplex, Big-M, and Two-Phase methods in engineering. | | |
| CO3 | Analyze classical optimization methods for constrained and unconstrained engineering problems. | | |
| CO4 | Apply numerical methods like Fibonacci and Region Elimination for nonlinear optimization. | | |
| | Course Contents | CO | Hours |
| Unit 1 | Introduction to Optimization: Engineering applications of optimization, statement of an optimization problem, terminology, design variables, design surface, constraints, objective function, Introduction to MATLAB/SCILAB optimization toolbox. | CO1 | 6 |
| Unit 2 | Linear Programming Problem Formulation of LPP. Geometry of LPP, Solution of LPP: Graphical method, Simplex Method, Big - M Method, Two - Phase Method, Introduction to Duality Theory. | CO2 | 6 |
| Unit 3 | Classical optimization techniques : Single variable Optimization, Unconstrained multivariable optimization, Nonlinear programming with equality constraints, Nonlinear programming KKT conditions | CO3 | 8 |
| Unit 4 | Numerical optimization : Non-linear programming - unimodal function, unrestricted search, Region elimination techniques, Fibonacci Method, Golden Section Methods, Interpolation Methods. | CO4 | 6 |
| Text Books | | | |
| 1. | “Engineering Optimization Theory and Practice”, S. S. Rao, 4th Edition ,John Wiley,2000 (Unit 1-6) | | |
| 2. | A. Ravindran and K.M. Ragsdeth, Optimization G.V. Reklaites, 3rd Edition, Wiley, New York, 2006 | | |
| Reference Books | | | |
| 1. | Kalyanmoy Deb, Optimization for Engineering Design, 2nd Edition, Prentice Hall of India, 2012 | | |
| 2. | J.C.Pant : Introduction to Optimization Research, Jain Brothers, New Delhi, 2015 | | |
| Useful Links | | | |
| 1. | http://nptel.ac.in/courses/111105039/ Optimization, IIT Kharagpur | | |
| 2. | https://onlinecourses.nptel.ac.in/noc21_me10/preview Optimization from fundamentals, IIT Bombay | | |
| 3. | https://sur1.li/cmrxqh | | |
| 4. | www.scilab.org | | |




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 1 | 2 | 2 | 3 |
| CO 2 | 2 | 3 | 3 | 2 | 2 | - | - | - | 1 | 3 | 2 | 2 | 2 |
| CO 3 | 3 | 3 | 2 | 2 | 3 | 1 | - | - | 1 | 3 | 2 | 3 | 1 |
| CO 4 | 2 | 2 | 3 | 2 | 3 | - | - | - | 1 | 3 | 2 | 3 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern(with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | - | - |
| Understand | 3 | 3 | 10 |
| Apply | 8 | 8 | 15 |
| Analyse | 4 | 5 | 15 |
| Evaluate | 5 | 4 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Third Year (Sem – V) B. Tech. Electrical Engineering

EE3528 : Open Elective III (MOOC) Optimization Techniques

| Teaching Scheme | | Examination Scheme | |
|-----------------|----|--------------------|-----|
| Lectures | -- | MSE | -- |
| Tutorials | -- | ISE | -- |
| Total Credits | 02 | ESE | 100 |

Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Apply linear and nonlinear optimization techniques to solve complex engineering problems with constraints, design variables, and objectives. |
| CO2 | Solve LPPs using Simplex, Big-M, and Two-Phase methods in engineering. |
| CO3 | Apply KKT and numerical methods like Fibonacci and Region Elimination for nonlinear optimization. |
| CO4 | Explore the optimization toolbox in MATLAB/SCILAB to solve engineering optimization problems. |

Course Contents

Students should complete the MOOC course certification in the domain of Energy Systems Engineering and submit a copy of the certificate to Head of Department prior to ESE.

Guidelines:

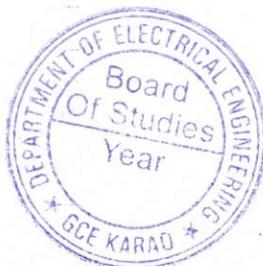
- Selection of the MOOC course should be with the prior permission of Head of Department
- Duration for completion of MOOC course certification is minimum 8 Weeks.
- Platform: NPTEL or SWYAM only Assessment Guideline:- The evaluation of the MOOC Course will be based on at actual score secured by the student in NPTEL or SWAYAM course certification and it will be converted to ESE score.
- If the student unable to submit the NPTEL or SWAYAM completion Certificate, in such cases evaluation will be based on assignment score (60% weightage) of registered NPTEL/SWAYAM and internal evaluation (40 % weightage).
- The rubrics for internal evaluation are given below.

**Government College of Engineering, Karad
Department of Electrical Engineering**

| A. Y. 2024-25 | | | | | | | | | |
|-----------------|---------|-----------------|--------------|--------------------------------|--------------------------------|-------------------------------|--------------------|------------------|-------------------------|
| Course Code : | | | | Assessment Sheet | | | | Class: | |
| Course Title :- | | | | | | | | | |
| Sr No. | Reg. No | Name of Student | Course Title | Knowledge of Course (08 Marks) | Communication Skill (08 Marks) | Presentation Skill (08 Marks) | Content (08 Marks) | Q & A (08 Marks) | Total Marks (out of 40) |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |

Guide Name and Sign.

Head of the Department



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| Government College of Engineering, Karad | | | | |
|---|---|--|----------------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3507: Control System Analysis Lab | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | 25 |
| Prerequisite : Introduction to MATLAB | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Analyse the transient characteristics of different first order and second order systems using simulation and experiments. | | | |
| CO2 | Determine the performance of system in time domain. | | | |
| CO3 | Determine the performance of system in frequency domain. | | | |
| CO4 | Analyse the system in state space. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Plot pole-zero configuration in s-plane for given transfer function using MATLAB. | | | CO1 |
| Experiment 2 | Determine steady state error of given transfer function using MATLAB. | | | CO1 |
| Experiment 3 | Verify output response of a second order system using RLC circuit. | | | CO1 |
| Experiment 4 | Time domain specifications of second order system using MATLAB. | | | CO1 |
| Experiment 5 | Plotting of root locus using MATLAB. | | | CO2 |
| Experiment 6 | Effect of addition of poles and zeros on performance of the system. | | | CO2 |
| Experiment 7 | Stability analysis using Bode plot in MATLAB | | | CO3 |
| Experiment 8 | Stability analysis using polar and Nyquist plot in MATLAB. | | | CO3 |
| Experiment 9 | Develop a state space model for a transfer function using MATLAB. | | | CO4 |
| Experiment 10 | Analyse system controllability and observability using state-space models in MATLAB. | | | CO4 |
| Minimum number of Experiments : 8(It should cover all CO's) | | | | |

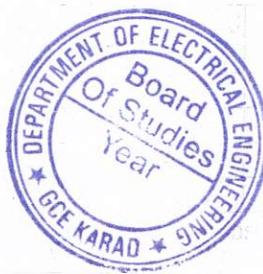
Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 3 | - | - | - | 2 | 2 | 1 | 3 | 3 | - |
| CO 2 | 3 | 3 | 1 | 3 | - | - | - | 2 | 2 | 1 | 3 | 3 | 1 |
| CO 3 | 3 | 3 | 1 | 3 | 2 | - | - | 2 | 2 | 1 | 2 | 3 | 1 |
| CO 4 | 3 | 3 | 1 | 3 | 2 | - | - | 2 | 2 | 1 | 3 | 3 | 1 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



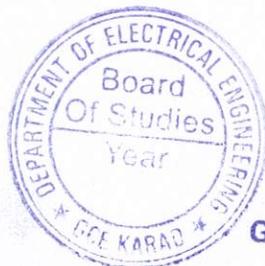
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Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Task III | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)



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| Government College of Engineering, Karad | | | | |
|--|--|--|---------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE 3508 :Microcontroller Lab | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | 25 |
| Prerequisite : Basics of analog and digital electronics | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Implement assembly as well as c programs for microcontroller | | | |
| CO2 | Apply interfacing knowledge with ADC,DAC, LCD, LED, Keyboard, | | | |
| CO3 | Demonstrate microcontroller technology with DC Motor as well as over current digital relay. | | | |
| CO4 | Demonstrate advance microcontroller. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Write a program to add two 8-bit numbers stored in registers or internal/External memory locations. | | | CO1 |
| Experiment 2 | Write a program to multiply two 8-bit numbers stored in registers or internal/External memory locations. | | | CO1 |
| Experiment 3 | Write a program to add block of data stored in internal/external memory locations. | | | CO1 |
| Experiment 4 | Write a program to transfer block of data from internal memory locations to external memory locations. | | | CO1 |
| Experiment 5 | Interfacing ADC and DAC | | | CO2 |
| Experiment 6 | Interfacing LED and LCD Displays. | | | CO2 |
| Experiment 7 | Interfacing stepper motor with microcontroller. | | | CO2 |
| Experiment 8 | Controlling DC motor using PWM. | | | CO3 |
| Experiment 9 | Interfacing DC motor in PIC microcontroller | | | CO4 |
| Experiment 10 | Interfacing LCD display in PIC microcontroller. | | | CO4 |
| Minimum number of Experiments : 08 (Covering all CO's) | | | | |

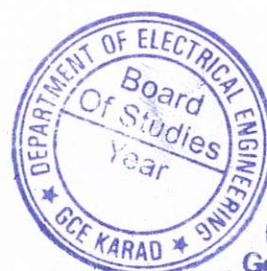
Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 |
| CO 2 | 3 | 3 | 1 | 2 | - | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| CO 3 | 3 | 3 | 1 | 2 | - | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



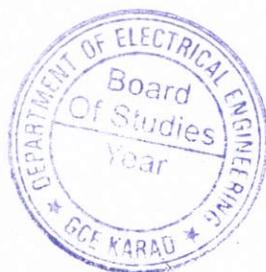
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Department Of Electrical Engineering
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Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Task III | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)




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|--|--|--|----------------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3519: Automation and Control Laboratory (Elective-I lab) | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | .. |
| Prerequisite : Control System lab, digital system lab | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Apply automation and control concepts to solve real-world problems. | | | |
| CO2 | Design logic base to control the various devices. | | | |
| CO3 | Demonstrate working of different PLC program for the given applications. | | | |
| CO4 | Develop the learning methodology and develop teamwork, communication skills. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Use PLC to test START-STOP logic for two inputs and one output system. | | | CO1 |
| Experiment 2 | Develop/Execute a ladder program for the given application using following-timer, counter, comparison, logical, arithmetic instructions. | | | CO1 |
| Experiment 3 | Use PLC to control the following devices: lamp, motor, push button switches, proximity sensor. | | | CO2 |
| Experiment 4 | Measure temperature of the given liquid using RTD or Thermocouple and PLC. | | | CO2 |
| Experiment 5 | Develop and test ladder program for pulse counting using limit switch / proximity sensor. | | | CO3 |
| Experiment 6 | Develop and test ladder program for automated car parking system. | | | CO3 |
| Experiment 7 | Develop and test ladder program for automated elevator control. | | | CO4 |
| Experiment 8 | Develop and test ladder program for tank level control. | | | CO3 |
| Experiment 9 | Develop and test ladder program to control speed of stepper motor with suitable drivers. | | | CO4 |
| Experiment 10 | a. Identify various front panel controls of Variable Frequency Drive (VFD) (smart drive) b. Control speed of AC/DC motor using VFD | | | CO1 |
| Experiment 11 | Develop a SCADA mimic diagram for tank level control. | | | CO4 |
| Experiment 12 | Simulate tank level control using available SCADA system. | | | CO3 |
| Minimum number of Experiments: 10 (It should cover all CO's) | | | | |

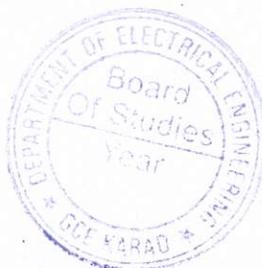
Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | 3 | 2 | 2 |
| CO 2 | 3 | 2 | 3 | 3 | 2 | - | - | 2 | 2 | 2 | 3 | 2 | 1 |
| CO 3 | 3 | 1 | 3 | 2 | 3 | - | - | 2 | 2 | 3 | 3 | 2 | 1 |
| CO 4 | 2 | 3 | 1 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 3 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



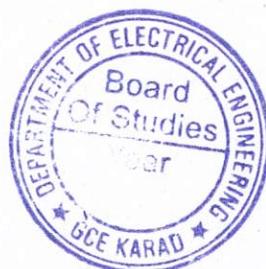
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Department Of Electrical Engineering
Government College of Engineering, Karad

Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| Task III | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)



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|---|---|--|---------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3529: Electrical Circuit Analysis Lab (Elective-I lab) | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | -- |
| Prerequisite : Basics of DC-AC Circuits | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Conclude ladder network and correlate star delta transformation. | | | |
| CO2 | Evaluate network theorems for the analysis of electrical circuits | | | |
| CO3 | Obtain the transient and steady-state response of electrical circuits | | | |
| CO4 | Deduce two-port circuit behaviour. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Study of Ladder Network. | | | CO1 |
| Experiment 2 | Identification of Star Delta transformation. | | | CO1 |
| Experiment 3 | Verification of Superposition Theorem. | | | CO2 |
| Experiment 4 | Verification of Thevenin's Theorem. | | | CO2 |
| Experiment 5 | Verification of Norton's Theorem. | | | CO2 |
| Experiment 6 | Verification of Reciprocity Theorem. | | | CO2 |
| Experiment 7 | Obtain step response of R-C Series circuit. | | | CO3 |
| Experiment 8 | Evaluate impedance parameters of two port network. | | | CO4 |
| Experiment 9 | Evaluate admittance parameters of two port network. | | | CO4 |
| Experiment 10 | Evaluate hybrid parameters of two port network. | | | CO4 |
| Minimum number of Experiments : 08 (All CO's should be covered) | | | | |

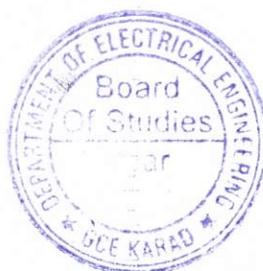
Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 2 | 3 | - |
| CO 2 | 3 | 3 | 1 | - | - | - | - | - | - | - | 3 | 3 | 1 |
| CO 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | 1 |
| CO 4 | 3 | 2 | 2 | - | - | - | - | - | -- | - | 3 | 3 | 1 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



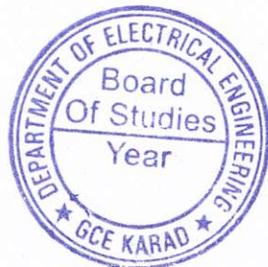
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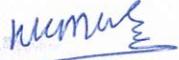
Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| Task III | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)




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|---|--|--|----------------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3539: High Power Converter Lab (Elective-I lab) | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | - |
| Prerequisite : Basics of MATLAB Simulink | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Analyse the multipulse diode rectifiers in MATLAB. | | | |
| CO2 | Demonstrate the multipulse controlled rectifiers in MATLAB. | | | |
| CO3 | Examine the performance of MLIs with various PWM techniques. | | | |
| CO4 | Illustrate the different topologies of multilevel inverters (MLIs) | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Simulation of 12-Pulse Diode Rectifier in MATLAB SIMULINK. | | | CO1 |
| Experiment 2 | Simulation of 24 Pulse Diode Rectifier in MATLAB SIMULINK | | | CO1 |
| Experiment 3 | Simulation of 12 Pulse Controlled Rectifier in MATLAB SIMULINK. | | | CO2 |
| Experiment 4 | Simulation of 5 Level Cascaded H Bridge Multilevel Inverter using SPWM technique in MATLAB SIMULINK | | | CO3 |
| Experiment 5 | Simulation of 7 Level Cascaded H Bridge Multilevel Inverter using SPWM technique in MATLAB SIMULINK. | | | CO3 |
| Experiment 6 | Simulation of three level diode clamped MLI with R load in MATLAB SIMULINK. | | | CO3 |
| Experiment 7 | Simulation of five level diode clamped MLI with R load in MATLAB SIMULINK. | | | CO4 |
| Experiment 8 | Design of Closed-Loop Controlled Multilevel Inverter Using PI/PID. | | | CO4 |
| Experiment 9 | Simulation of five level capacitor clamped MLI with R load in MATLAB SIMULINK. | | | CO4 |
| Experiment 10 | Simulation of 3-Level Space Vector PWM based three phase Multilevel Inverter in MATLAB SIMULINK. | | | CO4 |
| Minimum number of Experiments : 8 (Covering all CO's) | | | | |

Mapping of COs and POs

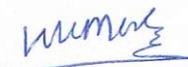
| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 2 | 2 | 1 | 2 | 2 | - | 1 | 1 | - | 2 | 3 | 1 |
| CO 2 | 3 | 2 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 2 | 3 | 1 |
| CO 3 | 2 | 2 | 2 | 1 | 3 | 1 | - | 1 | 1 | - | 1 | 2 | 2 |
| CO 4 | 3 | 2 | 3 | 1 | 2 | 3 | - | 1 | 1 | - | 2 | 3 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)




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Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Task III | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)




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|--|---|--|----------------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3549: Renewable Energy Systems Lab(Elective-I Lab) | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | -- |
| Prerequisite : Basic Mechanical Engineering & Basic Electrical Engineering, Environmental science | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Recognize the solar resources and utilization of solar thermal energy | | | |
| CO2 | Test the quality of Solar PV system installations, especially in the rooftop solar segment | | | |
| CO3 | Estimate available solar energy for a given site and application | | | |
| CO4 | Recognize current and possible future role of wind energy systems and its applications | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | To demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level. | | | CO1 |
| Experiment 2 | To demonstrate the I-V characteristics of series and parallel combination of PV module. | | | CO2 |
| Experiment 3 | To show the effect of variation in tilt angle of PV module. | | | CO2 |
| Experiment 4 | To demonstrate the effect of shading on module output power. | | | CO3 |
| Experiment 5 | To demonstrate the working of diode as bypass diode and blocking diode. | | | CO3 |
| Experiment 6 | Workout power flow calculations of stand-alone PV system with DC load and battery. | | | CO3 |
| Experiment 7 | Workout power flow calculations of stand-alone PV system with AC load and battery. | | | CO3 |
| Experiment 8 | To draw the charging and discharging characteristics of battery. | | | CO3 |
| Experiment 9 | Evaluate the efficiency of charge controller. | | | CO4 |
| Experiment 10 | Find out the start up speed and cut-in speed of wind turbine experimentally. | | | CO4 |
| Experiment 11 | Evaluate the tip speed ratio at different wind speeds | | | CO4 |
| Experiment 12 | Draw the power curve of turbine with respect to rotational speed of rotor at fix wind speeds. | | | CO4 |
| Minimum 08 number of Experiments (Including all CO's) | | | | |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 2 | 2 | 1 | - | 3 | - | 1 | 1 | - | 2 | 1 | 3 |
| CO 2 | 3 | 2 | 2 | 1 | - | 2 | - | 1 | 1 | - | 2 | 1 | 3 |
| CO 3 | 2 | 1 | 3 | 2 | 1 | 2 | - | 1 | 1 | - | 2 | 2 | 3 |
| CO 4 | 2 | 1 | 2 | 3 | - | 2 | - | 1 | 1 | - | 2 | 2 | 3 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



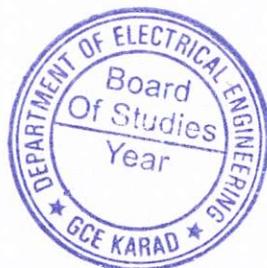

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Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Task I | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task II | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| Task III | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 | 05 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)



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Third Year (Sem –V) B. Tech. Electrical Engineering

EE3510 :Electrical Machine Lab (Multi-disciplinary Minor -03)

| Laboratory Scheme: | | Examination Scheme: | |
|---|---|---------------------|------------|
| Practical | 02 Hrs/week | ISE | 50 |
| Total Credits | 01 | ESE | - |
| Prerequisite : DC Machines and Transformers, AC machines | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Deduce conclusions about the performance using obtained readings. | | |
| CO2 | Adopt the appropriate DC machines for the application. | | |
| CO3 | Evaluate circuit parameters of single phase and three phase transformer. | | |
| CO4 | Adopt the appropriate AC machines for the application. | | |
| Course Contents | | | CO |
| Implementation of following concepts | | | |
| Experiment 1 | Study of characteristics of separately excited DC generator. | | CO2 |
| Experiment 2 | Load test on DC Shunt Motor. | | CO2 |
| Experiment 3 | Load test on 3-ph Induction Motor. | | CO4 |
| Experiment 4 | Study of methods of speed control of DC series motor as a function of load torque. | | CO1 |
| Experiment 5 | OC, SC test on induction motor. | | CO4 |
| Experiment 6 | Polarity test on induction motor. | | CO4 |
| Experiment 7 | To Find equivalent circuit parameters from O.C and S.C Test on single phase Transformer. | | CO3 |
| Experiment 8 | Polarity test on a single phase transformer and study of different connections of three phase transformers. | | CO3 |
| Experiment 9 | Scott connection. | | CO1 |
| Experiment 10 | Study of BLDC and stepper, servo motor, PMBLDC, PMSM | | CO4 |
| Minimum 08 number of Experiments (Including all CO's) | | | |

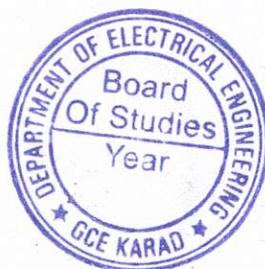
Mapping of COs and POs

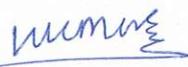
| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 1 | 1 | - | - | - | 2 | - | 1 | 2 | - | 1 | 3 | - |
| CO 2 | 1 | - | 1 | - | 1 | 1 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 3 | 1 | - | 1 | 1 | 1 | 1 | - | 2 | 2 | - | 1 | 3 | 1 |
| CO 4 | 1 | 2 | - | 2 | 1 | 1 | - | 2 | - | - | - | 3 | 1 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)




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Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Task I | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Task II | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task III | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| ISE | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

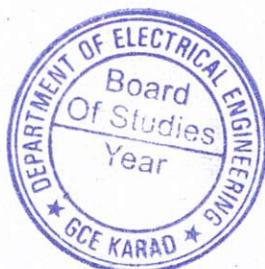
| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

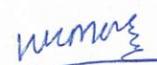
(Tasks can be decided by course coordinator.)



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|--|---|--|----------------------------|------------|
| Third Year (Sem – V) B. Tech. Electrical Engineering | | | | |
| EE3511: Numerical Computational Methods | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | -- |
| Prerequisite : Engineering Mathematics, Linear Algebra, Programming Fundamentals | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Apply numerical techniques like Gauss Elimination, LU Decomposition, and iterative methods to solve linear equations in MATLAB | | | |
| CO2 | Evaluate and compare root-finding methods and numerical integration techniques for solving nonlinear equations. | | | |
| CO3 | Solve ODEs using methods like Euler's, Runge-Kutta, and Adams', and assess their accuracy in MATLAB. | | | |
| CO4 | Analyze and implement various numerical techniques like regression, interpolation, and numerical integration to model real-world problems and compute approximations efficiently in MATLAB. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Implement the Gauss Elimination method to solve a system of linear equations in MATLAB. | | | CO1 |
| Experiment 2 | Perform LU Decomposition to solve a system of linear equations and verify results in MATLAB. | | | CO1 |
| Experiment 3 | Implement the Jacobi and Gauss-Seidel iterative methods to solve a system of linear equations. | | | CO1 |
| Experiment 4 | Solve a given nonlinear equation using the Bisection method in MATLAB. | | | CO2 |
| Experiment 5 | Implement the Regula-Falsi method to find the root of a nonlinear equation in MATLAB. | | | CO2 |
| Experiment 6 | Solve an equation using the Secant method and compare the results with the Bisection method. | | | CO2 |
| Experiment 7 | Implement the Newton-Raphson method to solve a nonlinear equation in MATLAB. | | | CO2 |
| Experiment 8 | Implement linear regression using the least squares method to fit data points and compute the best-fit line in MATLAB. | | | CO4 |
| Experiment 9 | Implement the Trapezoidal and Simpson's rules to numerically integrate a given function in MATLAB. | | | CO4 |
| Experiment 10 | Implement Euler's method to solve first-order ODEs and compare it with analytical solutions in MATLAB. | | | CO3 |
| Experiment 11 | Solve an ODE using the modified Euler's method and compare results with Euler's method. | | | CO3 |
| Experiment 12 | Implement the 4th-order Runge-Kutta method to solve simultaneous first-order ODEs. | | | CO3 |
| Experiment 13 | Solve second-order ODEs using Milne's method and analyze the accuracy. | | | CO3 |
| Experiment 14 | Implement Adams' method to solve first-order ODEs and compare results with the Runge-Kutta method. | | | CO3 |
| Experiment 15 | Solving Forward Interpolation Problems Using MATLAB: Implementation of Newton's Forward Difference Formula | | | CO4 |
| Minimum number of Experiments: 10, in which all CO's should get mapped. | | | | |




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 2 | 3 | 2 | - | - | 1 | 2 | 1 | 2 | 2 | 3 | 2 |
| CO 2 | 3 | 2 | 3 | 3 | - | - | - | 3 | 2 | 2 | 3 | 2 | 2 |
| CO 3 | 3 | 3 | 3 | 2 | - | 1 | - | 3 | 3 | 3 | 3 | 2 | 2 |
| CO 4 | 3 | 3 | 2 | 2 | - | 1 | - | 1 | 2 | 3 | 3 | 2 | 2 |

1: Slight(Low)

2: Moderate (Medium)

3: Substantial (High)

Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Task I | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Task II | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Task III | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)



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Government College of Engineering, Karad
Third Year (Sem – VI) B. Tech. Electrical Engineering
EE3601: Control System Design

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | - | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Control System Analysis

Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Review of classical controller/compensator design for linear systems. |
| CO2 | Design Compensators in time domain. |
| CO3 | Design Compensators in frequency domain. |
| CO4 | Design of controller in state space using pole placement and state observer. |

| Course Contents | | CO | Hours |
|--|---|------------|-----------|
| Unit 1 | Introduction to compensators: Lead compensation, Lag compensation, Lead- Lag compensation, Series and parallel compensation | CO1 | 04 |
| Unit 2 | Introduction to Controllers Different types of controllers, P,I,D, PI, PD and PID Controllers, Effects of these controllers on system performance, Tuning of controllers, Ziegler-Nichols methods for controller tuning, Modifications of PID control scheme | CO1 | 06 |
| Unit 3 | Control system design in time domain: Review of root locus, design of lead, lag, lead-lag compensator using root locus technique. | CO2 | 08 |
| Unit 4 | Control System Design in Frequency Domain: Review of Bode Plot, design of lead, lag, lead-lag compensator using Bode plot. | CO3 | 08 |
| Unit 5 | State Space Design using pole placement: Review of State Space, Pole placement technique for controller design, State Feedback Law, Pole placement technique by Transformation method, Direct Substitution Method and by Ackermann's formula. | CO4 | 08 |
| Unit 6 | State Space Design using State Observer: State Observers, Full Order State Observer, Transformation method, Direct Substitution method, and Ackermann's formula to Obtain Observer gain Matrix, Effect of addition of Observer on a Closed Loop System, transfer function of Observer based Controller, Design of Control System with Observer. | CO4 | 08 |
| Case study on controller design | | | |

Text Books

| | |
|----|---|
| 1. | Norman S. Nise , "Control System Engineering", John Willey and Sons, 6th Edition, 2015. (Unit 1,2) |
| 2. | I.J. Nagrath and M. Gopal, "Control System Engineering", New age International publication, 5th Edition, 2014(Unit 1,2,3,4) |
| 3. | Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt Ltd, 5th edition.(Unit 1-6) |

Reference Books

| | |
|----|--|
| 1. | M. Gopal, "Control Systems-Principles and Design", Tata McGraw-Hill Education Pvt. Ltd, 4th edition, 2014. |
| 2. | Benjamin C. Kuo, "Automatic Control System", Prentice Hall of India Pvt Ltd, Wiley publication, 9th edition. |
| 3. | M. Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill, 4th edition, 2012 |

Useful Links

| | |
|----|--|
| 1. | http://nptel.ac.in/courses/108103007/ Advanced Control Systems, IIT Guwahati |
| 2. | https://nptel.ac.in/courses/115108104 Control System Design, IISc Bangalore |



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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 1 | 2 | 1 | 1 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 1 | 1 | - | 3 | 3 | - | 2 | 3 | 2 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | 3 | 3 | - | 2 | 3 | 2 |
| CO 4 | 3 | 3 | 3 | 2 | 3 | 1 | - | 3 | 3 | - | 3 | 3 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 10 | 5 | 20 |
| Evaluate | - | 5 | 10 |
| Create | - | - | 10 |
| TOTAL | 20 | 20 | 60 |



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Government College of Engineering, Karad
Third Year (Sem. – VI) B. Tech. Electrical Engineering
EE3602 : Power System Analysis

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 01 Hrs/week | ISE | 20 |
| Total Credits | 04 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Elements of Power System, AC Machines

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Determine and solve load flow and short circuit studies. |
| CO2 | Apply symmetrical components to analyse faults on transmission lines. |
| CO3 | Analyse power system stability. |
| CO4 | Demonstrate and analyse case studies of real world examples of power system stability and develop critical thinking skills for problem solving. |

| | Course Contents | CO | Hours |
|---------------|---|------------|-----------|
| Unit 1 | Power Flow Analysis: Review of the structure of a power system and its components. Analysis of power flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations–Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. | CO1 | 08 |
| Unit 2 | Symmetrical components and Sequence Networks: Synthesis of unsymmetrical phasor from their symmetrical components, The symmetrical components of unsymmetrical phasor, Power in terms of symmetrical components, Representation of generators, lines and transformers in sequence networks, Unsymmetrical series impedances. | CO2 | 06 |
| Unit 3 | Fault Analysis: Balanced Faults: Introduction, Classification, Severity and occurrence of fault, Effect of faults, Balanced three phase fault, Transient on transmission line, Short circuit capacity. | CO2 | 08 |
| Unit 4 | Fault Analysis: Unbalanced Faults: Unsymmetrical faults on power systems, Single Line to ground, Line to line, Double line to ground fault, single & double conductor open faults. | CO2 | 06 |
| Unit 5 | Power System Stability: Dynamics of a synchronous machine, Power angle equation, Steady state stability, Equal area criterion and its application, M and H constant, Factors affecting transient stability, Critical clearance angle. | CO3 | 06 |
| Unit 6 | Case Studies and Real-World Applications for Stability Evaluation: Case studies of power system oscillations and their impact on grid stability, real-world power stability events in power grid with high penetration of inverter based resources (IBR), Role of advanced technologies in enhancing grid stability, Emerging technologies and trends in power system stability, Research challenges and opportunities in this field. | CO4 | 06 |

Text Books

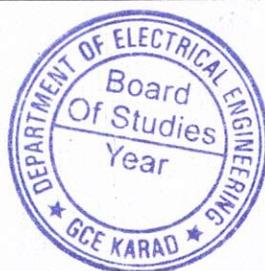
1. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2011(Unit 1-6)
2. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 2019.(Unit 1-6)

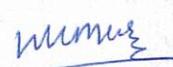
Reference Books

1. J. D. Glover and M. Sarma, “Power System Analysis and Design”, Brooks Cole Publishing, 2002
2. Stevenson W. D. , “Elements of Power System Analysis”, TMH ,
3. Weedy B M, Cory B J, John, “Electric Power Systems”, Wiley Publication
4. Hadi Sadat, “Power System Analysis”, McGraw Hill International, 2001

Useful Links

1. NPTELCourses: https://onlinecourses.nptel.ac.in/noc25_ee169/preview Power System Analysis, IIT Kharagpur




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| | |
|----|--|
| 2. | N.Hatziargyriou et al., "Definition and Classification of Power System Stability—Revisited & Extended," in IEEE Transactions on Power Systems, July 2021 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9286772 |
| 3. | Y. Cheng et al., "Real-World Subsynchronous Oscillation Events in Power Grids With High Penetrations of Inverter-Based Resources," in IEEE Transactions on Power Systems, vol. 38 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9740416 |

Note: Tutorials should be conducted based on all 6 units. At least one tutorial should be based on analyzing the real world problem of power system.

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 3 | 3 | 3 | - | 1 | 2 | 2 | - | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 2 | - | 1 | 2 | 2 | - | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | - | 1 | 2 | 2 | - | 1 | 2 | 2 |
| CO 4 | 3 | 3 | 3 | 3 | 2 | - | 1 | 2 | 2 | - | 2 | 2 | 3 |

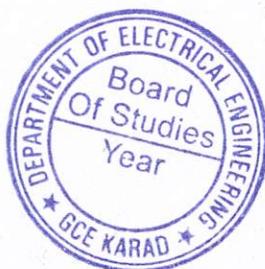
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

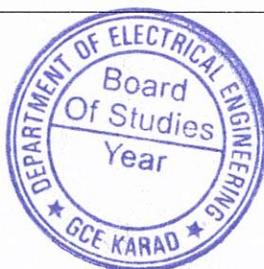
Assessment Pattern (with revised Bloom's Taxonomy)

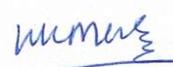
| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | - | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 10 | 5 | 20 |
| Evaluate | 5 | 5 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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|--|---|--------------------|---------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | |
| EE3603: Electrical Drives | | | |
| Teaching Scheme | | Examination Scheme | |
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | -- | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |
| Prerequisite : Electrical machines, Power Electronics | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Apply mathematical skill with Power Electronics to demonstrate drive characteristics and applications of various controllers in electrical drive systems. | | |
| CO2 | Analyse dynamics of electrical drives and its stability. | | |
| CO3 | Analyse and evaluate advanced control schemes for torque and speed control of electrical AC and DC motors drives. | | |
| CO4 | Recommend suitable control schemes for required drive application and basic knowledge of recent advancements in Electric Drives. | | |
| Course Contents | | | CO |
| Hours | | | |
| Unit 1 | Introduction: Drive concepts, parts of Electrical Drives, choice of Electrical Drives, advantages, fundamental torque equations, Equivalent values of drive parameters. open-loop, closed-loop, torque, speed, and current control of electrical drive, IP protection (ingress protection) | CO1 | 05 |
| Unit 2 | Dynamics of Electrical Drive : Modes of operation (Steady state, acceleration, deceleration), multi-quadrant operation of electrical drives, nature and classification of load torques, control & stability of electrical drive, load equalization, thermal effects in electrical machines. Classes of motor duty, criteria for selection of motor for various applications. | CO2 | 06 |
| Unit 3 | DC Motor Drives: Review of basic characteristics of DC motors, classical control schemes (starting, braking, speed, torque), Performance of dc motors, starting and braking methods of DC motor drives, Single phase and three phase controlled rectifier-fed dc drives, semi-converter drives, full converter drives ,dual converter control, chopper-controlled dc drives, Brushless DC motor drive, applications of DC drives. | CO3 | 07 |
| Unit 4 | Induction Motor Drives: Review of basic characteristics, classical control schemes (starting, braking, speed, torque), Scalar Control Schemes: Stator voltage control, V/f control, Static rotor resistance control method,static slip power recovery control- Static Scherbius drive and Static Kramer drive, Limitation of scalar control schemes, applications Vector Control Schemes: Voltage Source Inverter and its PWM strategy for motor control, Direct Torque Control (DTC), Field Oriented Control (FOC), applications | CO3 | 08 |
| Unit 5 | Synchronous Motor Drives: Review of starting, pull in and braking of Synchronous motor, Static variable frequency control for Synchronous motors,Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive, Permanent Magnet Synchronous Motor Drive, Switched Reluctance Motor Drive, applications. | CO3 | 08 |
| Unit 6 | Drives for Advanced Applications : Textile Mill, Steel Rolling Mill, Cement Mill, Sugar Mill. Electric Vehicles Drives: Battery powered drives for electric vehicles, Concept of hybrid electric drive trains. | CO4 | 06 |




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| Text Books | |
|-----------------|---|
| 1. | S.K.Pillai, "A first course in Electrical Drives", New Age International Publishers., 2000(Unit1-3) |
| 2. | G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing house.2002(Unit 1-5) |
| 3. | Piotr Wach, "Dynamics and Control of Electrical Drives," Springer Publications. |
| Reference Books | |
| 1. | B. K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall(I) Pvt. Ltd.2002(Unit 6) |
| 2. | R.Krishnan, "Electrical Motor Drives: Modelling, Analysis and Control", Prentice Hall (I) Pvt. Ltd. |
| 3. | P. C. Krause, "Analysis of Electric Machine", Wiley-IEEE press 3 rd edition. 2013 |
| Useful Links | |
| 1. | http://nptel.ac.in/courses/108102046/ Industrial Drives, IIT Delhi |
| 2. | http://nptel.ac.in/courses/108108077/ Industrial Drives - Power Electronics, IISc Bangalore |
| 3. | http://nptel.ac.in/courses/108104011/ Advanced Electric Drives, IIT Kanpur |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 3 | 3 | 2 | 1 | - | 1 | 1 | 2 | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 2 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 |

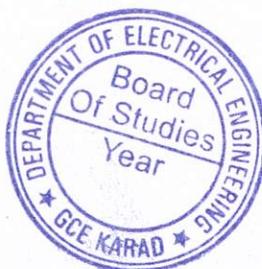
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | 5 | 10 |
| Understand | - | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 10 | - | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Third Year (Sem – VI) B. Tech. Electrical Engineering

EE3614: Digital Control (Elective-II)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Control System Analysis, Control System design

Course Outcomes (CO): Students will be able to

| | |
|------------|--|
| CO1 | Construct mathematical models of digital control system. |
| CO2 | Analyse the nonlinear systems using various basic and commonly used tools. |
| CO3 | Calculate the compensators and controllers for digital control system. |
| CO4 | Design of output feedback controllers. |

| Course Contents | | CO | Hours |
|-----------------|---|------------|-----------|
| Unit 1 | Digital Control System Review of Z transforms, Z transform method for solving difference equation, Impulse Sampling and Data Hold, Pulse Transfer Function, Sampling Theorem, Mapping between S Plane and Z Plane, Stability Analysis, Transient and Steady State Analysis. | CO1 | 08 |
| Unit 2 | Analysis of Digital Control System Control System State Space representation of Digital System, Controllable Canonical form, Observable Canonical form, Diagonal form, Jordan form, Solving State Space Equations, State Transition Matrix, Properties of State Transition Matrix, Pulse Transfer Function Matrix. Discretization of Continuous Time State Space Equation | CO2 | 07 |
| Unit 3 | Design of Digital Control System Construction of Root Locus, Design based on Root Locus, P, PI, PD, PID Controllers, Lead, Lag, Lead-Lag Compensators, Frequency Response Analysis, Bode Diagram. | CO3 | 08 |
| Unit 4 | Design of Classical Digital Control System: Compensator design in time domain and frequency domain. Design of DCS using dead beat response Practical issues with deadbeat response design | CO4 | 07 |
| Unit 5 | Design of state feedback DCS: Pole placement controller design. Partial state feedback design, stabilizing controller and Tracking controller design. Linear quadratic controller design | CO4 | 06 |
| Unit 6 | Design of Output feedback DCS: Observer based controller design, Reduced order observer design, Output feedback controller design, Multirate output feedback controller design, design of periodic output feedback controller Disturbance estimation-based controller | CO4 | 06 |

Text Books

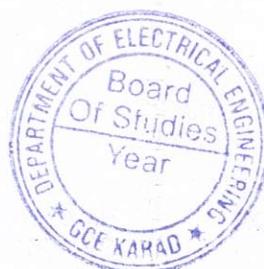
1. M. Gopal, Digital Control and State Variable Methods, Tata Mcgraw Hill, 2/e, 2009(Unit No. 1,2,3,4,5)
2. B. C.Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2012(Unit No. 2,3,4,5,6)

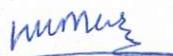
Reference Books

1. G. F. Franklin, J. D.Powell and M. L. Workman, Digital Control of Dynamic Systems, 1998 (Unit No. 1,2)
2. J.Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design,Prentice Hall, 3/e, 1997 (Unit No. 3,4)
3. Kannan M. Moudgalya, Digital Control, Wiley, ISBN 0470031433, 9780470031438, 2007(Unit No.5,6)

Useful Links

1. <https://nptel.ac.in/courses/108103008> Digital Control System, IIT Guwahati
2. https://onlinecourses.nptel.ac.in/noc20_ee90/preview Control systems, IIT Madras




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 2 | 3 | 2 | - | 1 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO 2 | 2 | 3 | 3 | 3 | 2 | 2 | - | 2 | 3 | 2 | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 2 | 3 | 2 | 2 | - | 3 | 2 | 2 | 3 | 2 | 1 |
| CO 4 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 3 | 2 | 1 |

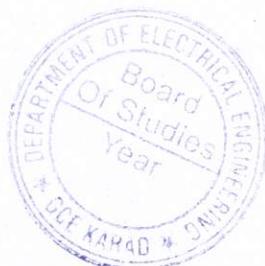
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | - | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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Government College of Engineering, Karad
Third Year (Sem – VI) B. Tech. Electrical Engineering
EE3624:Power Plant Engineering (Elective II)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

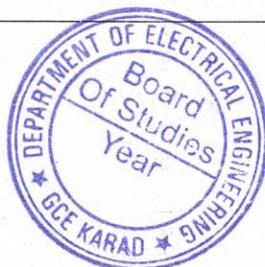
Prerequisite : Electrical Engineering Basics, Thermodynamics, Energy and Environmental Engineering, Engineering Economics

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Apply the principles of thermal, gas, diesel, nuclear, and hydroelectric power plants to evaluate their selection criteria, working principles, and performance parameters. |
| CO2 | Evaluate the environmental impact of thermal power plants and design strategies for pollution control, including particulate matter and greenhouse gas emissions. |
| CO3 | Compare different types of nuclear reactors and propose efficient cooling, control, and waste disposal strategies in nuclear power plants. |
| CO4 | Develop economic analysis models for power generation, optimize energy auditing processes, and formulate effective energy marketing strategies for the Indian power sector. |

| Course Contents | | CO | Hours |
|-----------------|--|------------|----------|
| Unit 1 | Introduction: Resources and development of power in India, NTPC, NHPC and their role in Power development in India, Power distribution, National Grid, Indian Electricity Grid Code, Structure of IEGC, Operating Policies and Procedures, Present Power position in India and Maharashtra. Power Plants Introduction, Factors affecting Selection and relative merits of steam, Gas, Diesel, Hydro Power Plants. | CO1 | 6 |
| Unit 2 | Steam turbine power plant: Introduction, general layout of modern thermal power plant, necessity of feed water treatment, high pressure boilers and importance of water purity. Gas Power plant: Introduction, general layout of gas power plant, effect of operating variable on thermal efficiency, regeneration, reheating, and performance of closed and semi closed cycle gas turbine plant. | CO2 | 8 |
| Unit 3 | Nuclear power plant: Elements of nuclear power plant, nuclear reactor and its types, coolants, control rod, classification of nuclear power plants, waste disposal. Diesel Power Plant: Diesel engine performance and operation, plant layout | CO3 | 6 |
| Unit 4 | Hydroelectric power plant: Hydroelectric Power Plant: site selection, classification of HPP, and their field of use, capacity calculation for hydro power, dam, head water control, penstock, water turbines, specific speeds, governors, hydroelectric plant auxiliaries, plant layout, automatic and pumped storage, project cost of hydroelectric plant. Advantages of hydro power plant. | CO1 | 8 |
| Unit 5 | Environmental aspects in power station: Environmental aspects: Introduction, Constitutes of the atmosphere, Different pollutants due to thermal power plant and their effect on human health, environmental control of different pollutants such as particulate matter, oxides of sulphur (Pre and Post Treatments) oxides of Nitrogen ,Global warming and greenhouse effect, Thermal Pollution of Water and its control. | CO2 | 6 |
| Unit 6 | Economic Analysis and Energy Audit And Energy Marketing: Cost of Electric Energy: Fixed and operating costs, tariff methods. Energy Audit: Techniques and implementation in power plants. Energy Marketing: Electricity market, supply chain, financial and legal aspects. Case Study on Power Plant | CO4 | 6 |

Text Books



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| | |
|------------------------|--|
| 1. | E.I.Wakil, —Power Plant EngineeringI, McGraw Hill Publications New Delhi, 1998 |
| 2. | P.K.Nag, —Power Plant EngineeringI, McGraw Hill Publications New Delhi, 2017. (Unit 1 – 5) |
| Reference Books | |
| 1. | Black & Veatch, Springer, Power Plant Engineering, 1996 |
| 2. | Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw-Hill, 1998. |
| 3. | Godfrey Boyle, Renewable energy. Open University, Oxford University Press in association with the open university, 2004 |
| 4. | B.R.Gupta, “Generation and utilization of Electrical Energy” S Chand publication first 1983 (Unit 6) |
| Useful Links | |
| 1. | https://nptel.ac.in/courses/112/107/112107291/ Power Plant Engineering, IIT Roorkee |
| 3. | https://online.vtu.ac.in/course-details/Power-Plant-Engineering |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | 2 | 3 | 3 |
| CO 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | - | 1 | - | 2 | 2 | 2 |
| CO 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | - | - | - | 2 | 3 | 3 |
| CO 4 | 2 | 2 | 3 | 2 | 3 | 2 | - | 1 | 2 | 3 | 3 | 3 | 2 |

1: Slight(Low)

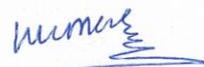
2: Moderate(Medium)

3: Substantial(High)

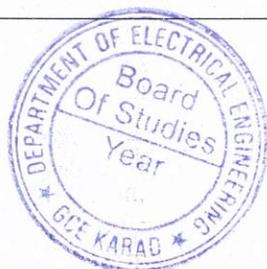
Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | 3 | 3 | 10 |
| Apply | 8 | 8 | 15 |
| Analyse | 4 | 5 | 15 |
| Evaluate | 5 | 4 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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|--|--|--------------------|---------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | |
| EE3634: Special Purpose Machines (Elective II) | | | |
| Teaching Scheme | | Examination Scheme | |
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |
| Prerequisite : Basics of Electrical Engineering, DC Machines, AC Machines | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Analyse the performance of special purpose machines and their industrial applications | | |
| CO2 | Apply foundation in Electrical machines with strong analytical skills and conceptual understanding of analytical methods in special electrical Machines. | | |
| CO3 | Create awareness for protective system with industry oriented learning. | | |
| CO4 | Identify the appropriate Electrical machines required for different applications, considering the parameters like input supply voltage, output torque and speed. | | |
| | Course Contents | CO | Hours |
| Unit 1 | Stepper Motors: Constructional features , principle of operation, variable reluctance motor, Hybrid motor, single & multi stack configurations, Torque equations, Modes of excitation, characteristics, drive circuits, Microprocessor control of stepper motors, closed loop control, concept of lead angle. Universal Motor, Servo Motor -Constructional feature, principle of operation, torque production, characteristics. | CO1 | (09) |
| Unit 2 | Synchronous Reluctance Motor: Constructional features, Types, Axial & Radial flux motors, Operating principles, Variable Reluctance Motors, Voltage & Torque equations, Phasor diagram, and Performance characteristics. | CO1 | (07) |
| Unit 3 | Switched Reluctance Motor(SRM): Constructional features, Rotary & linear SRM, principle of operation, Torque production, steady state performance prediction, Analytical methods, power converters & their controllers, Methods of rotor position sensing, Sensor less operation, characteristics & closed loop control . | CO2 | (08) |
| Unit 4 | Permanent Magnet Brushless DC Motors(PMBLDC): Constructional features, Permanent magnet materials, hysteresis loop, Magnetic characteristics, Permeance coefficient, principle of operation, Types, Magnetic circuit analysis, EMF & Torque equations, Commutation, power converter circuits & their controllers, Motor characteristics & control. | CO2 | (07) |
| Unit 5 | Permanent Magnet Synchronous Motors(PMSM): Constructional features ,principle of operation, EMF & Torque equations, Armature MMF, Synchronous reactance, sine wave motor with practical windings, phasor diagram, Torque/speed characteristics, power controllers, converter volt ampere requirement. | CO3 | (07) |
| Unit 6 | Industrial Applications: Applications of Synchronous Reluctance Motors, Stepper Motors, Switched Reluctance Motor, Permanent magnet brushless DC motors, Permanent magnet synchronous motors. Case Study on controller design of SRM Motor. | CO4 | (04) |
| Text Books | | | |
| 1. | K.Venkataratnam, “Special Electrical Machines”, Universities Press (India) Private Limited,2021(Unt 1-3) | | |
| 2. | E.G. Janardanan, “Special electrical machines”, PHI learning Private Limited, Delhi. 2014(Unit 4-6) | | |
| 3. | T.J.E. Miller, “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford. | | |
| Reference Books | | | |




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| 1. | T. Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press London., 2017. |
| 2. | R.Krishnan, "Switched Reluctance Motor Drives" Modelling, Simulation, Analysis, Design and Application', CRC Press, New York, 2017. |
| 3. | P.P. Aearnley, "Stepping Motors" A Guide to Motor Theory and Practice', Peter Perengrinus London, |
| Useful Links | |
| 1. | https://nptel.ac.in/courses/108108191 Design Of Electric Motors, IISc Bangalore |
| 2. | https://nptel.ac.in/courses/108102146 Electrical Machines, IIT Delhi |
| 3. | https://www.youtube.com/watch?v=fbXVt0VL5Rs&list=PLnFCBA6vU3uvD2z0BwaaOhYTx2NQlh35S by IIT, Delhi |
| 4. | Hameed, H.S., Al Azze, Q. and Hasan, M.S., 2023. Speed control of switched reluctance motors based on fuzzy logic controller and MATLAB/Simulink. Indonesian Journal of Electrical Engineering and Computer Science, 31(2), pp.647-657. https://pdfs.semanticscholar.org/b79b/5cb163d1e7260ebdeebbdd962c55cc2c9a6b.pdf |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 2 | 1 | 1 | 2 | - | 2 | 2 | - | 2 | 3 | 2 |
| CO 2 | 3 | 2 | 3 | 1 | 2 | 3 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 3 | 3 | 2 | 2 | 2 | 3 | 2 | - | 2 | 2 | - | 2 | 3 | 2 |
| CO 4 | 3 | 2 | 2 | 2 | 1 | 1 | - | 2 | 2 | - | 2 | 3 | 2 |

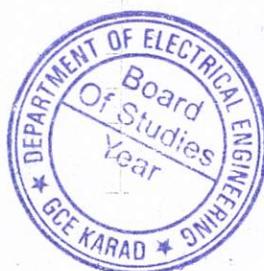
1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

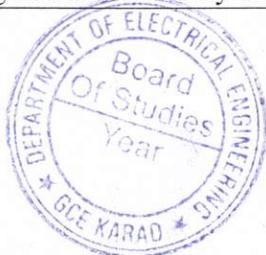
Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | - | 05 | 20 |
| Apply | 10 | 05 | 20 |
| Analyse | 05 | 05 | 10 |
| Evaluate | 05 | 05 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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|---|---|--------------------|---------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | |
| EE3644: Energy Storage (Elective II) | | | |
| Teaching Scheme | | Examination Scheme | |
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |
| Prerequisite : DC Circuits, Renewable Energy | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Understand the need for energy storage, devices and technologies available and their applications | | |
| CO2 | Explore the characteristics of energy from various sources and need for storage | | |
| CO3 | Classify various types of energy storage and various devices used for the purpose | | |
| CO4 | Identify various real time applications | | |
| | Course Contents | CO | Hours |
| Unit 1 | Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy. | CO1 | 06 |
| Unit 2 | Electrical Energy Storage Technologies: Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable. | CO1 | 06 |
| Unit 3 | Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H ₂), Synthetic natural gas (SNG). | CO2 | 06 |
| Unit 4 | Types of Electrical Energy Storage Systems: Electrical storage systems, Double-layer capacitors (DLC) , Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies. | CO3 | 06 |
| Unit 5 | Applications: Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications , Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries. | CO4 | 08 |
| Unit 6 | Case Study: Pumped hydroelectric power plant, Superconducting materials and Hydrogen cells. Study case papers, Detailed Report on the case study and case papers. | CO1, CO4 | 08 |
| Text Books | | | |
| 1. | James M. Eyer, Joseph J. Iannucci and Garth P. Corey , “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories. | | |
| 2. | The Electrical Energy Storage by IEC Market Strategy Board. | | |
| 3. | Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, “Energy Storage in Power Systems” Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016. | | |
| Reference Books | | | |
| 1. | Jim Eyer, Garth Corey , “Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment | | |




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| | Guide” , Report, Sandia National Laboratories, Feb 2010. |
| 2. | Electric Power Research Institute (USA), “Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits” (1020676), December 2010. |
| 3. | Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, “The Role of Energy Storage with Renewable Electricity Generation”, National Renewable Energy Laboratory (NREL) -a National Laboratory of the U.S. Department of Energy. |
| Useful Links | |
| 1. | https://www.pewtrusts.org/~media/.../energy_storage-backs_up_power_supply.pdf |
| 2. | https://energy.mit.edu/wp-content/uploads/2018/04/Energy-Storage-for-the-Grid.pdf |
| 3. | https://nptel.ac.in/courses/108102047/7 . Electrochemical Energy Storage, IIT Kharagpur |

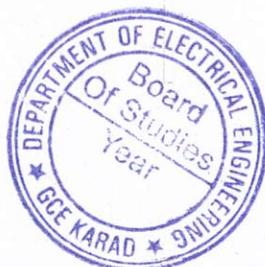
Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 1 | 3 | 2 | 2 | 1 | - | 2 | 2 | - | - | 1 | 1 |
| CO 2 | 2 | 3 | 1 | 2 | 2 | 1 | - | 2 | 2 | - | - | 1 | 2 |
| CO 3 | 2 | 2 | 3 | 2 | 2 | 1 | - | 2 | 2 | - | - | 2 | 2 |
| CO 4 | 2 | 1 | 2 | 2 | 2 | 1 | - | 2 | 2 | 2 | - | 2 | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom’s Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Government College of Engineering, Karad
Third Year (Sem – VI) B. Tech. Electrical Engineering
EE3615: Intelligent Control (Elective-III)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite: Digital Control System

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Introduce to intelligent systems by Providing examples of rule-based control systems |
| CO2 | Design requirements of intelligent controllers with studying a range of specifying methodologies. |
| CO3 | Apply systems engineering methods and techniques in the design and analysis of intelligent control systems. |
| CO4 | Develop the control methodologies using soft computing tools such as fuzzy logic, neural nets and Gas. |

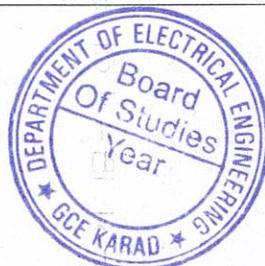
| Course Contents | | CO | Hours |
|-----------------|--|------------|-----------|
| Unit 1 | Fundamentals of Intelligent Control & Neural Networks Neural Networks, Rationale for Using NN in Engineering, Fuzzy Logic Control, Rationale for Using FL in Engineering, Evolutionary Computation, Hybrid Systems Basic Structure of a Neuron, Model of Biological Neurons, Elements of Neural Networks, | CO1 | 08 |
| Unit 2 | Neural Network Architectures Introduction, Neural Networks Classifications, Feed forward and feedback networks, Supervised and Unsupervised Learning Networks, Back Propagation Algorithm, Delta Training Rule, Radial Basis Function Network (RBFN), Hopfield Network | CO2 | 07 |
| Unit 3 | Application Of Neural Network In Design of Digital Filters Problem Approach, Neural Network for Identification, Neural Network Structure, A Training Algorithm for Filter Design, Representation, Training Objective, Weight Adjustment, The Training Algorithm, Implementation Issues, identifying a System in Canonical Form, Stability, Convergence, Learning Rate and Scaling, 2-D Filter Design Using Neural Network, Two-dimensional Signal and Digital Filters, Design Techniques | CO3 | 08 |
| Unit 4 | Introduction To Fuzzy Sets: Basic Definitions and Relations Introduction, Classical Sets, Classical Set Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Alpha-Cut Fuzzy Sets, Extension Principle, Classical Relations vs. Fuzzy Relations | CO3 | 07 |
| Unit 5 | Fuzzy Control and Stability Predicate Logic, Tautologies, Contradictions, Deductive Inferences, Fuzzy Logic, Approximate Reasoning, Basic Definitions, Inference Engine, Defuzzification, Fuzzy Control Design, Analysis of Fuzzy Control Systems, Stability of Fuzzy Control Systems | CO4 | 06 |
| Unit 6 | Autonomous Underwater Vehicle Control Using Fuzzy Logic Introduction, Background, Autonomous Underwater Vehicles (AUVs), Sliding Mode Control, Sliding Mode Fuzzy Control (SMFC), SMFC Design Examples, Guidelines for Online Adjustment, Sliding Slope λ Effects, Thickness of the Boundary Layer ϕ Effects | CO4 | 06 |

Text Books

1. Ali. Zilouchian and Mohammad Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, ISBN:0-8493-1875-0., 2001.(Unit no. 1,2,4 &5)
2. Pedro Ponce-Cruz, Fernando D. Ramírez-Figueroa, Intelligent Control Systems with LabVIEW, Springer, ISBN 978-1-84882-683-0, 2009. (unit 1,2, 5&6)
3. Huang, S., Tan, K. K., Tang, K. Z. Neural network control: theory and applications, Baldock: Research Studies, (Unit no. 3,4,5)

Reference Books

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 1994. (Unit No. 1,2,3)
2. Fredric M. Ham and Ivica Kostanic, Principles of Neuro computing for science and Engineering, McGraw Hill, 2000.(Unit o. 4,5,6)
3. T.J. Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 2012 (unit no. 3)



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Useful Links

1. <https://nptel.ac.in/courses/108104049> Intelligent Systems and Control, IIT Kanpur
2. https://onlinecourses.nptel.ac.in/noc24_ge60/preview Intelligent Feedback and Control, IIT Bombay

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 1 | 1 |
| CO 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 |
| CO 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO 4 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |

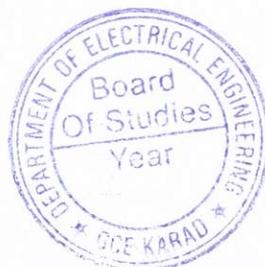
1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | 5 |
| Understand | - | - | 5 |
| Apply | 10 | 10 | 20 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Government College of Engineering, Karad
Third Year (Sem – VI) B. Tech. Electrical Engineering
EE3625: Restructured Power System (Elective III)

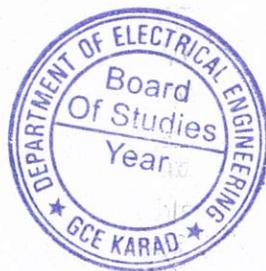
| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | -- | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Elements Of Power System, Power System Analysis

Course Outcomes (CO): Students will be able to

| | |
|------------|---|
| CO1 | Elaborate the process of restructuring of power industry |
| CO2 | Impart knowledge on fundamental concepts of congestion management |
| CO3 | Illustrate the different ancillary services. |
| CO4 | Analyse pricing mechanism and market strategies of power system. |

| Course Contents | | CO | Hours |
|-----------------|---|------------|----------|
| Unit 1 | Introduction to restructuring power industry: Reasons for restructuring of power industry, Understanding the restructuring process, Entities involved, The market place mechanisms, Reasons and objectives of deregulation of various power systems across the world, Salient features of electricity act 2003, Various national policies and guidelines under this act. | CO1 | 6 |
| Unit 2 | Fundamentals of Economics: Consumer and supplier behaviour, Total utility and marginal utility, Law of diminishing marginal utility, Elasticity of demand and supply curve, Market equilibrium, short-run costs and long-run cost, Various costs of production, market models based on contractual arrangement, comparison of various market models, consumer and supplier surplus, global welfare, deadweight loss, market architecture. | CO1 | 8 |
| Unit 3 | Transmission congestion management: Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market methods, Nodal pricing, Inter zonal and Intra zonal congestion management, Price area congestion management, Capacity alleviation method, Transfer capability, Importance of congestion management, Effects of congestion. | CO2 | 6 |
| Unit 4 | Ancillary service management: Introduction of ancillary services, Classification of Ancillary services, Load generation balancing related services, Voltage control and reactive power support devices, Black start capability service, Co-optimization of energy and reserve services, international comparison. | CO3 | 8 |
| Unit 5 | Pricing of transmission network usage and loss location: Introduction to financial transmission rights, FTR issuance process, Treatment of revenue shortfall, Secondary trading of FTRs, Flow gate rights, FTR and market power, FTR and merchant transmission investment, Introduction to loss allocation, Classification of loss allocation methods, Comparison between various methods. | CO4 | 6 |
| Unit 6 | Market power and generator bidding: Introduction to optimal bidding by a generator company, Optimal bidding methods, Different entities in deregulated electricity markets, Benefits from a competitive electricity market, Sources of market power, Effect of market power, Identifying market power, HHI Index, Entropy coefficient, Lerner | CO4 | 6 |



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| | index, Market power mitigation, Effects of contract for differences, Role of demand side bidding, Financial-markets. | | |
| Text Books | | | |
| 1. | Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.(unit 1to 6) | | |
| Reference Books | | | |
| 1. | Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2002. | | |
| 2. | Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001 | | |
| 3. | Loi Lei Lai, "Power system Restructuring and Deregulation", John Wiley & Sons Ltd., England, 2001 | | |
| 4. | Sally Hunt, "Making competition work in electricity", John Willey and Sons Inc. 2002 | | |
| Useful Links | | | |
| 1. | https://www.youtube.com/watch?v=uy9IZCdkQIM&list=PLD4ED2FAF3C155625 | | |
| 2. | 5EE5 11, L1 RPS, Introduction to RPS by Sanjay K Kakodia | | |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | - | - | - | 2 | 2 | 1 | - | - | - | 3 | 2 | 1 |
| CO 2 | 3 | 1 | - | 1 | 1 | - | - | - | - | - | 3 | 2 | 2 |
| CO 3 | 3 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | 3 | 2 | 1 |
| CO 4 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | - | - | - | 3 | 3 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | - | 5 | - |
| Apply | 10 | 5 | 20 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 20 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Third Year (Sem – VI) B. Tech. Electrical Engineering

EE3635: PE Converters for Renewable Energy Integration (Elective-III)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | - | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite: Power Electronics, Basic knowledge of renewable energy conversion.

Course Outcomes (CO): Students will be able to

- CO1** Review of various types of renewable sources of energy.
- CO2** Apply the principles of power converters in solar PV system and wind system.
- CO3** Analyse the PV system and wind energy conversion system.
- CO4** Elaborate hybrid renewable energy system.

| Course Contents | | CO | Hours |
|-----------------|---|------------|----------|
| Unit 1 | Introduction To Renewable Energy Systems: Classification of Energy Sources, Importance of Non-conventional energy sources, Advantages and disadvantages of conventional energy sources, Environmental aspects of energy, Impacts of renewable energy generation on the environment, Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy. | CO1 | 8 |
| Unit 2 | Power Converters For Solar PV Systems: Block diagram of solar photo voltaic system, Principle of operation line commutated converters (inversion-mode), Boost and buck-boost converters, selection of inverter, battery sizing, array sizing | CO2 | 8 |
| Unit 3 | Analysis of PV System: Analysis of PV system, Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems, Maximum Power Point Tracking (MPPT), Grid Connection Issues. | CO3 | 6 |
| Unit 4 | Power Converters For Wind Systems: Wind Energy Conversion: Wind Turbine characteristics, PMSM and DFIG for wind generators. Power Converters: Three-phase AC voltage controllers, AC-DC-AC converters, uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters, Matrix converter | CO2 | 8 |
| Unit 5 | Analysis of Wind Energy Conversion System: Analysis of Wind System: Standalone operation of fixed and variable speed wind energy conversion systems, grid requirement for Wind | CO3 | 6 |
| Unit 6 | Hybrid Renewable Energy Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind PV, Micro hydel-PV, Biomass-Diesel systems. | CO4 | 6 |

Text Books

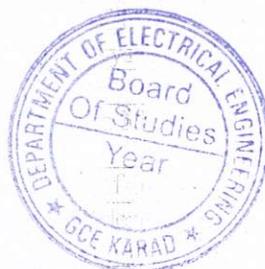
1. H.Khan "Non-conventional Energy sources ", Tata-McGraw-hill Publishing Company, New Delhi, 2017, 3rd Edition.(Unit 1 to 6)
2. M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994 (Unit 2,4)
3. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", Second edition, wiley India Pvt. Ltd, 2012.Unit (2,4)

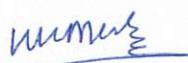
Reference Books

1. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017
2. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.

Useful Links

1. <https://nptel.ac.in/courses/103103206> Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems, IIT Guwahati
2. <https://nptel.ac.in/courses/108107128> Advance power electronics and Control, IIT Roorkee




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 2 | 1 | 1 | 2 | - | 2 | 2 | - | 2 | 3 | 1 |
| CO 2 | 3 | 2 | 2 | 1 | 2 | 2 | - | 2 | 2 | - | 2 | 3 | 3 |
| CO 3 | 3 | 2 | 2 | 2 | 3 | 2 | - | 2 | 2 | - | 2 | 3 | 3 |
| CO 4 | 2 | 2 | 2 | 1 | 1 | 2 | - | 2 | 2 | - | 2 | 3 | 3 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | - | - | - |
| Understand | 5 | 5 | 10 |
| Apply | 5 | 5 | 20 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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Government College of Engineering, Karad
Third Year (Sem – VI) B. Tech. Electrical Engineering
EE3645: Energy Audit (Elective- III)

| Teaching Scheme | | Examination Scheme | |
|-----------------|-------------|--------------------|---------------|
| Lectures | 03 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 03 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |

Prerequisite : Basics of power system

Course Outcomes (CO): Students will be able to

CO1 Present the idea of Economics of electrical distribution system.

CO2 Deduce the concepts in Economics of power generation.

CO3 Review energy conservation and management.

CO4 Develop lighting system and financial management.

| Course Contents | | CO | Hours |
|-----------------|--|------------|-----------|
| Unit 1 | Economics of electrical distribution system: Introduction to electrical power supply, electricity billing, tariff structure, electrical load management and maximum demand control, power factor improvement and benefits. | CO1 | 05 |
| Unit 2 | Economics of power generation: Introduction, Energy sources and their availability, Net metering concept, Present status and future trends in power generation, Economics of solar power, wind energy. Battery as storage system. | CO2 | 06 |
| Unit 3 | Energy conservation in application: Introduction, Energy conservation opportunities, importance of star rating a) motive power b) efficient pumping system c) heating system d) Ventilation and air conditioning system e) pumping system f) cogeneration and waste heat recovery system. | CO3 | 07 |
| Unit 4 | Energy management and audit: Definition, energy audit need, types of energy audit, energy management approach, understanding energy cost, bench marking, energy performance, matching energy use to requirements, maximum system efficiency, optimizing input energy requirements. | CO3 | 07 |
| Unit 5 | Lighting System: Introduction, basic parameters and terms in lighting system, light source and types, recommended illumination for various tasks, method of calculating luminance, lighting design for interior, general energy saving opportunities, energy efficient lighting control, lighting case study. | CO4 | 07 |
| Unit 6 | Financial management: Investment need, appraisal and criteria, financial analysis techniques-simple payback period, return of investment, net present value, internal rate of return, cash flow, risk and sensitivity analysis, financing options, energy performance contracts, energy audit case studies such as IT sector, textile, municipal corporation, educational institutes, thermal power stations. Case study: Prepare an energy audit report of electrical engineering department. | CO4 | 08 |

Text Books

1. Barun Kumar, "Energy Management Audit and Conservation" Vriand publication second 2007(Unit 1-6)
2. B.R.Gupta, "Generation and utilization of Electrical Energy" S Chand publication first 1983
3. Balsubramanian, "Energy Auditing made simple " Bala consultancy services second 2013

Reference Books

1. Bureau of energy efficiency, "Success story of energy conservation"
2. W.R.Murphy and Mcay Reed, "Energy Management", Elsevier India pvt lmt second 2009 (Unit 1-6)
3. S.C.Tripathi, "Utilization of electrical energy", Tata Mcgraw Hill First 1991

Useful Links

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview Basic Principles of Energy Management & Energy Audit, Chhattisgarh Swami Vivekanand Technical University (CSVTU)
2. https://onlinecourses.nptel.ac.in/noc25_ar10/preview Building Energy Systems and Auditing, IIT Kharagpur



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3. https://onlinecourses.swayam2.ac.in/ntr25_ed50/preview Energy Conservation and Audit Laboratory, National Institute of Technical Teacher's Training and Research, Chennai

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 2 | - | 2 | 2 | 1 |
| CO 2 | 2 | 1 | 1 | 1 | 1 | 2 | - | 1 | 2 | - | 2 | 2 | 2 |
| CO 3 | 1 | - | 1 | 1 | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | 2 |
| CO 4 | 1 | - | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----|-----|-----|
| Remember | - | - | - |
| Understand | - | 05 | 15 |
| Apply | 10 | 05 | 15 |
| Analyse | 05 | 05 | 15 |
| Evaluate | 05 | 05 | 15 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |



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|--|--|--------------------|---------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | |
| EE3606:Electrical Drives (Multi-disciplinary Minor - 04) | | | |
| Teaching Scheme | | Examination Scheme | |
| Lectures | 02 Hrs/week | MSE | 20 |
| Tutorials | 00 Hrs/week | ISE | 20 |
| Total Credits | 02 | ESE | 60 |
| | | Duration of ESE | 02 Hrs 30 Min |
| Prerequisite: DC Machines | | | |
| Course Outcomes (CO): Students will be able to | | | |
| CO1 | Discuss the concepts basics of power electronics. | | |
| CO2 | Analyse the various power electronics converters used in drive applications. | | |
| CO3 | Analyse and evaluate advanced control schemes for torque and speed control of electrical AC and DC motors drives. | | |
| CO4 | Apply the knowledge of electrical drives for various industrial applications | | |
| | Course Contents | CO | Hours |
| Unit 1 | Introduction to power electronics: Types of power electronics switches, Diodes, SCR, MOSFET, IGBT. Types of power electronics converters. AC-DC converters. Uncontrolled single phase rectifiers, controlled single phase rectifiers. | CO1 | 06 |
| Unit 2 | Converters for Drive applications: DC-DC Converters: Buck, Boost, Buck-Boost converters. Different configurations of DC-DC converters. DC-AC Converters: single phase inverters, three phase VSI and CSI. | CO2 | 07 |
| Unit 3 | DC Motor Drives: Review of basic characteristics of DC motors, classical control schemes (starting, braking, speed, torque), starting methods of DC motor drives , braking methods of DC motor drive: Regenerative braking, dynamic braking, plugging, dual converter control, chopper-controlled dc drives, Brushless DC motor drive, applications of DC drives. | CO3 | 07 |
| Unit 4 | Induction Motor Drives: Review of basic characteristics, classical control schemes (starting, braking, speed, torque), Stator voltage control, V/f control, Static rotor resistance control method, static slip power recovery control- Static Scherbius drive and Static Kramer drive, Voltage Source Inverter and its PWM strategy for motor control, applications of Induction drives. Drives for Advanced Applications : Textile Mill, Steel Rolling Mill, Cement Mill, Sugar Mill. Battery powered drives for electric vehicles. | CO4 | 07 |
| Text Books | | | |
| 1. | S.K.Pillai, "A first course in Electrical Drives", New Age International Publishers, 2000. | | |
| 2. | G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing house, 2002.(Unit 3-4) | | |
| 3. | M. H. Rashid , "Power Electronics: Circuits Devices and Applications" , 3rd Edition, Pearson/Prentice Hall Publications, 1993.(Unit 1-2) | | |
| Reference Books | | | |
| 1. | B. K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall(I) Pvt. Ltd.(Unit 4) | | |
| 2. | P.S. Bhimbra, "Power Electronics", Khanna Publications, 2012. | | |
| Useful Links | | | |
| 1. | http://nptel.ac.in/courses/108102046/ Industrial Drives, IIT Delhi | | |
| 2. | http://nptel.ac.in/courses/108108077/ Industrial Drives - Power Electronics, IISc Bangalore | | |
| 3. | https://nptel.ac.in/courses/108105066 Power Electronics, IIT Kharagpur | | |




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Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 3 | 3 | 2 | 1 | - | 1 | 1 | 2 | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 2 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 |

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | MSE | ISE | ESE |
|-----------------|-----------|-----------|-----------|
| Remember | 5 | - | 10 |
| Understand | 5 | 5 | 10 |
| Apply | - | 5 | 10 |
| Analyse | 5 | 5 | 20 |
| Evaluate | 5 | 5 | 10 |
| Create | - | - | - |
| TOTAL | 20 | 20 | 60 |




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|--|--|--|----------------------------|------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | | |
| EE3607: Electrical Drives Lab | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 50 |
| Total Credits | 01 | | ESE | 25 |
| Prerequisite: Electrical machine-II, Power Electronics | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Apply the knowledge of electrical drives for various industrial applications | | | |
| CO2 | Analyse the advanced control technique applicable for AC and DC motors in practice. | | | |
| CO3 | Design, simulate and develop advanced control schemes for electrical drives. | | | |
| CO4 | Evaluate the performance characteristics of special purpose machine drives. | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | To find moment of inertia (MI) of DC motor using retardation test (Performance based) | | | CO2 |
| Experiment 2 | To study speed control techniques for switched reluctance motor (Performance based). | | | CO4 |
| Experiment 3 | To study speed control techniques of brushless DC motor fed from inverter and controlled by microcontroller (Performance based). | | | CO4 |
| Experiment 4 | To study Speed control of DC motor drive with MOSFET using DC-DC converter (Performance based). | | | CO1 |
| Experiment 5 | To study V/F control of three phases induction motor drive (Performance based). | | | CO2 |
| Experiment 6 | To control speed of DC motor using dual converters (Performance based) | | | CO2 |
| Experiment 7 | Simulation based performance on chopper fed DC motor drive. | | | CO3 |
| Experiment 8 | Performance / Simulation based experiments for permanent magnet synchronous motor | | | CO3 |
| Experiment 9 | Performance / Simulation based experiments for reluctance motor. | | | CO3 |
| Experiment 10 | Study experiment(s) based on applications of motor (design, calculations, simulations, industry visits) | | | CO1 |
| Minimum number of Experiments : 08 | | | | |
| <i>Above list of experiment list is for guidelines, concern faculty can add / change the experiments based on advanced technology applications in electrical drives.</i> | | | | |

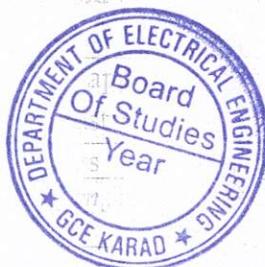
Mapping of COs and POs

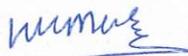
| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 3 | 3 | 3 | 3 | 3 | 1 | - | 1 | 2 | 3 | 3 | 2 | 1 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | 1 | - | 1 | 2 | 3 | 3 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 3 | 2 | 1 | - | 1 | 2 | 3 | 3 | 2 | 2 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



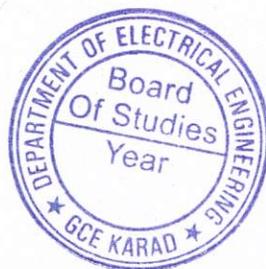

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Assesment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Task I | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Task II | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Task III | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| ISE | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course co-ordinator.)



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|---|---|--|----------------------------|------------|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | | |
| EE3608: Control System Design Lab | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 02 Hrs/week | | ISE | 50 |
| Total Credits | 01 | | ESE | 25 |
| Prerequisite : Control System Analysis Lab, Basics of MATLAB | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Demonstrate the classical controllers in control system | | | |
| CO2 | Design controllers in time domain. | | | |
| CO3 | Design controller in frequency domain. | | | |
| CO4 | Design state feedback controllers | | | |
| Course Contents | | | | CO |
| Implementation of following concepts | | | | |
| Experiment 1 | Study the effect PID controller parameters on transient response of given system. | | | CO1 |
| Experiment 2 | Study of Tuning of a PID controller using MATLAB/Simulink. | | | CO1 |
| Experiment 3 | Design of Lead Compensator using root locus technique. | | | CO2 |
| Experiment 4 | Design of Lag Compensator using root locus technique. | | | CO2 |
| Experiment 5 | Design of Lead Compensator using bode plot technique. | | | CO3 |
| Experiment 6 | Design of Lag Compensator using bode plot technique. | | | CO3 |
| Experiment 7 | Design of lead-lag compensator in MATLAB. | | | CO3 |
| Experiment 8 | To design state feedback controller to get the desired performance. | | | CO3 |
| Experiment 9 | To design state observer for a given system | | | CO4 |
| Experiment 10 | Study of Temperature Controller | | | CO4 |
| Simulation based mini project | | | | |
| Minimum number of Experiments : 8 (Covering all CO's) | | | | |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 1 | 2 | 1 | - | - | 2 | 2 | 2 | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 2 | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| CO 4 | 3 | 3 | 3 | 2 | 3 | - | - | 2 | 2 | 2 | 2 | 3 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



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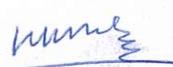
Assessment Pattern:

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Avg |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Task I | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Task II | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Task III | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Simulation Project | 25 | | | | | | | | |

| | |
|----------|--------------------------------------|
| Task I | Proactive Attentiveness |
| Task II | Core Competency |
| Task III | Submission/ Neatness/ Writing Skills |

(Tasks can be decided by course coordinator.)




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|---|--|--|----------------------------|----|
| Third Year (Sem – VI) B. Tech. Electrical Engineering | | | | |
| EE3609: Project Phase I | | | | |
| Laboratory Scheme: | | | Examination Scheme: | |
| Practical | 04 Hrs/week | | ISE | 50 |
| Total Credits | 02 | | ESE | -- |
| Prerequisite : | | | | |
| Course Outcomes (CO): Students will be able to | | | | |
| CO1 | Identify community needs. | | | |
| CO2 | Covert idea into product. | | | |
| CO3 | Demonstrate project model to meet desired result using suitable software and hardware. | | | |
| CO4 | Improve their presentation skill, communication skill. | | | |
| Course Contents | | | | |
| <p>The main aim of this course is to demonstrate the important attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The aim is also to make students aware with the process involved in making product from idea. Not more than three students may carry out the project together. One supervisor from the department shall be assigned five project batches of the minor project. The project may be related to electrical engineering or may be interdisciplinary.</p> <p>The steps involved for completion of minor project includes, but not limited to:</p> <ol style="list-style-type: none"> 1. Conceptualization of innovative idea through literature and market survey; sight visits; interaction with community or industry, socio-economic survey etc. 2. Design of product, processes, methods and systems using multidisciplinary knowledge 3. Fabrication of product, development of software, measurement methods etc. 4. Deployment, implementation and demonstration of project. 5. Presentation of project <p>(For purchase of consumables required for completion of project, every project batch shall receive funding from institute with maximum limit decided by BOM)</p> <p>List of Submission</p> <ol style="list-style-type: none"> 1 Working model of the project 2 Project Report 3 Presentation and demonstration of project in exhibition | | | | |
| <p>Teaching Load</p> <p>One supervisor from the department shall be assigned five project batches of the minor project. The weekly load for the supervisor is 4Hr/week</p> | | | | |

Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|--------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | - | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |
| CO 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | - | 2 | 3 |
| CO 3 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO 4 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | - | - | 3 | 2 |

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)



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Assessment Pattern

The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The end semester assessment shall be done by external referee one week before the term end. The department shall arrange exhibition (all department will arrange the exhibition on same day) of the minor projects done by students and the referee will judge the project work in accordance with the outcomes of the course by interacting with students and marks will be awarded to individual student. This exhibition will remain open for all students, parents, and other citizens visiting the exhibition.

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