# CENTRAL UNIVERSITY OF KARNATAKA
# KALABURAGI

**SCHOOL OF ENGINEERING**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

CENTRAL UNIVERSITY OF KARNATAKA

# REVISED COURSE STRUCTURE AND SYLLABUS

# B.Tech.

# in

# ELECTRICAL ENGINEERING

## 2024 Batch onwards

## I-VIII Semester

**(Effective for all the batches from the academic year 2024–25)**

Department of Electrical Engineering
School of Engineering
Central University of Karnataka
Kalaburagi-585367

**Updated on the last BOS May 2025**

| I SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course code** | **Course Type** | **Course Title** | **TeachingHrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration inHrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC10101 | BS | EngineeringPhysics | 3 | - | - | 3 | 3 | 25 | 50 | 75 | 3 |
| UEETC10102 | BS | EngineeringMathematics-I | 3 | - | - | 3 | 3 | 25 | 50 | 75 | 3 |
| UEETC10103 | ES | Basic Electronics | 3 | 1 | - | 4 | 4 | 40 | 60 | 100 | 4 |
| UEECC10104 | ES | ProgrammingforProblem-Solving | 2 | - | 2 | 4 | 4 | 25 | 50 | 75 | 3 |
| UEETA10105 | HSM | English For Technical Writing | 2 | - | - | 2 | 2 | 20 | 30 | 50 | 2 |
| UEETV10106 | HSM | Environmental Science | 2 | - | - | 2 | 2 | 20 | 30 | 50 | 2 |
| UEETS10107 | ES | Design Thinking | 1 | - | - | 1 | 1 | - | 25 | 25 | 1 |
| UEEPC10108 | ES | Basic Electronics Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| | | **Total** | **16** | **1** | **6** | **23** | **23** | **175** | **325** | **500** | **20** |
| | | | | | | | | | | | |

| II SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course code** | **Course Type** | **Course Title** | **Teaching Hrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC20109 | BS | Engineering Chemistry | 3 | - | - | 3 | 3 | 25 | 50 | 75 | 3 |
| UEETC20110 | BS | Engineering Mathematics II | 3 | - | - | 3 | 3 | 25 | 50 | 75 | 3 |
| UEETC20111 | ES | Basic Electrical Engineering | 3 | 1 | - | 4 | 4 | 40 | 60 | 100 | 4 |
| UEECC20112 | ES | Object Oriented Programming using JAVA | 2 | - | 2 | 4 | 4 | 25 | 50 | 75 | 3 |
| UEETC20113 | ES | Engineering Graphics & Design | 2 | - | 2 | 4 | 4 | 25 | 50 | 75 | 3 |
| UEETV20114 | HSM | Universal Human Values | 1 | - | - | 1 | 1 | - | 25 | 25 | 1 |
| UEEPC20115 | ES | Basic Electrical Engineering Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC20116 | ES | Engineering Workshop | | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| | | **Total** | **14** | **1** | **12** | **27** | **27** | **180** | **345** | **525** | **21** |
| | | | | | | | | | | | |

| III SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course code** | **Course Type** | **Course Title** | **Teaching Hrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC30201 | EC | Electrical Machines-I | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC30202 | EC | Electro Magnetic Fields | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC30203 | EC | Electrical Circuit Analysis | 3 | 1 | - | 4 | 4 | 40 | 60 | 100 | 4 |
| UEETC30204 | EC | Signals and Systems | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEEPC30205 | EC | Electrical Machines-I Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEECC30206 | EC | Programming with Python | 2 | - | 2 | 4 | 4 | 30 | 45 | 75 | 3 |
| UEEPC30207 | EC | Electrical Circuit Analysis Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEETV30208 | HSM | Indian Knowledge Systems | 2 | - | - | 2 | 2 | 20 | 30 | 50 | 2 |
| | | **Total** | **16** | **1** | **10** | **27** | **27** | **220** | **330** | **550** | **22** |
| | | | | | | | | | | | |

| IV SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course code** | **Course Type** | **Course Title** | **Teaching Hrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC40209 | EC | Electrical Machines-II | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC40210 | EC | Electrical Power Generation, Transmission and Distribution | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC40211 | EC | Linear Control Systems | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC40212 | EC | Analog & Digital Electronics | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETD40213 | HSM | Science Elective-Management/Mathematics/MOOCS/NPTEL | 2 | - | - | 2 | 2 | 20 | 30 | 50 | 2 |
| UEEPC40214 | EC | Electrical Machines-II Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC40215 | EC | Control System Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC40216 | EC | Analog & Digital Electronics Laboratory | | | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEETV40217 | HSM | Constitution of India, Professional Ethics and Human Rights | 2 | - | - | 2 | 2 | - | - | - | 0* |
| UEERC40218 | EC | Mini-Project | - | - | 4 | 4 | - | 20 | 30 | 50 | 2 |
| | | **Total** | **16** | **-** | **16** | **32** | **28** | **220** | **330** | **550** | **22** |
| Note:* Constitution of India, Professional Ethics and Human Rights is an Audit Course- IA test, and submitting an Assignment is mandatory. | | | | | | | | | | | |

| V SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course code** | **Course Type** | **Course Title** | **Teaching Hrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC50301 | EC | Power System Analysis-I | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC50302 | EC | Power Electronics | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC50303 | EC | Electrical Measurements and Instrumentation | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC50304 | PE | Professional Elective-1 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETD50305 | OE | Open Elective-1 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEEPC50306 | EC | Power System Laboratory-I | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC50307 | EC | Power Electronics Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC50308 | EC | Electrical Measurements Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEFV50309 | HSM | Sports and yoga, or NCC/NSS (Activity Based Evaluation) / Entrepreneurship and startup | - | - | 2 | 2 | 2 | - | 25 | 25 | 1 |
| | | **Total** | **15** | **-** | **14** | **29** | **29** | **210** | **340** | **550** | **22** |
| Open Elective-1- Offered at University Level, Professional Elective-1-Offered at departmental level. | | | | | | | | | | | |

| VI SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cours ecode** | **Course Type** | **Course Title** | **Teaching Hrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **Theory Lecture** | **Tutorial** | **Practical/ Drawing** | **Total** | **Duration in Hrs.** | **IAM arks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC60310 | EC | Power System Analysis-II | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC60311 | EC | Electrical Drives | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC60312 | EC | Power System Protection | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEECC60313 | EC | Microprocessors and Microcontrollers | 2 | - | 2 | 4 | 3 | 30 | 45 | 75 | 3 |
| UEETC60314 | PE | Professional Elective-2 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETD60315 | OE | Open Elective-2 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEEPC60316 | EC | Electrical Drives Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEEPC60317 | EC | Power System Laboratory-II | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEERC60318 | EC | Minor Project | - | - | 4 | 4 | - | 20 | 30 | 50 | 2 |
| | | **Total** | **17** | **-** | **14** | **31** | **26** | **240** | **360** | **600** | **24** |
| Note: Students must undergo an Internship during Summer Vacation between the VI and VII semesters. | | | | | | | | | | | |

| VII SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coursecode** | **CourseType** | **CourseTitle** | **TeachingHrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **TheoryLecture** | **Tutorial** | **Practical/Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC70401 | EC | Renewable Energy Sources | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC70402 | EC | Power System Operation and Control | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC70403 | EC | Digital Signal Processing | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEECC70404 | EC | Internet of Things | 2 | - | 2 | 4 | 3 | 30 | 45 | 75 | 3 |
| UEETC70405 | PE | Professional Elective-3 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETD70406 | OE | Open Elective-3 | 3 | - | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEEPC70407 | EC | Renewable Energy Laboratory | - | - | 4 | 4 | 4 | 20 | 30 | 50 | 2 |
| UEERC70408 | EC | Major Project -Phase-1 | - | - | 4 | 4 | - | 20 | 30 | 50 | 2 |
| UEEIS70409 | EC | Internship | - | - | - | - | - | - | 50 | 50 | 2 |
| | | **Total** | **17** | **-** | **10** | **27** | **22** | **220** | **380** | **600** | **24** |

| VIII SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coursecode** | **CourseType** | **CourseTitle** | **TeachingHrs./Week** | | | | **Examination** | | | | **Credits** |
| | | | **TheoryLecture** | **Tutorial** | **Practical/Drawing** | **Total** | **Duration in Hrs.** | **IA Marks** | **End Sem Marks** | **Total Marks** | |
| | | | **L** | **T** | **P** | | | | | | |
| UEETC80410 | PE | Professional Elective-4 | 3 | | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEETC80411 | PE | Professional Elective-5 | 3 | | - | 3 | 3 | 30 | 45 | 75 | 3 |
| UEERC80512 | EC | Major Project-Phase-II | - | - | 10 | 10 | 1 | 100 | 150 | 250 | 10 |
| UEERA80413 | EC | Technical Paper writing and presentation | - | - | - | - | 1 | - | 50 | 50 | 02 |
| | | **Total** | **06** | **-** | **10** | **16** | **8** | **160** | **290** | **450** | **18** |

Note: Technical Paper writing and presentation should be done in a research area other than the Major project work.

# ELECTIVES

| **Professional Elective-1 , V-Sem, UEETC50304** | | **Professional Elective-2, VI Sem, UEETC60314** | |
|---|---|---|---|
| **Course Code** | Subject | **Course Code** | subject |
| **Power and Energy Systems** | Power System Planning. | **Power and Energy Systems** | Energy Auditing and DSM.<br>Electrical Estimation and Costing |
| **Machines, Power Electronics, and Drives** | Electrical Machine Design | **Machines, Power Electronics, and Drives** | Special Electrical Machines<br>Electrical Vehicles<br>Advanced Power Electronics and Drives |
| **Control systems and automation** | Battery Management Systems<br>Modern Control System | **Control systems and automation** | Fundamentals of Robotics |
| **AI, ML, and Big Data** | Data Science and analytics | **AI, ML, and Big Data** | Block Chain Technology |
| **Others** | Optimization Techniques.<br>Engineering Materials | **Others** | Mechatronics System design |

| **Professional Elective-3, VII Sem, UEETC70405** | | |
|---|---|---|
| **Course Code** | Subject | |
| **Power and Energy Systems** | Energy Storage Systems<br>Power System Reliability.<br>HVDC Transmission System<br>Electrical Power Utilization | |
| **Machines, Power Electronics, and Drives** | Advanced Control And Applications Of Electrical Drives | |
| **Control systems and automation** | PLC and SCADA Systems<br>IOT and Automation | |
| **AI, ML, and Big Data** | | |
| **Others** | | |

| Professional Elective-4 , VIII Sem, UEETC80410 | | Professional Elective-5, VIII Sem, UEETC80411 | |
|---|---|---|---|
| **Course Code** | Subject | **Course Code** | subject |
| **Power and Energy Systems** | Smart Grid<br>Cyber Security in Power Systems<br>FACTS and Custom Power Devices<br>Solar and Wind Energy Systems | **Power and Energy Systems** | DG and Micro Grid<br>AI applications in Power Systems<br>Digital Protection of Power Systems<br>Power Quality<br>Electrical Power Utilization |
| **Machines, Power Electronics, and Drives** | High Power Multilevel Converters<br>Modelling and Analysis of Electrical Machines | **Machines,Power Electronics, and Drives** | Digital Control of Power Electronics |
| **Control systems and automation** | | **Control systems and automation** | Industrial Load Modelling and Control |
| **AI, ML, and Big Data** | | **AI, ML, and Big Data** | |
| **Others** | | **Others** | |

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# SYLLABUS

## SEMESTER- I

### ENGINEERING PHYSICS

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC10101** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

**COURSE OUTCOMES**

After completion of this course, the student will be able to

- Explain the basics of energy bands and gaps in solids and semiconductors.
- Analyze and solve problems involving variety of wave phenomena.
- Apply principles of electromagnetism and Maxwell's equation to simple systems.
- Describe principles and techniques used in the field of nanoscience.

**DETAILED SYLLABUS**

**UNIT-I**

**Waves and Oscillations:** Rectilinear motion, Oscillations or Vibrations, Simple Harmonic Motion; Damped Harmonic motion: Real oscillatory system, Forced or Driven oscillation; Types of Wave; Superposition of Waves, Reflection and Refraction, Standing Waves and Normal Modes, Beats, Resonance, Doppler's Effect. **RBT Levels: L2.**

**UNIT-II**

**Electricity and Magnetism:** Physical concepts of gradient, divergence, and curl; Laplacian operator, Concept of electricity and magnetism, Coulomb’s law, The Lorentz force, Maxwell's equations. **RBT Levels: L2.**

**UNIT-III**

**Introduction to Solids and Semiconductors:** Introduction to Quantum Mechanics, Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Kronig-Penney model and origin of energy bands, metals, semiconductors, and insulators. **RBT Levels: L2.**

## UNIT-IV

**Introduction to nanoscience:**Origin of nanoscience, nanoscale, surface to volume ratio, quantum confinement, dominance of electromagnetic forces, random molecular motion, bottom-up fabrication: Sol-gel, CVD and PVD techniques, top-down fabrication: ball mill method, characterization by XRD, SEM and TEM.

**RBT Levels:L2.**

## TEXT BOOKS


1. Griffiths, D.J. and Schroeter, D.F., 2018. Introduction to quantum mechanics. Cambridge University Press.
2. Solid State Physics, A. J. Dekkar, Macmillan publishers Ind. Ltd.,
3. Fundamentals of Physics, Alan Giambattisa, BM Richardson and Robert C Richardson, Tata McGraw hill Publishers.


## REFERENCES


1. G. Main, “Vibrations and waves in physics”, Cambridge University Press, 1993.
2. H. J. Pain, “The physics of vibrations and waves”, Wiley, 2006.
3. D. A. Neamen, “Semiconductor Physics and Devices”, Times Mirror High Education Group, Chicago, 1997.
4. E.S. Yang, “Microelectronic Devices”, McGraw Hill, Singapore, 1988.
5. B.G. Streetman, “Solid State Electronic Devices”, Prentice Hall of India, 1995.
6. Solid State Physics, Charles Kittel, Wiley student edition.
7. The Feynman Lectures on Physics, vol. 2,.
8. Fitzpatrick, R., 2018. Oscillations and waves: an introduction. CRC Press.
9. Griffiths DJ. Introduction to electrodynamics.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ENGINEERING MATHEMATICS-I

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC10102** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

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

- Solve the consistent system of linear equations and apply orthogonal and congruent transformations to a quadratic form
- Determine the power series expansion of a given function and Find the maxima and minima of multivariable functions
- Solve arbitrary order linear differential equations with constant coefficients
- Apply the concepts in solving physical problems arising in engineering

## DETAILED SYLLABUS

### UNIT I

**Matrix Theory:** Linear dependence and independence of vectors; Rank of a matrix; Consistency of the system of linear equations; Eigenvalues and eigenvectors of a matrix; Caley-Hamilton theorem and its applications; Reduction to diagonal form; Reduction of a quadratic form to canonical form - orthogonal transformation and congruent transformation; Properties of complex matrices - Hermitian, skew-Hermitian and Unitary matrices.**RBT Levels:L2.**

### UNIT II

**Differential Calculus:** Taylor's theorem with remainders; Taylor's and Maclaurin's expansions; Asymptotes; Curvature; Curve tracing; Functions of several variables - partial differentiation; total differentiation; Euler's theorem and generalization; Change of variables - Jacobians; maxima and minima of functions of several variables (2 and 3 variables) - Lagrange's method of multipliers. **RBT Levels:L2.**

### UNIT III

**Ordinary differential equations of first order:** Formation of differential equations; variable separable equations; homogeneous and non-homogeneous equations; exact and non-exact equations; integrating factors; linear first order equations; Bernoulli’s equation; applications- Newton’s law of cooling, Law of natural growth and decay, orthogonal trajectories.**RBT Levels:L2.**

## UNIT IV

**Linear Differential Equations of Higher order:** Definition, Complete solution, Operator D, Rules for finding complementary function, Inverse operator, Rules for finding particular integral, Method of variation of parameters, Cauchy's and Legendre's linear equations, Simultaneous linear equations with constant coefficients and applications of linear differential equations to oscillatory Electrical Circuits L-C, LCR – Circuits.**RBT Levels:L2.**

## TEXT BOOKS


1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 2015


## REFERENCE BOOKS


1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Fifth Edition, Narosa Publishing House, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Eighth Edition, John Wiley and Sons, 2015


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# BASIC ELECTRONICS

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **40** |
| **Course Code** | **UEETC10103** | **End Sem. Exam** | **60** |
| **Teaching Hours/Week (L:T:P)** | **3:1:0** | **Exam Duration (Hours)** | **03** |
| **Credits: 04** | | | |

## COURSE OUTCOMES

After studying this course, students will be able to:

- Describe the operation of Diodes and BJT
- Design and explain the construction of rectifiers, regulators, and amplifiers.
- Describe the general operating principles of optoelectronic devices and photodetectors.
- Explain the different number system and their conversions and construct simple combinational and sequential logic circuits using Flip-flops

## DETAILED SYLLABUS

### UNIT- I

**Semiconductors:** Bonding forces in solids, Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect semiconductors, Electrons and Holes, Intrinsic and Extrinsic materials, Conductivity and Mobility, Drift and Resistance, Effects of temperature and doping on mobility, Hall Effect.**RBT Levels: L2.**

### UNIT-II

**Forward and Reverse biased junctions**: Qualitative description of Current flow at a junction, Reverse bias, Reverse bias breakdown- Zener breakdown, avalanche breakdown, Rectifiers. Optoelectronic Devices, Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors. Light Emitting Diode. **RBT Levels: L2.**

### UNIT- III

**Bipolar Junction Transistor:** Fundamentals of BJT operation, Amplification with BJTS, BJT Fabrication, The coupled Diode model (Ebers-Moll Model), Switching operation of a transistor, Cutoff, saturation, switching cycle, specifications, Drift in the base region, Base narrowing, Avalanche breakdown. **RBT Levels: L2.**

### UNIT- IV

**Digital Electronics Fundamentals:** Difference betweenanalog and digital signals, Number system – Binary, Hexadecimal, Coversion – Decimal to binary, Hexagonal to decimal and vice-versa, Boolean Algebra, Basic to Universal gates, Half and full adder, Multiplexer, Decoder, SR and JK flip-flops, Shift register, 3 bit Ripple counter.

**RBT Levels: L3.**

## TEXT BOOKS

1. Ben. G. Streetman, Sanjay Kumar Banergee, "Solid State Electronic Devices", 7th Edition, Pearson Education, 2016, ISBN 978-93-325-5508-2.

## REFERENCE BOOKS

1. Thomas L. Floyed, "Electronic Devices" Pearson Education, 9th Edition, 2012

2. S. M. Sze, Kwok K. Ng, "Physics of Semiconductor Devices", 3rd Edition, Wiley, 2018.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **40 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **60 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# PROGRAMMING FOR PROBLEM SOLVING

| | | | |
|---|---|---|---|
| **Semester :** | **I** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEECC10104** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **2:0:2** | **Exam Duration (Hours) :** | **03** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Formulate simple algorithms for arithmetic and logical problems and translate the algorithms to programs (in C language).
- Test and execute the programs and correct syntax and logical errors and implement conditional branching, iteration and recursion.
- Decompose a problem into functions and synthesize a complete program-using divide and conquer approach.
- Use Arrays, strings and functions to formulate algorithms and programs.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to Programming:** Introduction to Computer, Components of a Computer System, Evolution of languages- Machine languages, Assembly languages, High-level languages. Software basics and its types. System softwares like operating system, compiler, linker, loader; Application programs like editor.

**Idea of Algorithm:** steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **RBT Levels: L2**

### UNIT-II

**Introduction to 'C' Programming Language:** History of C Programming, Basic structure of C program, Executing a C program, Constants, Variables and Data types, Operators and Expressions, Programming examples and exercises. **RBT Levels: L2.**

### UNIT-III

**Managing Input and Output operations:** Simple input and output with scanf and printf, formatted I/O, Command line arguments.

**Conditional Branching and Loops:** Conditional branching Statements (if, if-else, nested if-else and switch statements) in C, Loop control statements (For, while-do, do-while) in C, break and continue, Programming examples and exercises**. RBT Levels: L3**

**UNIT-IV**

**Arrays, Strings and Functions:**

**Arrays:** Concepts, Using Arrays (1-D and 2-D) in C, Array Applications, Searching and Sorting algorithms (Linear search, Binary Search, Selection and Bubble Sort), example programs.

**Strings:** Introduction to strings in C, handling strings as array of characters, basic string functions available in C, arrays of strings.

**Functions:** Functions in C, user defined functions, Argument Passing – call by value, call by reference, Recursion, Programming examples and exercises.**RBT Levels: L3.**

**TEXT BOOKS**


1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill
2. Brian W. Kernighan and Dennis M. Ritchie, The “C” Programming Language, Prentice Hall of India
3. V Rajaraman: Computer Programming in C, PHI, 2013.


**REFERENCE BOOKS**


1. Jacqueline Jones & Keith Harrow: Problem Solving with C, 1st Edition, Pearson 2011
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. Vikas Gupta: Computer Concepts and C Programming, Dreamtech Press 2013.
4. R S Bichkar, Programming with C, University Press, 2012.


**ONLINE RESOURCES**

1. https://nptel.ac.in/courses/106105171

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# ENGLISH FOR TECHNICAL WRITING

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **20** |
| **Course Code** | **UEETA10105** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **2:0:0** | **Exam Duration (Hours)** | **1.5** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

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

- Understand the purpose, summarize and paraphrase the information
- Identify grammatical errors and correct them
- Write a formal report and referencing properly.
- Develop own style of sensible writing

## DETAILED SYLLABUS

### UNIT-I

### 1. READING SKILLS

1.1 Types of Reading Skills
1.1.1 Skimming
1.1.2 Scanning
1.1.3 Extensive Reading
1.1.4 Intensive Reading
1.2 Reading Strategies
1.2.1 SQ3R Technique
1.2.2 Reading Efficiently by Reading Intelligently
1.3 Timed Reading Practice
1.3.1 Reading Groups of Words at Each Glance
1.3.2 Reading More Selectively

### UNIT-II

### 2. WRITING AND GRAMMAR

2.1 Writing Letters - Part I
2.1.1 Formal Letters - Part I
2.1.2 Letters of Enquiry
2.1.3 Letters of Complaint and Apology
2.1.4 Letters of Request
2.1.5 Email

2.2 Grammatical Elements
2.2.1 Phrase
2.2.2 Phrasal Verbs
2.2.3 Prepositional Phrasal Verbs
2.2.4 Adverbial Phrasal Verbs

**UNIT-III**

**3. TECHNICAL WRITING PART- I**

3.1 Introduction to Technical Writing
3.2 Technical Writing Basics
3.2.1 Structuring Your Writing
3.2.2 Positioning Your Writing
3.2.3 Choosing the Right Words
3.2.4 Avoiding Traps
3.2.5 Making Your Technical Writing More Interesting
3.2.6 The five Cs of Technical Writing
3.2.7 Referencing

**UNIT-IV**

**4. Nature and Style of Sensible Writing**

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

**5. Writing Practices**

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

**TEXT BOOKS/ REFERENCES**

1. Laplante, Philip A. Technical Writing: A Practical Guide for Engineers and Scientists. Boca Raton: CRC Press, 2012.

**REFERENCE BOOKS**

1. Maitland, Iain. Write That Letter. 2nd Ed. New Delhi: Kogan Page, 2009.
2. Abraham, T. C. Effective Letter Writing. New Delhi: Commonwealth, 2009.
3. Terttu Nevalainen and Sanna-Kaisa Tanskanen. Letter Writing.

Amsterdam/Philadelphia: John Banjamin's Publishing Company, 2007.
4. Seely John. Oxford Guide to Effective Writing and Speaking. New Delhi: OUP, 2009.
5. Inthira, S.R and V. Saraswathi (1995) Enrich your English Communication Skills Book (Book I) New Delhi: OUP & CIEFL., Hyderabad.
6. Inthira, S.R and V. Saraswathi (1995) Enrich your English: Academic Skills Book (Book II) New Delhi: OUP & CIEFL., Hyderabad.
7. Tickoo, M. L. and et al. Living English Grammar and Composition. Hyderabad: Orient Longman, 1993.
8. Crystal, David. A Little Book of Language. Hyderabad: Orient Blackswan, 2010.
9. Green, David. Contemporary English Grammar Structures and Composition. Delhi: Macmillan, 2011.
10. English Grammar by Wren and Martin
11. Practical English Usage. Michael Swan. OUP. 1995.
12. Remedial English Grammar. F.T. Wood. Macmillan.2007
13. On Writing Well. William Zinsser. Harper Resource Book. 2001
14. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
15. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
16. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# ENVIRONMENTAL SCIENCE

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **20** |
| **Course Code** | **UEETV10106** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **2:0:0** | **Exam Duration (Hours)** | **1.5** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Identify the Components of Environment Ecosystem: Types & Structure, Scope and the Impacts of Agriculture & Housing, Industry, Mining & Transportation.
- Ascertain the importance of. Natural Resources and different types of Energy.
- Comprehend the Environmental Pollutions and Global Environmental Issues.
- Examine the Air Pollution & Automobile Pollution their Effects and Solid Waste Management their sources, Characteristics.

## DETAILED SYLLABUS

### UNIT-I

**Introduction:** Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation. Environmental Impact Assessment, Sustainable Development.

**RBT Levels:L2.**

### UNIT-II

**Natural Resources, Water resources**: Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle.

Energy: Different types of energy, Conventional sources & Non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.

**RBT Levels: L2.**

### UNIT-III

**Environmental Pollution:** Water Pollution, Noise pollution, Land Pollution, Public Health Aspects.

Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management.

**RBT Levels: L2.**

## UNIT-IV

**Air Pollution & Automobile Pollution:** Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures.
Solid Waste Management, E - Waste Management & Biomedical Waste Management - Sources, Characteristics & Disposal methods.
**RBT Levels: L3.**

## TEXT BOOKS


1. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi.


## REFERENCE BOOKS


1. R Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005.
2. Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt. Ltd. 2012
3. Raman Sivakumar, "Principals of Environmental Science and Engineering", Second Edition, Cengage learning Singapore, 2005 63 64
4. 2. P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006
5. S.M. Prakash, "Environmental Studies", Elite Publishers Mangalore, 2007 4. Erach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2005
6. Erach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2005
7. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Tenth Edition, Thomson Brooks /Cole, 2004
8. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006
9. Dr.Pratiba Sing, Dr.Anoop Singh and Dr.Piyush Malaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# DESIGN THINKING

| | | | |
|---|---|---|---|
| **Semester :** | **I** | **Internal Assessment :** | **10** |
| **Course Code :** | **UEETS10107** | **End Sem. Exam :** | **15** |
| **Teaching Hours/Week (L:T:P) :** | **1:0:0** | **Exam Duration (Hours) :** | **01** |
| **Credits : 01** | | | |

**COURSE OUTCOMES:**

This course will enable students to:

- New ways of creative thinking and Learn the innovation cycle of Design Thinking.
- Developing innovative products idea, which are useful for a student in preparing for an engineering career.

**UNIT-I**

**Basics of Design Thinking**

Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test

**RBT Levels: L2.**

**UNIT-II**

**Being Ingenious & Fixing Problem:** Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving.**RBT Levels: L2.**

**TEXT BOOKS**

1.**E. Balaguruswamy (2022)**, Developing Thinking Skills (The way to Success), Khanna Book Publishing Company

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **10 Marks**)

- Internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **15 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# BASIC ELECTRONICS LAB

| | | | |
|---|---|---|---|
| **Semester** | **I** | **Internal Assessment** | **20** |
| **Course Code** | **UEEPC10108** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **0:0:4** | **Exam Duration (Hours)** | **03** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Examine the characteristics of basic semiconductor devices.
- Perform experiments to study the behavior of semiconductor devices for circuit design applications.
- Calculate various device parameter values from their IV characteristics.
- Interpret the experimental data for better understanding the device behavior.

## LIST OF EXPERIMENTS: (RBT Levels: L1, L2, L3, L4.)

1. Analyze the I-V Characteristics of normal PN Junction (Ordinary Diode).
2. Analyze the I-V Characteristics of Zener Diode (Special Diode).
3. Study and Analyze the I-V Characteristics of the CE Configuration of BJT.
4. Study and Analyze the I-V Characteristics of the CB Configuration of BJT.
5. Study and Analyze the I-V Characteristics of the CC Configuration of BJT.
6. Study and Analyze the I-V of JFET.
7. Design and analyze constant power supply using a Zener Diode.
8. To construct a Half-wave rectifier circuit and analyze its output.
9. To analyze the HW rectifier output using a capacitor in shunt as a filter.
10. To construct a Full-wave rectifier circuit and analyze its output.
11. To analyze the FW rectifier output using a capacitor in shunt as a filter.
12. To design and analyze regulated power supply using ICs (7805 and 7812).
13. To design and analyze regulated power supply using ICs (7905 and 7912).
14. Study the transfer function and phase shift of a low pass RC filter.
15. Study the transfer function and phase shift of a high pass RC filter.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# SEMESTER- II

## ENGINEERING CHEMISTRY

| | | | |
|---|---|---|---|
| **Semester** | **II** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC20109** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

**COURSE OUTCOMES**

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

- Apply the chemistry knowledge in solving engineering problems of society.
- Understand the fundamentals of electrochemistry, polymer chemistry and water technology.
- Assemble the concepts of chemistry that are in immediate need for engineering disciplines.
- Analyze various technologies available in electrochemistry, polymer chemistry, water & fuels.

**DETAILED SYLLABUS**

**UNIT-I**

**Electrochemistry:** Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).**Corrosion:**Causes and effects of corrosion, Types of corrosion ,Corrosion control methods. **Battery Technology:**Classification of batteries, emf of batteries, Modern batteries. Fuel cells and their applications.**RBT Levels: L2.**

**UNIT-II**

**Polymer Chemistry:** Introduction, Classification of polymers, Use and disposal of polymers, Polymer terminologies, commercially important polymers with synthesis and applications (plastics, fibres, adhesives, elastomers, conducting polymers), properties of polymers-Solubility, Molecular Weight, Crystallinity, Glass transition temperature, Role of additives in polymers, Reinforced plastics. **RBT Levels: L2.**

**UNIT-III**

**Water Technology:** Chemical analysis of water. Hardness of water. Determination of dissolved oxygen (DO) by Winkler or Iodometric method. Reverse osmosis. Source of water pollution. Chemical oxygen demand (COD) and Biological oxygen demand (BOD). Treatment of domestic waste. Nano-technology associated with water. **RBT Levels: L2.**

**UNIT-IV**

**Chemical fuels:** Introduction, classification with examples, calorific value-classification (HCV & LCV), determination of calorific value of solid and liquid fuels using Bomb calorimeter-numerical problems. Petroleum cracking -fluidized bed catalytic cracking. Reformation of petrol, Knocking in IC engine, its ill effects and prevention.Power alcohol and its advantages. Synthetic petrol – Bergius process. Renewable and non-renewable energies. Biofuel. Solar Energy. Nuclear fuel.

**RBT Levels: L2.**

**TEXT BOOKS**

1. Text book of Engineering Chemistry by Dr. K. Pushpalatha, published by Wiley publications 2nd edition.
2. A text book of Engineering Chemistry 15th Edition by P.C.Jain and Monica Jain, Dhanpat Rai Publishing Co (P) Ltd., New Delhi.

**REFERENCES**

1. Principles of Physical Chemistry by B.R.Puri, L.R.Sharma and M.S.Pathania, Nagin Chand and Co.
2. Text book of Physical Chemistry by Soni and Dharmatha, S.Chand & Sons.
3. Text book of Polymers science by Gowarikar and Vishwanathan.
4. Corrosion Engineering by M.G.Fontana, Mc Graw Hill Publications.
5. Introduction to Nanotechnology: Charles P. Poole, Frank J. Owens.
6. A textbook of Engineering Chemistry: Shashi Chawla, Dhanpatrai Publication.
7. A textbook of Engineering Chemistry: S. S. Dara, S. Chand Publication 2010 edn.
8. A textbook of Engineering Chemistry: Jain and Jain, Dhanpatrai Publication.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# ENGINEERING MATHEMATICS-II

| | | | |
|---|---|---|---|
| **Semester** | **II** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC20110** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

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

- Analyse improper integrals and evaluate multiple integrals in various coordinate systems
- Apply the concepts of gradient, divergence and curl to formulate engineering problems
- Apply Conversion of line integrals into area integrals and surface integrals into volume integrals
- Apply Laplace transforms to solve physical problems arising in engineering

## DETAILED SYLLABUS

### UNIT- I

**Integral Calculus:** Convergence of improper integrals; Beta and Gamma integrals; Differentiation under integral sign; Double and Triple integrals - computation of surface areas and volumes; change of variables in double and triple integrals. **RBT Levels: L2.**

### UNIT- II

**Vector Calculus:**Scalar and vector fields; vector differentiation; level surfaces; directional derivative; gradient of a scalar field; divergence and curl of a vector field; Laplacian; Line and Surface integrals; Green's theorem in a plane; Stoke's theorem; Gauss Divergence theorem. **RBT Levels: L2.**

### UNIT-III

**Laplace Transforms:** Laplace transforms; inverse Laplace transforms; Properties of Laplace transforms; Laplace transforms of unit step function, impulse function, periodic function; Convolution theorem; **RBT Levels: L2.**

### UNIT-IV

**Applications of Laplace transforms:** - solving certain initial value problems, solving system of linear differential equations, finding responses of systems to various inputs viz. sinusoidal inputs acting over a time interval, rectangular waves, impulses etc. **RBT Levels: L2.**

## TEXT BOOKS

1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Fifth Edition, Narosa Publishing House, 2016

## REFERENCE BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Eighth Edition, John Wiley and Sons, 2015
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 2015

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# BASIC ELECTRICAL ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **II** | **Internal Assessment** | **:** | **40** |
| **Course Code** | **:** | **UEETC20111** | **End Sem. Exam** | **:** | **60** |
| **Teaching Hours/Week (L:T:P)** | **:** | **3:1:0** | **Exam Duration (Hours)** | **:** | **2.5** |
| **Credits : 04** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Apply basic laws and analyse DC electrical circuits.
- Apply basic laws and analyse AC electrical circuits.
- Understand electrical machines working principle and their applications.
- Understand LT and domestic electrical safety, wiring and different measuring instrument and their use.

## DETAILED SYLLABUS

### UNIT-I

**Basics of DC Circuits:** D. C. Circuits covering, Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited by independent voltage sources; Power and energy; Electromagnetism covering, Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields. **RBT Levels: L3.**

### UNIT-II

**Basics of AC Circuits:**Single Phase A.C. Circuits covering, Generation of sinusoidal voltage-definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Three Phase A.C. Circuits covering, Necessity and Advantages of three phase systems.**RBT Levels: L3.**

### UNIT-III

**DC and AC Machines:** DC Machines, working principle of DC machine as a generator and a motor; Types of DC Machines and constructional features; EMF equation of generator.
Transformers, Principle of operation and construction of single phase transformers (core and shell types). Synchronous Generators, Principle of operation of ). Synchronous Generators. Three phase Induction motor principle of operation.
.**RBT Levels: L3.**

### UNIT-IV

**Basics of Electrical components and Protective devices:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Batteries, Elementary calculations for energy consumption. Lamps- fluorescent, CFL, LED. Electrical measuring instruments principle and applications- energy meter, megger, tong tester. Electrical Wiring. **RBT Levels: L3**

**TEXT BOOKS**


1. Ritu Sahdev (2022), Basic Electrical Engineering, Khanna Book Publishing.
2. Nagrath I.J. and D. P. Kothari (2001), Basic Electrical Engineering, Tata McGraw Hill.


**REFERENCE BOOKS**


1. Hayt and Kimberly, Engineering Circuit Analysis, Tata McGraw Hill


**ONLINE RESOURCES**

1. https://ieeexplore.ieee.org

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 40 Marks)**

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc. will be conducted. Appropriate marks weightage will be given as per the decision of concern faculty.

**B. End Sem Examination (Weightage 60 Marks)**

- End semester examination will be conducted by giving proper weightage for all units as per decision of concern faculty.

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# OBJECT-ORIENTED PROGRAMMING USING JAVA

| | | | |
|---|---|---|---|
| **Semester :** | **II** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEECC20112** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **2:0:2** | **Exam Duration (Hours) :** | **03** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Explain the features and object oriented concepts in JAVA programming
- Demonstrate proficiency in writing simple programs involving branching and looping structures.
- Design a class involving data members and methods for the given scenario and develop simple programs based on polymorphism and inheritance.
- Apply the concepts of inheritance and interfaces in solving real world problems and use the concept of packages and exception handling in solving complex problem

## DETAILED SYLLABUS

### UNIT-I

**An Overview of Java:** Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

**Data Types, Variables, and Arrays:** The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays.

**Operators:** Arithmetic Operators, Relational Operators, Boolean Logical Operators, the Assignment Operator, Operator Precedence, Using Parentheses.

**Control Statements:** Java's Selection Statements (if, switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop,Nested Loops), Jump Statements (Using break, Using continue, return). **RBT Levels: L2**

### UNIT-II

**Introducing Classes:** Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection.

**Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes. **RBT Levels: L2.**

## UNIT-III

**Inheritance:** Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.

**Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods. **RBT Levels: L3**

## UNIT-IV

**Packages:** Packages, Packages and Member Access, Importing Packages.
**Exceptions:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions. **RBT Levels: L3.**

## TEXT BOOKS


1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.


## REFERENCE BOOKS


1. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.
2. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008.
3. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with java, Tata
McGraw Hill education private limited.
4. Anita Seth and B L Juneja, JAVA One step Ahead, Oxford University Press, 2017.


## ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ENGINEERING GRAPHICS & DESIGN

| | | | |
|---|---|---|---|
| **Semester :** | **II** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC20113** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **2:0:2** | **Exam Duration (Hours) :** | **03** |
| **Credits : 03** | | | |

## COURSE OUTCOMES:

This course will enable students to:

- Understand the difference between engineering and artistic drawing
- Understand the points placing with all quadrant systems and the lines with all quadrant systems.
- Apply the concepts of planes to draw the projections.
- Apply the concepts of solids to draw the projections.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to Computer Aided Sketching**: Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Introduction to standard tool bar/menus. Dimensioning conventions. etc. in open source software. **RBT Levels: L2**

### UNIT-II

**Orthographic Projections:** Projections of points ($1^{st}$ , $2^{nd}$ $3^{rd}$ and $4^{th}$ angle projection ), Projections of straight lines (First Angle Projection), True and apparent lengths.**RBT Levels: L2.**

### UNIT-III

**Orthographic Projections of Plane Surfaces**: Projections of plane surfaces. (First Angle Projection), True and apparent lengths. **RBT Levels: L2.**

### UNIT-IV

**Orthographic Projections of solids**: Projections of solids. **RBT Levels:L3.**

## TEXT BOOKS


1. Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.

2. A Primer on Computer Aided Engineering Drawing-2006, Published by VTU, Belgaum.
3. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer .

## REFERENCE BOOKS

1. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
2. Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
3. Engineering Graphics & Design, A.P. Gautam & Pradeep Jain Khanna Publishing House
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers. (Corresponding set of) CAD Software Theory and User Manuals.

5. Graphics for Design and Production- by Luzadder Warren J., Duff John M., Eastern Economy
6. Edition, 2005- Prentice Hall of India Pvt. Ltd., New Delhi.
7. Engineering Graphics by K.R. Gopalakrishna, 32nd edition, 2005- Subash PublishersBangalore.

## ONLINE RESOURCES

1.https://nptel.ac.in/courses/112/103/112103019/#

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# UNIVERSAL HUMAN VALUES

| | | | |
|---|---|---|---|
| **Semester :** | **II** | **Internal Assessment :** | **10** |
| **Course Code :** | **UEETV20114** | **End Sem. Exam :** | **15** |
| **Teaching Hours/Week (L:T:P) :** | **1:0:0** | **Exam Duration (Hourse) :** | **01** |
| **Credits : 01** | | | |

## COURSE OUTCOMES

- Develop new ways of creative thinking
- Understand the innovation cycle of Design Thinking process for developing innovative products.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) ,Understanding Value Education, Happiness and Prosperity – Current Scenario,Harmony in the Nature/Existence.
**RBT Levels: L2.**

### UNIT-II

**Harmony in the Human Being**: Understanding Human being as the Co-existence of the Self and the Body ,Distinguishing between the Needs of the Self and the Body , The Body as an Instrument of the Self Understanding Harmony in the Self ,Programme to ensure self-regulation and Health, Implications of the Holistic Understanding.
**RBT Levels: L2.**

## TEXT BOOKS


1. The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. The Teacher’s Manual- Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53.

## REFERENCE BOOKS


1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **10 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **15 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# BASIC ELECTRICAL ENGINEERING LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **II** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEEPC20115** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **3** |
| **Credits : 02** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Identify the common electrical components and measuring instruments used for conducting
- Calculate and Analyze power consumed and power factor of lamps.
- Determine the impedance of an electric circuit and power consumed in a three-phase load.
- Measure the earth resistance and understand the usage of Megger.
- Understanding the difference between single phase and three phase systems.

## LIST OF EXPERIMENTS

| Sl. No. | Experiment Name |
|---|---|
| 1. | Understanding basic electrical components, tools, domestic wiring and meters. |
| 2. | Measurement of current,power, and power factor of incandescent lamp, Fluorescent lamp and LED lamp. |
| 3. | Measurement of resistance and inductance of a choke using 3 voltmeter method. |
| 4. | Verification of KCL and KVL for DC Circuit. |
| 5. | Study of effect of open and short circuit in simple circuit. |
| 6. | Two way and three-way control of lamp and formation of truth table. |
| 7. | Measurement of earth resistance and understanding the usage of megger. |
| 8. | Measurement of three phase power using two wattmeter method |
| 9. | Determination of phase and line quantities in three phase star and delta connected load. |
| 10. | Demonstration of cut-out sections of AC & DC machines. |
| 11. | Demonstration of significance of Pipe and Plate Earthing |
| 12 | Demonstration of Solar Energy Generation and its measurement. |

## TEXT BOOKS

1. Ritu Sahdev (2022), Basic Electrical Engineering, Khanna Book Publishing.

**REFERENCE BOOKS**

1. Nagrath I.J. and D. P. Kothari (2001), Basic Electrical Engineering, Tata McGraw Hill.
2. Hayt and Kimberly, Engineering Circuit Analysis, Tata McGraw Hill.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **20 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ENGINEERING WORKSHOP

| | | | |
|---|---|---|---|
| **Semester :** | **II** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC20116** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **03** |
| **Credits : 02** | | | |

## COURSE OUTCOMES

Upon completion of this laboratory course, students will be able:

- Perform fabrication of components with their own hands.
- Understand the practical knowledge of the dimensional accuracies
- Understand dimensional tolerances possible with different manufacturing processes.
- Develop small devices of their interest by assembling different components

## LIST OF EXPERIMENTS

1. Practicles in
   -Fitting, soldering, welding and cutting, casting, 3D printing, electrical wiring, raspberry pi and adrino etc.
2. Soldering of different components
3. Fitting of different composnets
4. Electical wiring
5. Sheet metal cutting and Joining
6. 3D Modelling of a single component
7. Assembly of CAD modelled Components
8. 3D Priting of modeled components
9. Inspection and defect analysis of the additively manufactured product.
10. Comparison of Additively manufactured product with conventional manufactured
11. counterpart.
12. Casting (Demostration)
13. Welding shop (Arc welding + Gas welding). (Demostration)
14. Raspberry pi and adrino etc. (Demostration)

**Text Book:**

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

**Reference Books:**

1. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.

2. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
4. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **20 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# SEMESTER- III
## ELECTRICAL MACHINES - I

| | | | |
|---|---|---|---|
| **Semester :** | **III** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC30201** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- Comprehend the nomenclature and principles related to the concepts of energy balance and various excited systems
- Elucidate the principle of operation, characteristics, and parallel operation of DC Generators
- Analyze the starting methods, speed control, and testing methods under different conditions of a given DC motor
- Explain the principle of operation, performance,testing methods, and parallel operation aspects of single & three - phase transformer

**DETAILED SYLLABUS**

**UNIT-I**

**Electromechanical energy conversion:** Introduction to Magnetic circuits, forces and torques in magnetic field system, energy balance, singly excited and multiple excited magnetic systems, co-energy. **RBT Levels: L2.**

**UNIT-II**

**DC Generators:** Constructional features and Principle of operation of a DC Generators, armature windings diagram (Lap and Wave winding), analysis of EMF equation of a DC generator, Armature reaction and its effects, commutation, methods of excitation and classification of DC generators, Performance of DC generators. **RBT Levels: L4.**

**UNIT-III**

**DC Motors:** Construction and operation of DC motor, back EMF, electromagnetic torque, types of DC motors, characteristics, analysis of speed control methods, necessity of starters DC motors, Testing of DC motors (Efficiency, Regulation and Testing) and applications. **RBT Levels: L4.**

**UNIT-IV**

**Single Phase Transformer:** Construction and operation of single phase transformer, EMF equation, Equilent circuit, phaser diagrams, Testing methods of transformers,voltage regulation and efficiency, Parallel operation of transformer.

**Three-Phase Transformers:** Construction, types of connection and their comparative features, Scott connection. Auto transformer and Tap-changing transformers**RBT Levels: L4.**

## TEXT BOOKS


1. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
2. M. G. Say, and E.O. Taylor, “Direct Current Machines”, Pitman Publishing, 1980.


## REFERENCE BOOKS


1. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. Ashfaq Hussain “Electrical Machines”, 3rd Edition, Danpat Rai and sons, 2012.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. J.B Gupta, “Theory and performance of electrical machines”, 14th Edition, S.K. Kataria & Sons, 2014.


## ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_ee71/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee24/preview

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ELECTRO MAGNETIC FIELDS

| | | | |
|---|---|---|---|
| **Semester :** | **III** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC30202** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

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

- Identify differential coordinate elements for the various electric and magnetic field applications
- Estimate the flux density, field intensity of electric and magnetic fields for various charges.
- Analyze the time varying and static electric and magnetic fields for various charges.
- Select the suitable time varying Maxwells equation for real-time application of electromagnetism.

## DETAILED SYLLABUS

### UNIT-I

**Review of Vector Analysis**: Introduction To Scalars And Vectors. Coulomb's Law And. Electric Field Intensity: Experimental Law Of Coulomb, Electric Field Intensity, Field Due To Continuous Volume Charge Distribution, Field Of A Line Charge, Field Of A Sheet Charge. Electric Flux Density, Gauss'Law ,Maxwell's first equation (Electrostatics), vector operator V , Gauss Divergence Theorem.**RBT Levels: L3**

### UNIT-II

**Energy and Potential and Conductors:** Energy expended in moving a point charge in an electric filed, the line integral, definition of potential difference and potential. The potential field of a point charge and system of charges, potential gradient. Uniqueness theorem. Metallic conductors, Conductor properties , Current and current density, continuity of current. **RBT Levels: L4.**

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### UNIT-III

**The Steady Magnetic Field:** Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density. Poisson's and Laplace's Equations. Magnetic Forces: Force on a moving charge and differential current element, force between differential current elements, Force and torque on a closed circuit. **RBT Levels: L4.**

### UNIT-IV

**Materials and Inductance: :** Types of Magnetic materials and its Properties, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials. Time Varying Fields and Maxwell's Equations: Faraday's law,

displacement current, Maxwell's equation in Differential form and Integral form.. **RBT Levels: L4.**

## TEXT BOOKS AND REFERENCE BOOKS

1. WilliamH.Hayt Jr. and JohnABuck, "Engineering Electromagnetics", 17th - edition,Tata McGrawHill, 2012.
2. John Karuss and Daniel A Fleisch, "Electromagnetics with Applications"VeditionMcGraw-Hill,1999.

## REFERENCE BOOKS

1. Edward C. Jordan and Keith G Balmain, "Electromagnetic Waves and Radiating Systems," II- edition, Prentice Hall of India / Pearson Education, 1968. Reprint 2002.
2. Dr. D. Ganesh Rao, "Field Theory" Sanguine Technical Publishers, 1st Edition, 2014.
3. Mathew N.O., Sadiku, - Elements of Electromagnetics, Oxford Press University, 4th Edition
4. N. Narayana Rao, - Fundamentals of Electromagnetics for Engineering, Pearson

## ONLINE RESOURCES

1. NPTEL and other online courses

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Sem Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ELECTRICAL CIRCUIT ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **III** | **Internal Assessment** | **:** | **40** |
| **Course Code** | **:** | **UEETC30203** | **End Sem. Exam** | **:** | **60** |
| **Teaching Hours/Week (L:T:P)** | **:** | **3:1:0** | **Exam Duration (Hours)** | **:** | **2.5** |
| **Credits : 04** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand the concept network reduction, super node and super mesh.
- Apply the basic electrical concept for analysis of courses.
- Analyze and simplifying network parameters using network theorems.
- Analysis of transient behaviour of networks and two port network parameters and their conversion.

## DETAILED SYLLABUS

### UNIT-I

**Basic Concepts of Circuit Analysis:**Practical sources, Source transformations, Network reduction using Star–Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.**RBT Levels: L4.**

### UNIT-II

**Network Theorems:** Superposition, Reciprocity, Millman's theorems, Thevinin's and Norton's theorems, Maximum Power transfer theorem and Millers Theorem **RBT Levels: L4.**

### UNIT-III

**Transient Behavior and Initial Conditions:** Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RLC circuits for AC and DC excitations. Laplace Transformation & Applications: Solution of networks, step, ramp and impulse responses. **RBT Levels: L4.**

### UNIT-IV

**Two Port Network Parameters:** Definition of z, y, h and transmission parameters, modelling with these parameters, relationship between parameters sets. **RBT Levels: L4**

**TEXT BOOKS**


1. William Hayt, J. E. Kemmerly, J. D. Philips and S. M. Durbin, *Engineering Circuit Analysis*, Mc-Graw Hill 9th Edition, 2020.
2. .Roy Choudhury, *Networks and Systems*, 2nd Edition, New Age International Publications, 2006.


**REFERENCE BOOKS**


1. M. E. Van Valkenberg, *Network Analysis*, Prentice Hall of India, 3rd Edition, 2000.


**ONLINE RESOURCES**

1. https://nptel.ac.in/courses/108/105/108105159/

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 40 Marks)**

Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc. will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

**B. End Sem Examination (Weightage 60 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per decision of concerned faculty.

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# SIGNALS AND SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **III** | **Internal Assessment** | **:** | **30** |
| **Course Code** | **:** | **UEETC30204** | **End Sem. Exam** | **:** | **45** |
| **Teaching Hours/Week (L:T:P)** | **:** | **3:0:0** | **Exam Duration (Hours)** | **:** | **2** |
| **Credits : 03** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand Continuous time and discrete time Linear shift-invariant (LSI) systems.
- Apply differential equations for system representation through.
- EvaluateFourier series representation for various signals.
- Analysis of Laplace Transform for continuous time signals and systems.

## DETAILED SYLLABUS

### UNIT-I

**Introduction and Classification of signals:** Definition of signal and systems, communication, and control system as examples Classification of signals. Basic Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shift, and time reversal. Elementary signals/Functions: Exponential, sinusoidal, step, Impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals. **RBT Levels: L3**.

### UNIT-II

**System Classification and properties:** Linear-nonlinear, Time variant-invariant, causal-non causal, static-dynamic, stable-unstable, invertible. Time – Domain Representations for LTI Systems: Convolution, impulse response, properties, solution of differential and difference equations, block diagram representation.**RBT Levels: L4.**

### UNIT-III

**The Continuous-Time Fourier Transform:** Representation of a non -periodic signals: continuous-time Fourier transform (FT), Properties of continuous-time Fourier transform, Applications. The Discrete-Time Fourier Transform: Representations of non-periodic signals: The discrete time Fourier transform (DTFT), Properties of DTFT and applications.**RBT Levels: L4.**

### UNIT-IV

**Z- Transforms:** Introduction, Z-transform, properties of ROC, properties of Z transforms, inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations..**RBT Levels: L4**

**TEXT BOOKS**

1. R. Anand, Signals and Systems, Khanna Publishing House, 2019

**REFERENCE BOOKS**


1. A.V. Oppenheim, A.S. Willsky and I.T. Young,"Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998


**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc. will be conducted. Appropriate marks weightage will be given as per the decision of concern faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per decision of concern faculty.

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# ELECTRICAL MACHINES LAB- I

| | | | |
|---|---|---|---|
| **Semester :** | **III** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC30205** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **03** |
| **Credits : 02** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Comprehend the nomenclature and principles related to the concepts of energy balance and various excited systems
- Elucidate the principle of operation , characteristics and parallel operation of DC Generators
- Analyze the starting methods , speed control and testing methods under different conditions of a given DC motor
- Explain the principle of operation, performance ,testing methods and parallel operation aspects of single & three - phase transformer

## List of Experiments

| Sl.No | List of Experiments- |
|---|---|
| 1. | Demonstration on cross sectional view of DC Machines. |
| 2. | Load test on DC shunt motor to draw speed–torque and horse power–efficiency characteristics. **RBT Level: L1-L4** |
| 3. | Speed control of DC shunt motor by armature and field control. **RBT Level:L1- L3** |
| 4. | Swinburne's Test on DC motor. **RBT Level: L1-L3** |
| 5. | Field Test on DC series machines. **RBT Level:L1- L3** |
| 6. | Load test on DC Compoud motor to draw speed–torque and horse power–efficiency characteristics. **RBT Level: L1-L4** |
| 7. | Retardation test on DC shunt motor. **RBT Level:L1- L3** |
| 8. | Load Characteristics of DC Shunt Generator. **RBT Level:L1- L3** |
| 9 | Magnetization Characteristics of DC Shunt Generator. **RBT Level:L1- L3** |
| 10. | Hopkinson’s Test on DC Shunt machines. **RBT Level:L1- L3** |
| 11. | Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit. **RBT Level: L1-L4** |
| 12. | Polarity and Turns Ratio test on single phase transformer. **RBT Level:L1- L3** |

## TEXT BOOKS


1. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
2. M. G. Say, and E.O. Taylor, “Direct Current Machines”, Pitman Publishing, 1980.

## REFERENCE BOOKS


1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. Ashfaq Hussain "Electrical Machines", 3rd Edition, Danpat Rai and sons, 2012.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. J.B Gupta, "Theory and performance of electrical machines", 14th Edition, S.K. Kataria & Sons, 2014.


## ONLINE RESOURCES

- https://onlinecourses.nptel.ac.in/noc21_ee71/preview
- https://onlinecourses.nptel.ac.in/noc21_ee24/preview

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment test will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concern faculty.

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| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# PROGRAMMING WITH PYTHON

| | | | |
|---|---|---|---|
| **Semester :** | **III** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEECC30206** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **2:0:2** | **Exam Duration (Hours) :** | **03** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Describe the constructs of python programming and use looping and conditional constructs to build python programs.
- Apply the concept of data structure to solve the real world problem.
- Develop programs using functions and modules.
- Apply the NumPy, Pandas and Matplotlib packages for data analytics.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to Python:** History of Python, Features and Future of Python, Variables and Assignement statement, Data types, Keywords, Operators & Expressions, Simple input/output statements.

**RBT Levels: L2**

### UNIT-II

**Decision Control Statements:** Conditional branching statements (if, if-else,nested if-else and if-elif-else), Looping structures (while, for), Jump statements (break, continue, pass)

**Data Structures:** Lists, Tuples, Sets and Dictionaries: Operations.

**RBT Levels: L3**

### UNIT-III

**Functions**: - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Lambda or Anonymous Functions, Scope of the Variables in a Function - Global and Local Variables.

**Modules**: Creating modules, import module and name spacing. Packages in python.

**RBT Levels: L3**

### UNIT-IV

**GUI Programming:** Introduction to Tkinter and Python Programming. Simple GUI building. **Data Analytics with Python:** Introduction to python packages NumPy, SciPy, Pandas, Matplotlib and Scikit-Learn. **RBT Levels: L4.**

## TEXT BOOKS

1. Reema Thareja, “Python Programming using problem solving approach”, Oxford university press, 2017
2. S. Sridhar, J. Indumathi, V.M. Hariharan “Python Programming” Pearson publishers, 1st edition 2023

**REFERENCE BOOKS**

1. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, CreateSpace Independent Publishing Platform, 2016.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015.
3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt. Ltd. ISBN-13: 978-8126556014
4. Mark Lutz, “Programming Python”, 4th Edition, O’Reilly Media, 2011. ISBN-13: 978-9350232873
5. Fabio Nelli, “Python Data Analytics”, Apress, Publishing, 1st Edition, 2015.
6. Paul Deitel and Harvey deitel,”Intro to Python for Computer Science and Data science”, 1st edition Pearson Publisher 2020.

**ONLINE RESOURCES**

1. https://nptel.ac.in/courses/106/106/106106182/

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc., will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ELECTRICAL CIRCUIT ANALYSIS LAB

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **III** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEEPC30207** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **3** |
| **Credits : 02** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Analyze & experimentally verify various Network Theorems.
- Analyze & experimentally verify various resonance phenomenon.
- Apply and experimentally analyze two port network parameters.
- Analyze various current locus diagrams and simulate the DC & AC Circuits.

## LIST OF EXPERIMENTS

| Sl. No. | Experiment Name |
|---|---|
| 1. | Verification of Thevenin's Theorem |
| 2. | Verification of Norton's Theorem |
| 3. | Verificaton of Superposition Theorem |
| 4. | Verification of Millman's Theorem |
| 5. | Determination of Resonance Frequency of Parallel RLC Circuit |
| 6. | Determination of Resonance Frequency of Series RLC Circuit |
| 7. | Locus Diagram of RL Series Circuits |
| 8. | Locus Diagram of RC Series Circuits |
| 9. | Determination of Z and Y Parameters |
| 10. | Determination of Transmission and Hybrid parameters |
| 11. | Simulation of AC Circuits |
| 12. | Simulation of DC Circuits |

## TEXT BOOKS


1. Valkenburg, Van "Network Analysis", PHI
2. W. H. Hayt and J. E. Kemmerly, ―Engineering Circuit Analysis, McGraw Hill Education, 2013.
3. Kuo, F.F., "Network Analysis", John Wiley and Sons Inc..

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment test will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concern faculty.

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# INDIAN KNOWLEDGE SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **III** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEETV30208** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **2:0:2** | **Exam Duration (Hours) :** | **1.5** |
| **Credits : 02** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Describe the ancient discovery and research in physics, chemistry, mathematics, metallurgy, astronomy, architecture, textile, transport, agriculture and Ayurveda.
- Develop the ancient knowledge systems to make meaningful contribution to development of science today.

## DETAILED SYLLABUS

### UNIT-I

**Indian Traditional Knowledge**; Introduction to the Science and way of doing science and research in India, Ancient Sciencein Intra & Inter Culture Dialogue & coevolution.Traditional agricultural practices, Traditional water-harvesting practices, TraditionalLivestock and veterinary Sciences Traditional Houses & villages, Traditional Forecasting,Traditional Ayurveda & plant based medicine, Traditional writing Technology.Physics, Chemistry and Mathematics in India.**RBT Levels: L2**

### UNIT-II

**Ancient Indian Science (metallurgy, Astronomy, Architecture):**

Metallurgy in India: Survarṇa(gold) and its different types, prosperities, Rajata(silver),Tamra(copper), Loha(iron), Vanga(tin), Naga / sisa(lead), Pittala(brass). Astronomy in India Vedang Jyotish, aryabhatta siddhanta, Mahabhaskriya,Laghubhaskariya, vatesvarasiddhanta, Sisyadhivrddhida, Grahashyay, Goladhyaya, Architecture in India: Nagara (northern style), Vesara (mixed style), and Dravida (southernstyle), Indian vernacular architecture, Temple sytle, cave architecture, rock cut architecture,kalinga architecture, chandels architecture, rajput architecture, jain architecture.

.**RBT Levels: L2**

### UNIT-III

**Ancient Indian Science (Textile, Agriculture, Transport):**Textile Technology in India: Cotton (natural cellulose fiber), silk, wool (natural protein fibers), bast and leaf fibers.Agriculture in India: krishisuktas, Krishiparashara, Brihatsamhita, Types of crops,Manures, Types of land- devamatruka, nadimatruka, use of animals in warfare, animalhusbandry, Animals for medicines.Ancient transport in Indias.

**RBT Levels: L2**

## TEXT BOOKS

1. Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru.

**REFERENCE BOOKS**

1. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of
   Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.
2. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.
3. SK Das, The education system of Ancient hindus, Gyan publication house, India
4. R P Kulkarni, Glimpese of Indian Engineering and Technology (Ancient & Medieval period,
   Munshiram Manoharlal Publishers Pvt. Ltd. 2018

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc., will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# SEMESTER- IV

## ELECTRICAL MACHINES - II

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC40209** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

### COURSE OUTCOMES

After the completion of this course, the student will be able to

- Acquire the knowledge of Constructional and operational features of ac machines.
- Understand the various starting methods and speed control of ac machines.
- Explain the concepts of ac machines.
- Describe the performance characteristics and applications of ac machines.

### DETAILED SYLLABUS

### UNIT-I

**Three phase Induction Motors:** Construction and Operational of features of Induction Motors, equivalent circuit, torque expression, starting torque, maximum torque, torque-slip characteristics, parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency), cogging and crawling, power flow, losses and efficiency, no load and blocked rotor test-Numerical predetermination of performance characteristics using circle diagram, Starting methods, Speed control methods from stator and rotor side.**RBT Levels: L2.**

### UNIT-II

**Classification of three Phase Induction Generators**

**Single-phase induction motors :** Constructional features double field revolving theory, Split phase, Shaded pole and Capacitor type motors, equivalent circuit, applications**. RBT Levels: L4.**

### UNIT-III

**Synchronous generators:** Constructional features of Synchronous generator, Types of rotors - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, open circuit, short circuit and zero power factor characteristics, voltage regulation by EMF, MMF and ZPF method, Salient pole alternators two reaction theory, Phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division. Analysis of short circuit current wave form – determination of sub-transient, transient and steady state reactance's. **RBT Levels: L4.**

### UNIT-IV

**Synchronous motor :** Theory of Operation, methods of starting, variation of current and power factor with excitation. on no load and on load-V and inverted V curves. Hunting and its

prevention. Synchronizing power, Synchronous condenser. **RBT Levels:L4.**

**TEXT BOOKS**

1. M. G. Say, “Performanceand design of AC machines”, CBS Publishers, 2002.
2. Turan Gonen, “Electrical Machines with MATLAB”, CRC Press, 2012.

**REFERENCE BOOKS**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. Ashfaq Hussain “Electrical Machines”, 3rd Edition, Danpat Rai and sons, 2012.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. J.B Gupta, “Theory and performance of electrical machines”, 14th Edition, S.K. Kataria & Sons, 2014.

**ONLINE RESOURCES**

1. https://onlinecourses.nptel.ac.in/noc21_ee13/preview

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc. will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# POWER GENERATION, TRANSMISSION and DISTRIBUTION

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC40210** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand the working principles of different electric power generation plants and economics of power generation.
- To understand different types of transmission, insulators and computation of sag in the transmission lines.
- Analyze the transmission lines parameters and performance of lines.
- To understand the basics of power distribution

## DETAILED SYLLABUS

### UNIT-I

**Structure of electric power system: generation, transmission and distribution.**
**Introduction to different sources for electric power generation:** Hydroelectric power plants: Steam Power Plants, Diesel power plant:, Gas Turbine Power Plant, Nuclear Power Plant.etc. Economics of Generation.**RBT Levels: L3.**

### UNIT-II

Advantages of higher voltage transmission, A brief introduction to types of supporting structures and line conductors, types of insulators, potential distribution over a string of suspension insulators, insulating materials, Sag calculation, Introduction to Underground Cable. **RBT Levels:L3.**

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### UNIT-III

**Transmission Linesparameters:**Introduction to line parametersResistance, Inductance and capacitance of transmission lines, , classification of transmission lines, ABCD parameters,performance of transmission lines. Corona, Ferrenti effect. **RBT Levels:, L4**

### UNIT-IV

Distribution: Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated loads.. Reliability and Quality of Distribution System: . **RBT Levels:L3.**

**TEXT BOOKS**

1. A Course in Electrical Power, Sony Gupta and Bhatnagar, Dhanpat Rai
2. "Power Plant Engineering" P.K. Nag McGraw Hill 4th Edition, 2014.

**REFERENCE BOOKS**

1. "Generation of Electrical Energy" B. R. Gupta S. Chand 2015.
2. Electrical power Generation, Transmission and Distribution, S.N. Singh, PHI, 2nd Edition,2009
3. Principles of Power System, V.K. Mehta, Rohit Mehta, S. Chand
4. Power System Analysis and Design, J. Duncan Gloverat el, Cengage Learning, 4th Edition 2008
5. Electrical Power, S.L.Uppal, Khanna Publication
6. Electrical Power Systems, C. L. Wadhwa, New Age, 5th Edition, 2009
7. Electrical Power Systems, Ashfaq Hussain, CBS Publication
8. Electric Power Distribution, A.S. Pabla, McGraw-Hill, 6th Edition,2012

**ONLINE RESOURCES**

1. NPTEL and other Online courses

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc. will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# LINEAR CONTROL SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **IV** | **Internal Assessment** | **:** | **30** |
| **Course Code** | **:** | **UEETC40211** | **End Sem. Exam** | **:** | **45** |
| **Teaching Hours/Week (L:T:P)** | **:** | **3:0:0** | **Exam Duration (Hours)** | **:** | **02** |
| **Credits : 03** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Develop the mathematical model of Mechanical and Electrical systems.
- Determine transfer function for a given control system using block diagram reduction techniques and signal flow graph method.
- Analyze the time domain specifications for first and second order systems.
- Illustrate the stability of a system in the time domain using Routh-Hurwitz criterion.
- Evaluate the stability of a system in the frequency domain using Nyquist and Bode plots.

## DETAILED SYLLABUS

### UNIT-I

**Introduction:** Types of control system, Effect of feedback system, Differential equation of physical systems –Mechanical systems, Electrical systems, Electromechanical systems, Analogous systems. **RBT Levels: L3.**

### UNIT-II

**Block diagrams and Signal flow graphs:** Transfer functions, Block diagram algebra and signal flow graphs

**Time Response of feedback control systems:** Standard test signals, Unit step response of First and Second order Systems.**RBT Levels: L3.**

### UNIT-III

**Time domain analysis:** Time response specifications of second order systems, steady state errors and error constants, Introduction to PI, PD and PID controllers (Excluding design).

**Stability Analysis:** Concept of stability, necessary conditions for stability, Routh stability criterion, Introduction to Root-Locus Techniques, construction of root locus.**RBT Levels: L4.**

### UNIT-IV

**Frequency domain analysis and Stability:** Correlation between time and frequency response, Bode plots, Introduction to lead, lag and lead-lag compensating network (excluding design).

**Introduction to state variable analysis:** Concept of state, state variable and state models for electrical systems. **RBT Levels: L4**

**TEXT BOOKS**


1. J. Nagarath and M. Gopal, - Control System Engineering, New Age International (P) Limited, Publishers, Fifth Edition – 2005, ISBN: 81-224-2008-7.


**REFERENCE BOOKS**


1. Benjamin, C. Kuo -Automatic Control Systems, John Wily India PVT. Ltd., 8th Edition, 2008.
2. K. Ogata, - Modern Control Engineering, Pearson Education Asia / PHI, 4th Edition, 2002,


**ONLINE RESOURCES**

1. www.teoma.co.uk
2. https://ieeexplore.ieee.org

**COURSE ASSESSMENT**

**A. Continuous Assessment (Weightage 30 Marks)**

Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc., will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

**B. End Sem Examination (Weightage 45 Marks)**

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ANALOG & DIGITAL ELECTRONICS

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC40212** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES:**

After completing this Course, the students should be able to:

- Design the linear and non-linear applications of Op-Amp circuits.
- Design & analyze modular combinational circuits with MSI devices like MUX/DEMUX, Decoder, Encoder, etc.
- Design & analyze synchronous sequential logic circuits with FFs and combinatorial circuits
- Design & analyze modular combinational circuits with MSI devices like MUX/DEMUX, Decoder, Encoder, etc..

## DETAILED SYLLABUS

### UNIT-I

**Op-Amp Parameters Circuits with resistive feedback:** Concept of feedback & their types, Inverting & non-inverting configurations, current to voltage converters, voltage to current converters, summing amplifier, difference amplifier, and instrumentation amplifier.

**Non-linear Circuits:** Schmitt trigger, Voltage comparators, sample & hold circuits, Integrators & differentiators, Clippers and Clampers Feedback & Oscillator Circuit: Effect of positive and negative feedback. **RBT Levels: L3**.

### UNIT-II

**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, digital comparator, parity checker/generator, code converters, priority encoders, Q-M method of function realization.**RBT Levels: L3**

### UNIT-III

**Sequential Circuits & Systems**: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flipflops, applications of flip flops, shift registers,

applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, asynchronous sequential counters, applications of counters. **RBTLevels:L3.**

**UNIT-IV**

**A/D and D/A Converters: Digital to analog converters:** weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs algorithm. **RBT Levels: L3.**

## TEXT BOOKS

1. A.K. Maini, “Analog Electronics”, Khanna Book Publishing Co., 2022.
2. A.V.N. Tilak, “Design of Analog Circuits”, Khanna Book Publishing Co., 2022.
3. Aditya Chaturvedi, “Fundamentals of Digital Electronics”, Khanna Book Publishing, 2016.

## REFERENCE BOOKS

1. Thomas L Floyd, “Electronic Devices”, 10th edition, Pearson, 2017.
2. G.B. Clayton, “Operational Amplifiers”, International Edition, 2nd Edition,1979.
3. Behzad Razavi, “Fundamentals of Microelectronics”, Second Edition; Wiley, 2016.
4. Ramakant A Gaikwad, “Op-Amps and Linear Integrated Circuits”, PHI, 4th edition, 2016.

## COURSE ASSESSMENT

### A. Continuous Assessment (Weightage 30 Marks)

Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc., will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

### B. End Sem Examination (Weightage 45 Marks)

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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|---|---|---|
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# ELECTRICAL MACHINES LAB- II

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC40214** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **03** |
| **Credits : 02** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- Comprehend the nomenclature and principles related to the concepts of energy balance and various excited systems
- Elucidate the principle of operation , characteristics and parallel operation of DC Generators
- Analyze the starting methods , speed control and testing methods under different conditions of a given DC motor
- Explain the principle of operation, performance ,testing methods and parallel operation aspects of single & three - phase transformer

## List of Experiments

| Sl.No | List of Experiments- |
|---|---|
| 1 | Separation of hysteresis and eddy current losses in single phase transformer **RBT Level: L1-L3** |
| 2 | Sumpner's test on similar transformers and determination of combined and individual transformer efficiency. **RBT Level:L1- L3** |
| 3 | Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load. **RBT Level:L1- L3** |
| 4 | Scott connection with balanced and unbalanced loads. **RBT Level: L1-L3** |
| 5 | Load test on three phase induction motor. **RBT Level: L1-L3** |
| 6 | No-load and Blocked rotor test on three phase induction motor to draw (i) Equivalent circuit. (ii) Circle diagram. Determination of performance parameters at different load conditions **RBT Level: L1-L4** |
| 7 | Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics. **RBT Level: L1-L4** |
| 8 | Break test on single phase induction motor. **RBT Level: L1-L3** |
| 9 | Conduct an experiment to draw **'V'** and Inverted **'V'** curves of synchronous motor at no load and load conditions. **RBT Level: L1-L4** |
| 10 | Voltage regulation of an alternator by ZPF method. **RBT Level:L1- L3** |

| | |
|---|---|
| 11 | Voltage regulation of an alternator by EMF and MMF methods. **RBT Level:L1- L4** |
| 12 | Load Test on three phase synchronous motor. **RBT Level:L1- L3** |
| 13 | Power angle curve of synchronous generator or Direct load test on three phase synchronous generator to determine efficiency and regulation. **RBT Level:L1- L4** |
| 14 | Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines. **RBT Level: L1- L4** |
| 15 | Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa. **RBT Level:L1- L4** |

**TEXT BOOKS**


1. M. G. Say, “Performanceand design of AC machines”, CBS Publishers, 2002.
2. Turan Gonen, “Electrical Machines with MATLAB”, CRC Press, 2012.


**REFERENCE BOOKS**


1. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. Ashfaq Hussain “Electrical Machines”, 3rd Edition, Danpat Rai and sons, 2012.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. J.B Gupta, “Theory and performance of electrical machines”, 14th Edition, S.K. Kataria & Sons, 2014.


**ONLINE RESOURCES**

- https://onlinecourses.nptel.ac.in/noc21_ee71/preview
- https://onlinecourses.nptel.ac.in/noc21_ee24/preview

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment test will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concern faculty.

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|---|---|---|
| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# CONTROL SYSTEMS LAB

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **IV** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEEPC40215** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **3** |
| **Credits : 02** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Using software package and discrete components in assessing the time and frequency domain response of a given second order system.
- Analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.
- Illustrate the performance characteristics of AC and DC servomotors
- Apply the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.

## LIST OF EXPERIMENTS

| Sl. No. | Experiment Name |
|---|---|
| 1. | Experiment to draw the speed torque characteristics of AC servo motor. |
| 2. | Experiment to draw the speed torque characteristics of DC servo motor. |
| 3. | Experiment to determine frequency response of a second order system. |
| 4. | To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response. |
| 5. | To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. |
| 6. | Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function. |
| 7. | Experiment to determine the time response of a second order system |
| 8. | To study a second order system and verify the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response. |
| 9. | (a) To simulate a typical second order system and determine step response and evaluate time response specifications.<br>(b) To evaluate the effect of adding poles and zeros on time response of second order system.<br>(c) To evaluate the effect of pole location on stability |

| | |
|---|---|
| 10. | (a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response.<br>(b) To study the effect of open loop gain on transient response of closed loop system using root locus. |
| 11. | (a) To study the effect of open loop poles and zeros on root locus contour<br>(b) Comparative study of Bode, Nyquist and root locus with respect to stability. |

**TEXT BOOKS**


1. J. Nagarath and M. Gopal, - Control System Engineering, New Age International (P) Limited,
   Publishers, Fifth Edition – 2005, ISBN: 81-224-2008-7.
2. K. Ogata, -Modern Control Engineering, Pearson Education Asia / PHI, 4th Edition, 2002


**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment test will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concern faculty.

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|---|---|---|
| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# ANALOG & DIGITAL ELECTRONICS LAB

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC40216** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **3** |
| **Credits : 02** | | | |

## COURSE OUTCOMES:

AftercompletingthisCourse, thestudentsshould beableto:

- Analyze the experimental characteristics of BJT, FET and MOSFET.
- Finding transfer characteristics of Differential Amplifier.
- Verifying experimental basic and universal gates operations.
- Conducting experimentations on different digital circuit operation like multiplexer and encoder.

## Experiments List:

1. Input and output Characteristics of BJT,FET & MOSFET.
2. Design of the Regulated Power Supplies.
3. Frequency response of CE,CB,CC and CS amplifiers
4. Differential Amplifier –Transfer Characteristics, CMRR Measurement
5. Cascaded Amplifiers.
6. Study and Verification of Basic Gates (AND, OR& NOT)
7. Study and Verification of Universal Gates (AND, OR& NOT)
8. Implementation of given Boolean function using logic gates.
9. Realization of Half Adder & Full Adder using Basic Gates
10. Realization of Half Subtractor & Full Subtractor using Basic Gates.
11. Multiplexer and De-multiplexer.
12. Encoder and Decoder

## TEXT BOOKS


1. A.K. Maini, “Analog Electronics”, Khanna Book Publishing Co., 2022.
2. A.V.N. Tilak, “Design of Analog Circuits”, Khanna Book Publishing Co., 2022.
3. Behzad Razavi, “Fundamentals of Microelectronics”, Second Edition; Wiley, 2016.
4. Ramakant A Gaikwad, “Op-Amps and Linear Integrated Circuits”, PHI, 4th edition, 2016.
5. Aditya Chaturvedi, “Fundamentals of Digital Electronics”, Khanna Book Publishing, 2016.

## REFERENCE BOOKS

1. Thomas L Floyd, “Electronic Devices”, 10th edition, Pearson, 2017.
2. G.B. Clayton, “Operational Amplifiers”, International Edition, 2nd Edition,1979.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment test will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concern faculty.

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| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

| | | | |
|---|---|---|---|
| **Semester :** | **IV** | **Internal Assessment :** | **10** |
| **Course Code :** | **UEETV40217** | **End Sem. Exam :** | **15** |
| **Teaching Hours/Week (L:T:P) :** | **1:0:0** | **Exam Duration (Hours) :** | **01** |
| **Credits : 0* Audit Course** | | | |

**COURSE OUTCOMES**

After completing this Course, the students should be able to:

- Demonstrate sustainable solutions to the problems in society and nature.
- Exhibit competence in Professional Ethics.

## DETAILED SYLLABUS

### UNIT-I

**Introduction and Basic Information about Indian Constitution:**

Introduction to the Indian constitution, The making of the Constitution, The Role of the Constituent Assembly – Nature of the Indian constitution, Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations.

### UNIT-II

**Union Executive and State Executive:**

Parliamentary System, Centre-State Relations,Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS,Supreme Court of India, Judicial Reviews and Judicial Activism, State Executives – Governor , Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts.

### UNIT-III

**Amendments and Emergency Provisions:**

Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Emergency Provisions, types of Emergencies and its consequences.

### UNIT-IV

**Professional / Engineering Ethics:**

Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India) : Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest.

## TEXT BOOKS

The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

## COURSE ASSESSMENT

### A. Continuous Assessment (Weightage 10 Marks)

Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc., will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

### B. End Sem Examination (Weightage 15 Marks)

End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# SEMESTER- V

## POWER SYSTEM ANALYSIS-I

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC50301** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

**COURSE OUTCOMES**

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

- Understand the per unit system and analyze the power system using the per unit system.
- Compute three phase symmetrical fault current on synchronous machines and simple power systems.
- Illustrate symmetrical components, their applications to the power system.
- Analyze unsymmetrical faults using symmetrical components of synchronous machines and simple power systems.

**DETAILED SYLLABUS**

**UNIT-I**

**Representation of Power System Components:** Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Power Transformer, Transmission of electrical Power, Representation of Loads. **RBT Levels: L4**

**UNIT-II**

**Symmetrical Fault Analysis:** Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine(On No Load), Short Circuit of a Loaded Synchronous Machine, Selection of Circuit Breakers. **RBT Levels: L4.**

**UNIT-III**

**Symmetrical Components**: Introduction, Symmetrical Component Transformation,Sequence Impedances and Sequence Network of Power System, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System.

**RBT Levels: L4.**

**UNIT-IV**

**Unsymmetrical Fault Analysis:** Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line-To-Ground (LLG) Fault, Open Conductor Faults.**RBT Levels: L4.**

**TEXT BOOKS**


1. John.J. Grainger, William D Stevenson JR, "Power System Analysis", MCGRAW HILL SERIES IN ELECTRICAL AND COMPUTER ENGINEERING.
2. Olle I. Elgerd, "Electric Energy Systems Theory: An Introduction", MCGRAW HILL SERIES IN ELECTRICAL AND COMPUTER ENGINEERING.
3. Neelkantan, "Power System Analysis and Stability" .
4. A. NagoorKani, " Power System Analysis". RBA Publication, First Edition.


**REFERENCE BOOKS**


1. J. DUNCAN GLOVER,THOMAS J. OVERBYE,MULUKUTLA S. SARMA,"Power System Analysis and Design", Cengage Learning, Sixth Edition.
2. C L Wadhwa, "Electrical Power Systems", New Age International Publishers.
3. D. P. Kothari, I J Nagrath, "Modern Power System Analysis", McGraw Hill Publisher, Fifth Edition.
4. A.Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar," Power System Engineering", Dhanpat Rai and Company.
5. Hadi Sadat, " Power System Analysis" , , McGraw Hill.


**ONLINE RESOURCES**

1. https://nptel.ac.in/courses//Power Systems

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

# POWER ELECTRONICS

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC50302** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOME

After completing this Course, the students should be able to:

- Understand the basics of Power Electronics and types of converters.
- Illustrate the characteristics and operation of power semiconductor switching devices.
- Analyze the various power converters.
- Examine the different aspects of power converters under various loads.

## DETAILED SYLLABUS

### UNIT-I

**Introduction:** Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects.

**Power Devices:** Diodes, SCRs, GTO, BJT, MOSFET, IGBT- Characteristics, working, Selection and Protection, Driver Circuits.

**RBT Levels: L3.**

### UNIT-II

**Controlled Rectifiers:** Introduction, Single-Phase Full Converters with R and R-L load, Single-Phase Dual Converters, Three- Phase Full Converters.

**DC-DC Converters:** Introduction, principle of step-down and step-up chopper with RL load, performance parameters, DC-DC converter classification, Switched mode regulators.

**RBT Levels:L4**

### UNIT-III

**DC-AC Converters**: Introduction, principle and operation of single phase, three phase inverters. PWM techniques, Voltage source inverters and Current source inverters. **RBT Levels: L4.**

### UNIT-IV

**AC-AC Converters:** Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single-phase voltage controllers for R, R-L loads and its applications. Cyclo-converter Principle of operation of single phase cyclo-converters, circulating current mode of operation.**RBT Levels: L4.**

## TEXT BOOKS


1. Daniel W. Hart “Power Electronics”, McGraw Hill 1st Edition 2011.
2. Muhammad H. Rashid, “Power Electronics - circuits, devices and applications”, Prentice Hall of India, 4th Edition, 2014.
3. Ned Mohan, Tore M Undeland and W.P.Robbins “Power electronics:converters, applications, and design”, John Wiley & Sons, Inc, New Yark, Second edition.
4. Andrzej M. Trzynadlowski “Introduction To Modern Power Electronics” WILEY Third edition.


## REFERENCE BOOKS


1. P.S.Bimbhra,”Power Electronics”, 4th Edition, Khanna Publishers, 2010.
2. Robert W. Erickson and Dragan Maksimovic, “Fundamentals of Power Electronics” 2nd Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, “Power Electronics”, New Age International (P) Limited, 1996.
4. “Power Electronic Control of Alternating Current Motors” by J.M.D.Murphy
5. V.R.Murthy, “Power Electronics”, 1st Edition, Oxford University Press, 2005.
6. P.C.Sen, “Power Electronics”, Tata Mc Graw-Hill Education, 1987.


## ONLINE RESOURCES

- https://onlinecourses.nptel.ac.in/noc21_ee01/preview
- https://nptel.ac.in/courses/108101038

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
   - Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
   - End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC50303** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand different types of measuring instruments.
- Analyze the construction of potentiometers and instrument transformers.
- Illustration of measuring the energy and power.
- Identify the measuring instruments of resistance, inductance and capacitance.
- Apply the knowledge about transducers and Digital Instruments.

## DETAILED SYLLABUS

### UNIT-I

**Measuring Instruments:** Classification, Absolute and secondary instruments, indicating instruments, control, balancing and damping, constructional details, characteristics, errors in measurement, Ammeters, voltmeters: (DC/AC) PMMC, MI, Electrodynamometer type

**Wattmeters**: Electrodynamometer type, induction type, single phase and three phase wattmeter, compensation, Energymeters: AC. Induction type single phase and three phase energy meter, compensation, creep, error, testing, Frequency Meters: **RBT Levels: L2.**

### UNIT-II

**Instrument Transformers**: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications. Galvanometers: General principle and performance equations of D' Arsonval Galvanometers, Vibration Galvanometer and Ballistic Galvanometer.

**Potentiometers**: DC Potentiometer, Crompton potentiometer, construction, standardization, application. AC Potentiometer, Drysdale polar potentiometer; standardization, application. **RBT Levels: L4.**

### UNIT-III

**DC/AC Bridges :** General equations for bridge balance, measurement of self inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device, Kelvin's double bridge. **Transducer:** Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Torque meters, inductive torque transducers, electric tachometers, photo-electric tachometers, Hall Effect Transducer. **RBT Levels: L4.**

## UNIT-IV

**CRO:** Block diagram, Sweep generation, vertical amplifiers, use of CRO in measurement of frequency, phase, Amplitude and rise time of a pulse.
**Digital Multi-meter:** Block diagram, principle of operation, Accuracy of measurement, Electronic Voltmeter: Transistor Voltmeter, Block diagram, principle of operation, various types of electronic voltmeter, Digital Frequency meter: Block diagram, principle of operation**.**
**Levels: L4.**

## TEXT BOOKS


1. A Course in Elec. & Electronics Measurements & Instrumentation: A K. Sawhney, Dhanpat Rai Publishers, 2021.
2. Modern Electronic Instrumentation and Measurement Techniques: Helfrick & Cooper, Prentice Hall Publishers, 2021.
3. Electrical Measurement and Measuring Instruments - Golding & Waddis, Reem Publishers, 2011.


## REFERENCE BOOKS


1. Buckingham and Price, “Electrical Measurements”, Prentice – Hall, 1988.
2. Reissland, M. U, “Electrical Measurements: Fundamentals, Concepts, Applications”, New Age International (P) Limited Publishers, 1st Edition 2010.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

| | | |
|---|---|---|
| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# POWER SYSTEM LABORATORY-I

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **20** |
| **Course Code** | **UEEPC50306** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **0:0:4** | **Exam Duration (Hours)** | **03** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand Transmission line performance characteristics.
- Determine power angle characteristics of synchronous machines.
- Compute sequence impedances and fault currents using different techniques.
- Perform saturation characteristics study for CT and PT.
- Analyze Fuse and MCB characteristics.

## LIST OF EXPERIMENTS

RBT Level: L1 to L4

| | |
|---|---|
| 1. | Determination of Efficiency and Regulation for Transmission Line by Formation of symmetric π /T configuration and Verification of $AD-BC$=1. |
| 2. | Determine Symmetrical Fault Currents and Voltages. |
| 3. | Determine Unsymmetrical Fault Currents and Voltages. |
| 4. | Fuse Testing Kit: Study of different types of Fuse characteristics. |
| 5. | MCB & OL/R Test Kit: Study of different types of MCB characteristics and thermal OLR characteristics. |
| 6. | Transmission Line Simulation Unit: Study the Ferranti effect, ABCD parameter evaluation, Surge impedance loading calculation and Transmission line efficiency and calculation of losses. |
| 7. | Perform Characteristics and calibration study of Current Transformer. |
| 8. | Perform Characteristics and calibration study of Potential Transformer. |
| 9. | Perform Characteristics study of Miniature Circuit Breakers (MCB). |
| 10. | Determination of Positive, Negative & zero seq. impedances of 3 phase Transformer. |
| 11. | Determinations of Sequence Impedances for three phase Alternator. |

| | |
|---|---|
| 12. | Measurement of Capacitance of 3 Core Cables. |

**TEXT BOOKS**

1. John.J. Grainger, William D Stevenson JR, “Power System Analysis”, MCGRAW HILL SERIES IN ELECTRICAL AND COMPUTER ENGINEERING.
2. Olle I. Elgerd, “Electric Energy Systems Theory: An Introduction”, MCGRAW HILL SERIES IN ELECTRICAL AND COMPUTER ENGINEERING.
3. Neelkantan, “Power System Analysis and Stability” .
4. A. NagoorKani, “ Power System Analysis”. RBA Publication, First Edition.

**REFERENCE BOOKS**

1. C L Wadhwa, “Electrical Power Systems”, New Age International Publishers.
2. D. P. Kothari, I J Nagrath, “Modern Power System Analysis”, McGraw Hill Publisher, Fifth Edition.
3. A.Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar,” Power System Engineering”, Dhanpat Rai and Company.
4. Hadi Sadat, “ Power System Analysis” , , McGraw Hill.

**COURSE ASSESSMENT**

A. Continuous Assessment **(Weightage 20 Marks)**

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concerned faculty.

B. End Sem Examination **(Weightage 30 Marks)**

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

# POWER ELECTRONICS LABORATORY

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **20** |
| **Course Code** | **UEEPC50307** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **0:0:4** | **Exam Duration (Hours)** | **03** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand and analyze various characteristics of power electronic devices with gate firing circuits and forced commutation techniques.
- Analyze the operation of single-phase half or fully-controlled converters and inverters with different types of loads.
- Analyze the operation of DC-DC converters, single-phase AC Voltage controllers with different loads.
- Create and analyze various power electronic converters using MATLAB software.

## DETAILED SYLLABUS

RBT Level: **L1** to **L4**

| Sl.No | List of Experiments- |
|---|---|
| 1. | Study of Characteristics of SCR, MOSFET & IGBT. |
| 2. | Gate firing circuits for SCR's: R, R-C triggering and UJT Triggering |
| 3. | Single Phase AC Voltage Controller using TRIAC and DIAC with R and RL Loads |
| 4. | Single Phase fully controlled bridge converter with R and RL loads. |
| 5. | Single Phase Bridge inverter with R and RL loads. |
| 6. | Four Quadrant Operation of Chopper with DC Motor. |
| 7. | Simulation of Buck and Boost chopper |
| 8. | Simulation of single-phase Inverter with PWM control. |
| 9. | Simulation of three phase fully controlled converter with R and RL loads, with and without freewheeling diode. |
| 10. | Simulation of Single Phase Cycloconverter with R and RL loads |
| 11. | Speed control of a universal motor using an AC voltage regulator. |
| 12. | Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper. |

## TEXT BOOKS


1. Daniel W. Hart “Power Electronics”, McGraw Hill 1st Edition 2011.
2. Muhammad H. Rashid, “Power Electronics - circuits, devices and applications”, Prentice Hall of India, 2nd edition.


## REFERENCE BOOKS


1. P.S.Bimbhra,”Power Electronics”, 4th Edition, Khanna Publishers, 2010.
2. Robert W. Erickson and Dragan Maksimovic, “Fundamentals of Power Electronics” 2nd Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, “Power Electronics”, New Age International (P) Limited, 1996.
4. “Power Electronic Control of Alternating Current Motors” by J.M.D.Murphy
5. V.R.Murthy, “Power Electronics”, 1st Edition, Oxford University Press, 2005.
6. P.C.Sen, “Power Electronics”, Tata Mc Graw-Hill Education, 1987.
7. L. Umanand, “Power Electronics Essentials and Applications”, WILEY, First Edition: 2009


## ONLINE RESOURCES

- https://onlinecourses.nptel.ac.in/noc21_ee01/preview
- https://nptel.ac.in/courses/108101038

## COURSE ASSESSMENT

A. Continuous Assessment **(Weightage 20 Marks)**

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concerned faculty.

B. End Sem Examination **(Weightage 30 Marks)**

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

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| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# ELECTRICAL MEASUREMENTS LABORATORY

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **20** |
| **Course Code** | **UEEPC50308** | **End Sem. Exam** | **30** |
| **Teaching Hours/Week (L:T:P)** | **0:0:4** | **Exam Duration (Hours)** | **03** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Calibrate LPF Watt Meter, Energy Meter. P.F Meter using electro dynamometer type instrument as the standard instrument.
- Determine unknown inductance, resistance, capacitance by performing experiments on D.C Bridges & A.C Bridges.
- Determine three phase active & reactive powers using single wattmeter method practically.
- Determine the ratio and phase angle errors of current transformer and potential transformer.

List of Experiments: RBT Level: L1 to L4

1. Calibration and Testing of a single phase energy meter.
2. Measurement of tolerance of batch of low resistances by Kelvin’s double bridge.
3. Measurement of Power.
4. Measurement of unknown Capacitance using Schering Bridge.
5. Measurement of the self inductance of the coil using Anderson bridge.
6. Measurement of displacement with the help of LVDT.
7. Measurement of iron losses and Permeability of ring specimen .
8. Measurement of Inductance using Maxwell’s Bridge.
9. Measurement of medium resistance using Wheatstone Bridge.
10. Measurement of voltage, frequency & phase with the help of CRO.

**TEXT BOOKS**


1. A Course in Elec. & Electronics Measurements & Instrumentation: A K. Sawhney
2. Modern Electronic Instrumentation and Measurement Techniques: Helfrick & Cooper
3. Electrical Measurement and Measuring Instruments - Golding & Waddis


**COURSE ASSESSMENT**

A. Continuous Assessment **(Weightage 20 Marks)**

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. End Sem Examination **(Weightage 30 Marks)**

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

# SPORTS AND YOGA, OR NCC/NSS (ACTIVITY BASED EVALUATION) / ENTREPRENEURSHIP AND STARTUP

| | | | |
|---|---|---|---|
| **Semester** | **V** | **Internal Assessment** | **-** |
| **Course Code** | **UEEFV50309** | **End Sem. Exam** | **25** |
| **Teaching Hours/Week (L:T:P)** | **0:0:2** | **Exam Duration (Hours)** | **01** |
| **Credits: 01** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand the importance of sound health and fitness principles as they relate to better health.
- Perform physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- Create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- Develop an appreciation of physical activity as a lifetime pursuit and a means to better health.

## DETAILED SYLLABUS

**Introduction to Physical Education**: Meaning & definition of Physical Education o Aims & Objectives of Physical Education, Changing trends in Physical Education. Physical Fitness, Wellness & Lifestyle, Meaning & Importance of Physical Fitness & Wellness, Components of Physical fitness, Components of Health related fitness, Components of wellness, Preventing Health Threats through Lifestyle Change, Concept of Positive Lifestyle.

**Yoga**: Meaning & Importance of Yoga, Elements of Yoga, Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas, Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana), Relaxation Techniques for improving concentration - Yog-nidra.

**Yoga & Lifestyle**: Asanas as preventive measures. Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana. Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana. Back Pain: Tadasana, Ardh Matsyendrasana,

Vakrasana, Shalabhasana, Bhujangasana. Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana. Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

**COURSE ASSESSMENT**

Activity based assessment by respective faculty in charge at the end of the semester.

# SEMESTER- VI

## POWER SYSTEM ANALYSIS-II

| | | | |
|---|---|---|---|
| **Semester** | **VI** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC60310** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

**COURSE OUTCOMES**

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

- Apply graph theory for modeling of power systems and compute various incidence matrices.
- Execute Power flow analysis of the power system using various methods.
- Perform economic generation scheduling of thermal power plants.
- Comprehend Power System stability using various techniques.

**DETAILED SYLLABUS**

**UNIT-I**

**Network Topology:** Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis, Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation without Mutual Coupling. Y bus by Inspection Method without Mutual Coupling.

**RBT Levels: L4.**

**UNIT-II**

**Load Flow Studies:** Introduction, Classification of buses. Power flow equation, Operating Constraints, Data for Load flow. Gauss-Seidal iterative method, Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of LFS methods and Numerical on Load flow studies. Comparison of Load Flow Methods.

**RBT Levels: L4.**

**UNIT-III**

**Economic Operation of Power System:** Introduction and Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses, Economic dispatch including transmission losses, Derivation of transmission loss formula. Unit Commitment.

**RBT Levels: L4.**

**UNIT-IV**

**Power System Stability:** Introduction, Classification, Power angle Equation, Swing Equation,

Equal area criterion. **RBT Levels: L4.**

**TEXT BOOKS**

1. Glenn W Stagg, Ahmed Ei - Abiad, "Computer Methods in Power Systems Analysis", McGraw Hill 1st Edition.
2. K.Uma Rao,"Computer Techniques and Models in Power Systems", Dreamtech Press, Second Edition.

**REFERENCE BOOKS**

1. J. DUNCAN GLOVER,THOMAS J. OVERBYE,MULUKUTLA S. SARMA,"Power System Analysis and Design", Cengage Learning, Sixth Edition.
2. C L Wadhwa, "Electrical Power Systems", New Age International Publishers.
3. D. P. Kothari, I J Nagrath, "Modern Power System Analysis", McGraw Hill Publisher, Fifth Edition.
4. A.Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar," Power System Engineering", Dhanpat Rai and Company.
5. Hadi Sadat, " Power System Analysis" , , McGraw Hill.

**ONLINE RESOURCES**

1. https://nptel.ac.in/courses//Power Systems

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted with appropriate marks weightage will be given as per the decision of concerned faculty.

B. **End Sem Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per decision of concerned faculty.

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# ELECTRICAL DRIVES

| | | | |
|---|---|---|---|
| **Semester** | **VI** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC60311** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

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

- Comprehend the characteristics of electric motor drives.
- Analyze DC motors characteristics with control techniques.
- Analyze AC motors with soft starting methods and braking methods.
- Understand the vector control and sensor less control concepts of AC Motors.
- Select the appropriate motor drive system for the required load dynamics.

## DETAILED SYLLABUS

### UNIT-I

**Dynamics of Electrical Drives:**Dynamics of Electric Drives: Types of loads, Multi quadrant operation, Moment of Inertia;Starting and Braking methods; Selection of Motor Power rating: Heating, Classes of Duty,Determination of motor power rating. **RBT Levels: L2.**

### UNIT-II

**DC Motor Drives:** Factors governing speed and torque of DC motors, Controlled rectifiers-based speed control:single quadrant, two quadrant and four quadrant-controlled DC motor drive; Chopper fed speed control: four quadrant operation; Open loop and Closed loop Control.**RBT Levels: L4.**

### UNIT-III

**Scalar and Vector Control of Induction Motor Drives :**Characteristics and equivalent circuit of poly-phase induction motor; Speed control techniques: Stator voltage control, variable frequency control; Soft starting methods, braking methods; overview of single-phase drives; Kramer's drive, Scherbius drive, doubly fedinduction motor drive

Phasor Diagram, dqModelling, decoupling of torque and flux; Field Oriented control: stator flux-oriented control, rotor-flux-oriented control, magnetizing-flux-oriented control; Direct Torque control.

**RBT Levels: L4.**

### UNIT-IV

**Synchronous Motor Drives :**Characteristics; Separate Control Mode; Self-Control Mode; Power factor control; Marginal angle control; BLDC motor control; Switch reluctance motor control. **RBT Levels: L4.**

## TEXT BOOKS

1. R. Krishnan, Electric Motor Drives: Modeling, Analysis, and Control, 2015, 2nd edition,Pearson Education.
2. Bimal K. Bose, Modern Power Electronics and AC Drives, 2005, Prentice Hall, NewJersey.

## REFERENCE BOOKS

1. S. K. Pillai, A First Course on Electrical Drives, 2012, New Age International Publisher
2. G. K. Dubey, Fundamentals of Electrical Drives, 2010, 2nd edition, Narosa Publications
3. Raja Singh, Energy Conservation Strategies for Asynchronous Machine Drives, 2021,LAP LAMBERT Academic Publishing

## ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_ee71/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee24/preview

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# POWER SYSTEM PROTECTION

| | | | |
|---|---|---|---|
| **Semester** | **VI** | **Internal Assessment** | **30** |
| **Course Code** | **UEETC60312** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **3:0:0** | **Exam Duration (Hours)** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

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

- Understand the need of power system protection
- Analyze operation of circuit breaker
- Analyze different aspects of relaying
- Understand over voltage protection

## DETAILED SYLLABUS

### UNIT-I

Need for protective schemes, Nature and Cause of Faults, Types of Faults, Effects of Faults. Power system components. Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection.Current and VoltageTransformers for protection,Auto Reclosers, Introduction to fuses. **RBT Levels: L3.**

### UNIT-II

Circuit Breakers: Introduction Arc phenomenon and interruption of arc, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air-Break Circuit Breakers, Oil Circuit Breakers, Air-Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers. Advancement in circuit breakers. **RBT Levels: L4.**

### UNIT-III

Classification of relays, Introduction to EM relays, static relays. Numerical relays, phasor estimation, WAMP and PMU. Overcurrent protection, distance protection, unit protection.Protection of generators, transformers, motors and bus bars, Computer based relaying and advancement in protective relays. **RBT Levels: L4.**

### UNIT-IV

Causes of overvoltages and surges, Protection against over voltage and surges.Introduction to lightning phenomena. Insulation Coordination, Basic Impulse Insulation Level (BIL). Modern Trends in Power System Protection,Gas insulated substation/switchgear (GIS). **RBT Levels: L4.**

## TEXT BOOKS and REFERENCE BOOKS

1. S. S. Rao, Switchgear and Protection, Khanna Publishers..
2. Badri Ram, D. N. Vishwakarma Power System Protection and Switchgear McGraw Hill 2nd Edition.
3. C. Russell Mason The Art & Science of Protective Relaying - Wiley–Blackwell
4. P M Anderson, Power System Protection, WILEY, IEEE Press, Second edition
5. Arun G. Phadke, James S. Thorp, Computer Relaying for Power Systems, Wiley.. 2nd edition
6. Y. G. Paithankar and S R Bhide, Fundamentals of Power System Protection, Prentice Hall of India..
7. Allan Thomas Johns, S.K. Salman, Digital Protection for Power Systems, The Institution of Engineering and Technology.
8. A. G. Phadke, J.S. Thorp, Synchronized Phasor Measurements and Their Applications, Springer
9. Bhuvanesh Oza et al Power System Protection and Switchgear McGraw Hill 1st Edition, 2010

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# MICROPROCESSORS AND MICROCONTROLLERS

| | | | |
|---|---|---|---|
| **Semester** | **VI** | **Internal Assessment** | **30** |
| **Course Code** | **UEECC60313** | **End Sem. Exam** | **45** |
| **Teaching Hours/Week (L:T:P)** | **2:0:2** | **Exam Duration (Hours)** | **03** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

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

- Develop a clear understanding of microprocessor, machine and assembly language.
- Describe the architecture and functional block of 8085/8086 microprocessors.
- Describe the architecture details of 8051 and Atmega328 microcontroller.
- Develop an application using 8051 for the given specification

## DETAILED SYLLABUS

### UNIT-I

**Basic functional blocks of a computer:** CPU, memory, Iinput-output subsystems, control unit. Instruction Set Architecture of a CPU
**Introduction to Microprocessors:** Definition, Need and evolution of microprocessors.
**Core of programming:** Concept of machine language and assembly language. Building our own machine and assembly language. RBT Levels: L3.

### UNIT-II

**Intel 8085:** Features, Architecture, Pin diagram, Memory, Addressing modes , Assembly Languanage Programming.
**Intel 8086:** Features, Architecture, Addressing modes and Memory . RBT Levels: L4.

### UNIT-III

**Intel 8051:** Features, Architecture, Pin diagram, Ports, Internal Memory and Addressing modes. Interrupts, Timers and Counters. Assembly Language Programming 8051.
RBT Levels: L4.

### UNIT-IV

**AVR Microcontrollers:** Introduction to AVR, Atmega328 Architecture, Pin Configuration, Registers, Addressing modes, Ports and DDR register and control operations.
**Application development using Microcontrollers:** RBT Levels: L4

## TEXT BOOKS


1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing.
2. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition 2006.
3. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition, Cengage learning,2010
4. Advanced microprocessors and peripherals-A. K ray and K.M.Bhurchandani, TMH, 2nd edition 2006.


## REFERENCE BOOKS


1. Muhammad Ali Mazidi , Janice Gillispie Mazidi and Rolin D McKinlay, The 8051 microcontroller and embedded systems using assembly and C, second edition Pearson education Asia
2. Mohamed Rafiquzzaman, Microprocessor and Microcomputer based system design, second edition, CRC press.
3. Danny Causey, Muhammad Ali Mazidi, and Rolin D. McKinlay, PIC Microcontroller and Embedded SystemsUsing Assembly and. C for PIC18. Pearson 2008.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ELECTRIC DRIVES LABORATORY

| | | | |
|---|---|---|---|
| **Semester :** | **VI** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC60316** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **03** |
| **Credits: 02** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Perform the speed control of motors using various converters.
- Verify the performance of various types of power electronic converters.
- Perform the speed control of motor using processors.
- Develop and simulate the various Power Electronics circuit models.

## LIST OF EXPERIMENTS
**RBT Level:L1- L5**

| | |
|---|---|
| 1. | Speed control of Converter fed DC motor. |
| 2. | Speed control of Chopper fed DC motor. |
| 3. | V/f control of three-phase induction motor. |
| 4. | Micro controller-based speed control of Stepper motor. |
| 5. | Speed control of BLDC motor. |
| 6. | DSP based speed control of SRM motor. |
| 7. | Speed and position control of servo motor by DSP controller. |
| 8. | Single phase Multi Level Inverter based induction motor drive. |
| 9. | VSI/CSI fed induction motor drive analysis using software. |
| 10. | Regenerative/ Dynamic breaking operation for DC motor study using software. |

## TEXT BOOKS


1. Fundamentals of Electrical Drives, Gopal K. Dubey, Narosa Publishing, 2nd Edition, 2001
2. Electrical Drives: Concepts and Applications, Vedum Subrahmanyam, McGraw Hill, 2nd Edition, 2011


## REFERENCE BOOKS


1. Electric Drives N.K De,P.K. Sen PHI Learning 1st Edition, 2009
2. Bimal K Bose, “Modern Power Electronics and AC Drives” PHI
3. R. Krishnan, “Electric motor drives: modeling, analysis and control, Pearson.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concerned faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

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# POWER SYSTEM LABORATORY-II

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **VI** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEEPC60317** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **03** |
| **Credits: 02** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand the formation of Bus incidence matrices.
- Perform Power flow study and Stability analysis.
- Conduct experiments on relays and draw the characteristics.
- Demonstrate the Knowledge of protective schemes on Power system components.

## LIST OF EXPERIMENTS
**RBT Level: L1- L5**

| | |
|---|---|
| 1. | Formation of Bus admittance matrix for Power Systems with and without Mutual Coupling, by Singular Transformation and Inspection Method. |
| 2. | Determination of Bus Currents, Bus Power and Line Flow for a Specified System Voltage (Bus) Profile. |
| 3. | Power Flow Analysis using Gauss Siedel Method, NR Method and Fast Decoupled Method for Both PQ and PV Buses. |
| 4. | Perform an experiment to draw characteristics of electromechanical relays. |
| 5. | Experiments on Feeder Protection. |
| 6. | Perform an experiment to draw characteristics of static and digital relays. |
| 7. | Perform an experiment on Transformer protection Schemes. |
| 8. | Perform an experiment on Transmission line protection Schemes. |
| 9. | Perform an experiment on generator Protection schemes. |
| 10. | Perform an experiment on Motor Protection schemes. |
| 11. | Perform an experiment on Stability Studies using Power angle diagrams. |
| 12. | Perform an experiment on Optimal Generation Scheduling for Thermal power plants. |

## REFERENCE BOOKS

1. Power System Protection and Switchgear Badri Ram, D.N. Vishwakarma McGraw Hill 2nd Edition.
2. Power System Protection and Switchgear BhuvaneshOza et al McGraw Hill 1st Edition, 2010.
3. S. S. Rao, Switchgear and Protection, Khanna Publishers.
4. Y. G. Paithankar and S R Bhide, Fundamentals of Power System Protection, Prentice Hall of India.
5. Arun G. Phadke, James S. Thorp, Computer Relaying for Power Systems, Wiley.
6. A Web Course on Digital protection of power systems by Prof. Dr. S.A.Soman, IIT Bombay.
7. MassonArt And Science of Protective Relaying –Blackburn Protection of power systems.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concerned faculty.

B. **End Sem Examination** (Weightage **30 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

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# MINOR PROJECT

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **VI** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEERC60318** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **-** |
| **Credits: 02** | | | | | |

## COURSE OUTCOMES

After the completion of minor project, students should be able to:

- Construct working models and explore fields independently.
- Devise system integration skills
- Demonstrate documentation skills
- Develop Project management skills

## GUIDELINES

There shall be an UG Minor-project under the guidance of one of the department faculties of their specialization. Students will register for this immediately after Vth semester. The UG minor-project shall be submitted in a report form and presented before the committee in VI semester. The following points need be followed for UG Minor project:

1. Students have to select a project either of their own interest or in consultation with faculty members of the department.
2. Students should carry out the mini project independently/group.
3. If a student has his/her own idea for an individual Project, it is the student's responsibility to find a faculty member who both approves of the proposed programme of work and is willing to be the supervisor.
4. It is the responsibility of the student to update the progress of the work to the concerned supervisor regularly.
5. Students must submit the brief report with minimum10 pages (printed on double side) at the end of the semester in the following format.

## REPORT FORMAT

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  -Title of the Project: 24, Bold.

-Main/Chapter Header (1, 2, etc..): 16, Bold.
-Sub title: 14, Bold
-Running Text: 12, Regular
-Lines Spacing: 1.5 Lines
-Paragraph Beginning: 0pt (No Space)
-Paragraph Spacing: 6pt
-Figure Caption (Below Figure, Centre Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Centre Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continuous assessment will be done at a regular interval of time.

B. **End Sem Examination** (Weightage **30 Marks**)

- The evaluation shall be based on the report submitted and a viva-voce exam.

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# SEMESTER- VII

## RENEWABLE ENERGY SOURCES

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70401** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- Understand need of renewable and alternative energy resource
- Analyze solar and wind energy systems
- Understand the wave, OTEC, tidal,geothermal,hydel and bio-energy
- Understand energy storage, hybrid system and grid integration

**DETAILED SYLLABUS**

**UNIT-I**

Conventional and nonconventional energy resources. Energy Crisi.Energy flow/chain.Energy scenario, Energy use,attributes of different energy sources, Energy and Environment. Energy:quality of life,development, economics,security and balance. Carbon footprint and credit, Climate change Sustainable energy systems. Energy Conservation and audit.

**RBT Levels: L2.**

**UNIT-II**

Solar Energy: Solar radiation, measurements, solar geometry. Solar thermal systems.Solar thermal applications. Solar PV system: Photovoltaic cell. Characteristics, equivalent circuit, solar PV power system.MPPT. Introduction to direct energy conversion. **RBT Levels: L4.**

**UNIT-III**

Wind energy: Wind resource, power in wind, characteristics of wind turbine, different types of wind turbines, control of wind turbines,different generators. Wind forms and MPPT.Hydro power- small/Mini/micro hydro power generation, Energy from Ocean-Wave,Tidal, Ocean Thermal Energy. **RBT Levels: L4.**

**UNIT-IV**

Geothermal energy. Bio Energy and conversion- Biogas and Biofuels.Cleaner energy production from fossil fuels, Hydrogen energy, Fuel cell,Energy storage, Energy from waste,

Life cycle costing. Hybrid energy systems,Integration of renewable energy into the grid**.**
**RBT Levels: L4.**

## TEXT BOOKS and REFERENCE BOOKS

1. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.
2. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi
3. Non-Conventional Energy Sources, G.D.Rai, NewDelhi
4. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub.,2009
5. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996
6. Sustainable Energy Systems and Applications, Springer, 2011, 978-0-387-95860-6
7. Mukund R. Patel, *Wind and Solar Power Systems* ,CRC Press; (1999)
8. Kothari D.P, Singhal..K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.
9. Online resource- NPTEL, research papers, online documents etc…

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# POWER SYSTEM OPERATION AND CONTROL

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70402** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand states of power system operation and control.
- Analyze automatic generation control and modelling.
- Interpret the relation between the reactive power and voltage control.
- Articulate the power system state estimation and contingency analysis

## DETAILED SYLLABUS

### UNIT-I

**Introduction:** Operating States of Power System, Objectives of Control, Key Concepts of Reliable Operation, Preventive and Emergency Controls. **RBT Levels: L3.**

### UNIT-II

**AGC:** Automatic Generation Control, Modeling of Automatic Load Frequency Control, Interconnected systems,Operation of single area. Introduction to multi-area systems.
**RBT Levels:L4.**

### UNIT-III

**Voltage Stability:** Voltage and Reactive Power Control,Production and Absorption of Reactive Power, Methods of Voltage Control, Dependence of Voltage on Reactive Power, Sensitivity of Voltage to Changes in P And Q, Cost Saving, Methods of Voltage Control.
**RBT Levels: L4.**

### UNIT-IV

**SCADA and EMS:** SCADA and EMS architecture and functions, Load dispatch center, Restructuring of power system. State estimation: Importance of state estimation. Introduction to contingency analysis. Load forecasting.
**RBT Levels: L4.**

## TEXT BOOKS


1. Dr.K. Uma Rao, " Power System Operation and Control", WILEY INDIA.
2. Allen J. Wood, Bruce F. Wollenberg, "Power System Operation and Control", WILEY INDIA.
3. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education Private Limited.
4. K.N.Shubhanga, "Power System Analysis: A dynamic perspective", Pearson Publishers.


## REFERENCE BOOKS


1. C.L. Wadhwa, "Electrical Power Systems", 3rd Edn, New Age International Publishing Co., 2001.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", 5th Edn, Tata McGraw Hill Education Private Limited 2024.
3. B.M. Weedy, B.J. Cory et al, "Electric Power systems" , Wiley 2012.
4. K. Bhattacharya, H. J. Bollen, J. E. Daalder, "Operation of Restructured Power Systems", Springer Science Business Media.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

B. **End Sem Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per decision of concerned faculty.

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# DIGITAL SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70403** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits: 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Explain and solve discrete time systems.
- Analysis of discrete time systems using various transforms techniques.
- Apply DFT and IDFT for filtering and computing the given sequence.
- Design and Realization of Digital Filters.

## DETAILED SYLLABUS

### UNIT-I

**Basic elements of digital signal Processing**: Introduction to DSP processor, Concept of frequency in continuous time and discrete time signals –Sampling theorem – Discrete time signals. Discrete time systems –Analysis of Linear time invariant systems –Z transform – Convolution and correlation. **RBT Levels: L3.**

### UNIT-II

**Frequency domain analysis:** Discrete Fourier transform (DFT), Inverse DFT, Inter relationship with z-transform and Hilbert-transforms, Discrete Hilbert transform, FFT algorithms Decimation in time and decimation in frequency. Spectral analysis using DFT. **RBT Levels: L4.**

### UNIT-III

**Design of IIR Digital Filters:** Design of digital Chebyshev –type 1filter by impulse invariant transformation and bilinear transformation, Frequency transformations. Realization of IIR digital systems: direct form, cascade form and parallel form, Ladder structures for equal degree polynomials. **RBT Levels: L3.**

### UNIT-IV

**Design of FIR Digital Filters:** Design of FIR digital filters by use of windows, Design of FIR digital filters-frequency sampling techniques. Realization of FIR systems: direct form, cascade form, linear phase form**. RBT Levels: L4.**

## TEXT BOOKS


1. John G. Proakis, Dimitris G. Mamalakis, “Digital Signal Processing, Principles, Algorithms and Applications”, Pearson Publishers.
2. Johnny R. Jhonson, “Introduction to Digital Signal Processing”, Pearson Publishers,
3. Simon Haykin, Berry Van Veen, “Signals and Systems”, Wiley India.


## REFERENCE BOOKS


1. Antonious, “Digital Filter Design”, Mc-Graw-Hill International Editions.
2. S. Salivahanan C Gnanapriya, “Digital Signal Processing”, Tata McGraw Hill Education Private Limited.
3. NagoorKani, “Digital Signal Processing”, McGraw Hill Education Private Limited.
4. Alan V. Oppenheim Ronald W. Schafer, “Digital Signal Processing”, PHI, India.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

B. **End Sem Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per decision of concerned faculty.

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# INTERNET OF THINGS

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **VII** | **Internal Assessment** | **:** | **30** |
| **Course Code** | **:** | **UEECC70404** | **End Sem. Exam** | **:** | **45** |
| **Teaching Hours/Week (L:T:P)** | **:** | **2:0:2** | **Exam Duration (Hours)** | **:** | **03** |
| **Credits: 03** | | | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand the basic concepts of the IoT system.
- Design and development of necessary hardware and software for IoT systems.
- Employ advanced level knowledge, techniques, skills and modern tools for the IoT system.
- Illustrate different sensor technologies for sensing real world entities

## DETAILED SYLLABUS

**Hardware and Software for IoT: RBT Levels: L4.**

1. Familiarization with the concept of IoT, Arduino/ Raspberry Pi and performing software installation.
2. Study of different operating systems for Arduino/Raspberry-Pi.
3. Understanding the process of OS installation on Arduino/Raspberry-Pi.

**Working with AVR / Arduino: RBT Levels: L4**

2. To implement an Arduino based simple digital I/O system.
3. To implement analog output from the Arduino board in the form of Pulse Width Modulation.
4. Interface a SSD and LCD with Arduino board.
5. Interfacing Sensors with Arduino (Temperature, IR etc sensor).
6. Interfacing Motors with Arduino (Stepper or DC OR Servo).
7. Interface a heat sensor to the Arduino board and display its reading on an LCD.
8. Use the external interrupts of the Arduino board.

**Working with Raspberry-Pi: RBT Levels: L4.**

1. Study of Connectivity and configuration of Raspberry-Pi board with basic peripherals, LEDS.
2. Understanding GPIO and its use in programs.
3. Interfacing Sensors with Raspberry-Pi (Temperature, IR etc sensor).
4. Use the X-Bee module to understand the connectivity of Raspberry-Pi board with camera. Write

an application to capture and store the image.

5.Interfacing Motors with Raspberry-Pi (Stepper or DC OR Servo)

6. Write a server application to be deployed on Raspberry-Pi board. Write client applications to get

services from the server application.

7. Understanding of the Raspberry Pi with Cloud Interfacing

**TEXT BOOKS**

1. Arshdeep Bahga, and Vijay Madisetti, “Internet of Things (A Hands-on-Approach)”, 1 st Edition, VPT, 2014.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013.
4. Cuno Pfister, Getting Started with the Internet of Things, O“Reilly Media, 2011.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Continuous evaluation of the record book and proper marks will be awarded.
- Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concern faculty.

B. **End Sem Examination** (Weightage **45 Marks**)

- As per the question paper given in the end semester examination, the student has to perform and execute the experiment.
- The weightage of the marks will be awarded as per the decision of the concerned faculty.

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# RENEWABLE ENERGY LABORATORY

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **20** |
| **Course Code :** | **UEEPC70407** | **End Sem. Exam :** | **30** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:4** | **Exam Duration (Hours) :** | **03** |
| **Credits : 03** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- Understand the different sources for power generation.
- Generalize the PV cell characteristics.
- Analyze the wind energy system performance characteris
- Understand the working of hybrid energy systems .

**LIST OF EXPERIMENTS -RBT Level:L1- L5**

| Exp. No. | Experiment Name |
|---|---|
| 1. | Study of IV and PV characteristics of PV module |
| 2. | Study of PV module characteristics in series and parallel combination |
| 3. | Study of PV module characteristics for different tilt angle |
| 4. | Study of PV module characteristics under shading conditions |
| 5. | Study blocking diode and bypass diode affect on performance of PV module |
| 6. | Study of power curve of wind energy system |
| 7. | Study performance characteristics of wind turbine |
| 8. | Simulation of PV module and MPPT |
| 9. | Simulation of wind turbine power curve |
| 10. | Simulation wind turbine performance curves and MPPT |
| 11. | Study of solar-wind hybrid system in standalone mode |
| 12. | Study of solar-wind hybrid system in grid connected mode |
| 13. | Study PMDC generator and PMSG characteristics |
| 14. | Demonstration of Solar PV system in grid connected mode |

## TEXT BOOKS and REFERENCE BOOKS


1. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.
2. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi
3. Non-Conventional Energy Sources, G.D.Rai, NewDelhi
4. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub.,2009
5. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996
6. Sustainable Energy Systems and Applications, Springer, 2011, 978-0-387-95860-6
7. Mukund R. Patel, *Wind and Solar Power Systems* ,CRC Press; (1999)
8. Kothari D.P, Singhal..K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.
9. Online resource- NPTEL, research papers, online documents etc…


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)
   - Continuous evaluation of the record book and proper marks will be awarded.
   - Internal assessment tests will be conducted and appropriate weightage of marks will be awarded as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **30 Marks**)
   - As per the question paper given in the end semester examination, the student has to perform and execute the experiment. The weightage of the marks will be awarded as per the decision of the concerned faculty

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# MAJOR PROJECT PHASE-1

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **VII** | **Internal Assessment** | **:** | **20** |
| **Course Code** | **:** | **UEERC70408** | **End Sem. Exam** | **:** | **30** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:4** | **Exam Duration (Hours)** | **:** | **-** |
| **Credits: 02** | | | | | |

## COURSE OUTCOMES

After the completion of major project phase- 1, students should be able to:

1. Identify the problems in real time.
2. Develop Project management skills.
3. Development of problem solving methodologies.
4. Demonstrate documentation skills.

## GUIDELINES:

There shall be an UG major-project to be chosen in consultation with the department faculties of their specialization. Students will register for the project at the time of commencement of VII semester. The UG major-project shall be submitted in a report form. The following points need be considered for UG Major Project Phase-I

1. Students have to select a project either of their own interest or in consultation with faculty members of the department.
2. Students are advised to carry out projects independently, however depending on the complexity of the proposed idea, they can do it in groups consisting of not more than three, with appropriate permission from Supervisor/Coordinator and HOD.
4. It is the responsibility of the student to report the progress of the work regularly to the concerned supervisor. A proper documentation has to be maintained in this regard.
5. In this phase students are expected to complete the literature review and should define the problem statement to implement the project in the subsequent semester.
6. A report must be submitted to the department.

## REPORT FORMAT :

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  -Title of the Project: 24, Bold.
  -Main/Chapter Header (1, 2, etc..): 16, Bold.
  -Sub title: 14, Bold
  -Running Text: 12, Regular

-Lines Spacing: 1.5 Lines
-Paragraph Beginning: 0pt (No Space)
-Paragraph Spacing: 6pt
-Figure Caption (Below Figure, Centre Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Centre Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against plagiarism as suggested by UGC.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **20 Marks**)

- Continues assessment from internal supervisor.
- Project assessment will be carried out in a regular interval.

B. **End Sem Examination** (Weightage **30 Marks**)

- The evaluation shall be based on the report submitted and a viva-voce exam.

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# INTERNSHIP

| | | | | | |
|---|---|---|---|---|---|
| **Semester** | **:** | **VII** | **Internal Assessment** | **:** | **-** |
| **Course Code** | **:** | **UEEIS70409** | **End Sem. Exam** | **:** | **50** |
| **Teaching Hours/Week (L:T:P)** | **:** | **0:0:0** | **Exam Duration (Hours)** | **:** | **-** |
| **Credits: 02** | | | | | |

## COURSE OUTCOMES

After the completion of summer internship, students should be able to:

1. Understand the ecosystem of practical implementation.
2. Explore the field aspects as per the industrial standards.
3. Develop hands-on and real-time working skills.
4. Demonstrate problem solving skills.

## GUIDELINES FOR SUMMER INTERNSHIP:

There shall be Summer Internship of two weeks to four weeks duration, in collaboration with an Industry/ educational institute of national repute of their specialization. Students will register for this immediately after the completion of VI semester examinations. The UG summer internship shall be submitted and viva-voce examination will be conducted. The following points need to be followed for UG summer internship.

1. Students have to apply for the summer internship in consultation with faculty advisor or coordinator/head of the department.
2. Approval from the department is mandatory for applying to the summer internship.
3. Students must maintain all records while undergoing the internship like ideas, results, and analysis.
4. Some photographs need to be included in the report to support your internship work.

## REPORT FORMAT :

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  -Title of the Project: 24, Bold.
  -Main/Chapter Header (1, 2, etc..): 16, Bold.
  -Sub title: 14, Bold
  -Running Text: 12, Regular
  -Lines Spacing: 1.5 Lines
  -Paragraph Beginning: 0pt (No Space)

-Paragraph Spacing: 6pt
-Figure Caption (Below Figure, Centre Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Centre Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against Plagiarism and the percentage of duplication must be less than 10% (As suggested by UGC).

**COURSE ASSESSMENT:**

At the end of the summer internship course, the department will conduct a viva-voce examination and presentation by the student.

# SEMESTER- VIII

## MAJOR PROJECT-PHASE-II

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **100** |
| **Course Code :** | **UEERC80512** | **End Sem. Exam :** | **150** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:10** | **Exam Duration (Hours) :** | **01** |
| **Credits : 10** | | | |

### COURSE OUTCOMES

After the completion of major project phase- 2, students should be able to:

1. Develop working models.
2. Apply system integration skills.
3. Demonstrate technical writing and documentation skills.
4. Develop Project management skills.

### GUIDELINES:

There shall be an UG major-project phase-2, in collaboration with an Industry / department faculties / Educational institute of national repute of their specialization. The following points need to be followed for UG Major Project Phase-II.

1. Students will have to continue the project chosen in the 7$^{th}$semester for its implementation. Those who would like to go for an external project with industry/an educational institute of national importance may continue the existing project or may choose a different one as per the suggestion of an external supervisor.
2. The UG major-project shall be submitted in a report form and presented.
3. In case students would like to work with another institute or industry, they have to take prior permission from the Coordinator/HoD /Dean.
4. In this phase students are expected to complete the project implementation and should keep the working model ready at the time of final internal demonstration/external examination.

### REPORT FORMAT:

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  -Title of the Project: 24, Bold.
  -Main/Chapter Header (1, 2, etc..): 16, Bold.

-Sub title: 14, Bold
-Running Text: 12, Regular
-Lines Spacing: 1.5 Lines
-Paragraph Beginning: 0pt (No Space)
-Paragraph Spacing: 6pt
-Figure Caption (Below Figure, Centre Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Centre Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against Plagiarism as suggested by UGC.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **100 Marks**)

- Continues assessment from internal project supervisor.
- Project assessment will be carried out in a regular interval by project supervisors.

B. **End Sem Examination** (Weightage **150 Marks**)

- The evaluation shall be based on the report submitted and a viva-voce exam by project supervisors.

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# TECHNICAL PAPER WRITING AND PRESENTATION

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | | |
| **Course Code :** | **UEERA80413** | **End Sem. Exam :** | **50** |
| **Teaching Hours/Week (L:T:P) :** | **0:0:0** | **Exam Duration (Hours) :** | **01** |
| **Credits : 02** | | | |

## COURSE OUTCOMES

After the completion of the course students should be able to:

- Demonstrate the presentation skills.
- Develop technical writing skills.

GUIDELINES:

1. Identify advanced latest technologies or research topics.
2. Carrying literature survey on the same topic.
3. Preparation and submission of technical reports on the same topic.
4. Delivering a seminar on the same topic.

## COURSE ASSESSMENT:

A. **End Sem Examination** (Weightage **50 Marks**)

- The evaluation shall be based on the report submitted and a viva-voce exam.

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# PROFESSIONAL ELECTIVES

## POWER SYSTEM PLANNING

| | | | |
|---|---|---|---|
| **Semester :** | **V** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC50305** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

### COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand Energy Consumption and Power Sector scenarios.
- Analyze Power Generation scenario and Economic operation of power system.
- Perform Power System Reliability Studies.

### DETAILED SYLLABUS

### UNIT-I

**Introduction To Power System Planning:** Introduction to power system planning, National and Regional Planning, Structure of Power System, Planning tools, Electricity Regulation, Load Forecasting, techniques and modeling. **RBT Levels: L3.**

### UNIT-II

**Planning Tools:** Structure of Power System, Planning tools, Electricity Regulation, Load Forecasting, techniques and modeling. **RBT Levels: L3.**

### UNIT-III

**Generation and Transmission Planning:** Introduction, Integrated power generation, Co-generation, Power pooling and power trading, Transmission and distribution planning. Power system economics and finance. Private participation**, RBT Levels: L3.**

### UNIT-IV

**Power Supply Reliability:** Power System Reliability Studies, Power System operation

planning, Load prediction and management, Reactive power balance, Online power flow studies, Tariff Structure and Design. **RBT Levels: L3.**

## TEXT AND REFERENCE BOOKS

1. Glenn W Stagg Ahmed H Ei - Abiad . "Computer Methods in Power Systems Analysis", McGraw Hill 1stEdition.

2. A.S.Pabla, "Electrical Power System Planning", by – Macmillan India Ltd.

3. Roy Billington, "Power System Reliability Evaluation". Gordon and Breach Science Publishers.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# BATTERY MANAGEMENT SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **V** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC50306** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Review various Battery Management System parts.
- Clarify the basic information about batteries and demonstrate Lithium-Ion Battery Fundamentals.
- Measure different battery parameters and analyze battery performance to identify Battery Management System Functionality.
- Need of Charge Balancing and state of charge estimation using various algorithms and estimate state of health and battery fault detection.

## DETAILED SYLLABUS

### UNIT-I

**Battery Management System parts:** The Power Module (PM), The battery, The DC/DC converter, load, communication channel, Examples of Battery Management Systems, Comparison of BMS in a low-end and high-end shaver, Comparison of BMS in two types of cellular phones. **RBT Levels: L2.**

**Basic information on batteries:** Battery systems, Definitions Battery design, Battery characteristics, General operational mechanism of batteries, Basic thermodynamics, Kinetic and diffusion over potentials, Double-layer capacitance, Battery voltage **RBT Levels: L2.**

### UNIT-II

**Lithium-Ion Battery Fundamentals:** Battery Operation, Battery Construction, Battery Chemistry, Safety Longevity, Performance, Integration. **RBT Levels: L2.**

**Measurement of battery parameters:** Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management, System Performance

### UNIT-III

**Battery Management System Functionality:** Charging, Strategies, CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes. **RBT Levels: L2.**

**Charge Balancing:** Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults.
**State-of-Charge Estimation Algorithms:** Challenges, Definitions, Coulomb Counting, SOC Corrections, OCV Measurements, Temperature Compensation, Kalman Filtering, Other Observer Methods. **RBT Levels: L2.**

**UNIT-IV**

**State-of-Health Estimation Algorithms:** State of Health, Mechanisms of Failure, Predictive SOH Models Impedance Detection, Passive Methods, Active Methods, Capacity Estimation, Self-Discharge Detection Parameter Estimation, Dual-Loop System, Remaining Useful Life Estimation.
**Fault Detection:** Overview, Failure Detection, Overcharge/Overvoltage, Over-Temperature, Over current Battery Imbalance/Excessive Self-Discharge, Internal Short Circuit Detection, Detection of Lithium Plating, Venting Detection, Excessive Capacity Loss, Reaction Strategies. **RBT Levels: L2.**

## TEXT AND REFERENCE BOOKS

1. H. J. Bergveld, “Battery management systems : design by modelling” University Press Facilities, Eindhoven,2001Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Phillip Weicker, “A Systems Approach to Lithium-Ion Battery Management”, artech house, 2014.
3. Gregory L. Plett, “Battery Management Systems: Battery Modeling”, Artech house, 2015.
4. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, “Electrochemical Power Sources: Primary & Secondary Batteries”, IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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| CENTRAL UNIVERSITY OF KARNATAKA | **Central University of Karnataka**<br>**(Established by an Act of the Parliament in 2009)**<br>**School of Engineering**<br>**Department of Electrical Engineering** | **Dept.: EEE Dept.**<br>**Curriculum**<br>**Syllabus Contents**<br>**2024-25** |

# MODERN CONTROL SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **V** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC50307** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Develop state space models for continuous and analyze their time response
- Design of controllers and observers for dynamical systems using state feedback
- Model, analyse the performance and design controllers for discrete time dynamical systems
- Analyse the characteristics and asses the stability of nonlinear dynamical systems
- Evaluate the performance of dynamical systems using simulation tools.

## DETAILED SYLLABUS

### UNIT-I

**State space analysis:** Dynamic Systems Modeling in State Space - State space models from Transfer function - Transfer function from state space model- Similarity transformations and Canonical forms – Controllable, Phase variable, diagonal, Jordan canonical forms - Eigenvalues and eigenvectors - system stability - Solution of state equations of LTI systems- State transition matrix – Computation of state transition matrix methods. **RBT Levels: L2.**

### UNIT-II

**State space based controller design State Space design** - Controllability and Observability from state space models – Kalman test – Gilbert test – DualityPole zero cancellation - design of state feedback controllers from time domain specifications – dominant poles - pole placement - Ackerman's formula– design of full order and reduced order observers – separation principle**. RBT Levels: L4.**

## UNIT-III

**Digital control systems -** Pulse transfer function - Difference equation - Solution by z-transform - Stability of linear digital control systems - Stability tests – Jury's test – Routh Hurwitz based stability analysis using bilinear transformation. State space models for digital control systems - Controllability and observability of digital control systems – Loss of controllability and observability on discretization - Pole placement using state feedback for digital control systems. **RBT Levels: L4.**

## UNIT-IV

**Nonlinear Systmes Analysis:** Nonlinear phenomena - different types of nonlinearities and their occurrence – Equilibrium points - Linearization - classification of equilibrium points - stability of equilibrium points - Phase plane analysis - limit cycles in phase plane - existence of limit cycle. Lyapunov function - Lyapunov method for linear systems – Lyapunov equation. **Levels: L4.**

## TEXT BOOKS


1. Katsuhiko Ogata, Modern Control Engineering, 5th edition, Pearson Prentice Hall, 2015.
2. I J Nagrath and M Gopal, Control Systems Engineering, 7rd ed., Tata McGraw Hill, 2021.
3. M.Gopal, Digital control and State Variable methods, 4th ed, Tata McGraw –Hill, 2017
4. Benjamin C Kuo, Digital Control Systems, 2nd edition, Oxford University Press, 1995.


## REFERENCE BOOKS


1. S. Wiggins, Introduction to Applied Nonlinear Dynamical Systems and Chaos, Springer Verlag, 1990.
2. K P Mohandas, Modern Control Engineering, Revised Edition, Sanguine Pearson, 2010
3. Hassan K Khalil, Control Systems : An introduction, Michigan State University, 2023.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# OPTIMIZATION TECHNIQUES

| | | | |
|---|---|---|---|
| **Semester :** | **V** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC50308** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understands the concepts to use the Metaheuristics Optimization techniques.
- Analyze any problem of optimization in an engineering system
- Formulate a mathematical model to the problem and solve it by the techniques that are presented.
- Apply various constrained and unconstrained optimization techniques for the specific problems.

## DETAILED SYLLABUS

### UNIT-I

Introduction: Definitions, Characteristics, Objective function, Classification of optimization problems, Engineering applications and limitations. Single-Variable Optimization, Multivariable Optimization, Multivariable Optimization.**RBT Levels: L3.**

### UNIT-II

Linear Programming: Definitions and Formulation of the LPP, Construction of L.P. Models, Slack and surplus variables, Standard form, Canonical form and matrix form of LP Problems. Artificial Variables. **RBT Levels: L3.**

### UNIT-III

Random Search Methods concepts: Introduction, Direct Search Methods - Univariate Method, Gradient of a Function, Indirect Search Methods. Binary Genetic Algorithm: Introduction, Genetic Algorithms Natural Selection on a Computer, Components of a Binary Genetic Algorithm. Selecting the Variables and the Cost Function, Components of a Continuous Genetic Algorithm. **RBT Levels: L3.**

## UNIT-IV

Metaheuristics Optimization: Concepts of Simulated Annealing, Theoretical approaches, Advantages and disadvantages, applications, Ant Colony Algorithms – Introduction. **RBT Levels: L3.**

## TEXT BOOKS


1. Rao, S.S. (2009). "Engineering Optimization: Theory and Practice." John Wiley & Sons, Inc.

2. Taha, H.A. (2008). "Operations Research, Pearson Education India." New Delhi, India.

3. Randy L. Haupt and Sue Ellen Haupt, "Practical genetic algorithms" second edition, a John Wiley & sons, inc., publication -2004.

4. Sharma J.K. (2013). "Operation Research: Theory and Applications." Fifth Edition, Macmillan Publishers, New Delhi, India.

5. J. Dreo A. Petrowski, P. Siarry E. Taillard. "Metaheuristics for Hard Optimization" Springer.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ENERGY AUDITING AND DSM

| | | | |
|---|---|---|---|
| **Semester :** | **VI** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC60315** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Identify the Energy and its various forms and Electricity tariffs.
- Analyse types of energy audit, energy costs, benchmarking, energy performance.
- Estimate Electricity billing, electrical load management and maximum demand control.
- Discuss various types of air compressors, compressor efficiency and Compressed air system components.

## DETAILED SYLLABUS

### UNIT-I

**Basics of Energy and its various forms:** Overview of Energy, Units and Conversions, GDP, GNP and Per Capita Energy Consumption, Renewable Energy Act, International Energy Agency, OECD and Kyoto Protocol**.** Introduction, Electricity tariff, load management and maximum demand control, power factor improvement, selection and location of capacitors, units and conversion. **RBT Levels: L2.**

### UNIT-II

**Energy Management and Audit:** Definition, energy audit, types of energy audit. Energy management (audit) approach understanding energy costs, energy performance, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow. Economic analysis of investment, Cash Flows and CF diagrams, Economic analysis technique, Interest Factors. **RBT Levels: L3.**

### UNIT-III

**Energy Efficiency in Electrical Systems**: Electricity billing, power factor improvement and its benefit, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: losses in induction motors, energy saving opportunities with energy efficient motors.Lighting and efficiency

Energy Management and Audit: Energy management; Developing energy use profiles; Sankey Diagram; Process flow diagrams; Material and energy balance; Energy auditing instruments. Energy audit – Need for energy audit, Scope of energy audit, Types of energy audit – Preliminary energy audit, Detailed energy audit; **RBT Levels:L3.**

## UNIT-IV

**Energy Efficient Technologies in Electrical Systems**: Maximum demand controllers, automatic power factor controllers, efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving. Concept of energy conservation. Different methods of energy conservation. Energy conservation in transportation, industry, electricity generation, transmission and distribution, agricultural sector. Introduction to DSM: Definition, Evolution, Benefits and Scope; Load Management, Application of Load Control.**RBT Levels: L3.**

## TEXT BOOKS


1. S. C. Tripathy, ―Utilization of Electrical Energy and Conservation‖, McGraw Hill, 1991.
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects.
3. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
5. Suresh Kumar Soni and Manoj Nair, Energy Conservation and Audit, Satya Prakashan, New Delhi, 2010
6. Rajiv Shankar, Energy Auditing in Electrical Utilities, Viva Books, New Delhi 2010
7. Larry C. White, Philip S. Schmidt, David R. Brown, “Industrial Energy Management Systems”, Hemisphere Publishing Corp, New York
8. Albert Thumann, “Fundamentals of Energy Engineering”, Prentice Hall Inc,
9. Englewood Cliffs, New Jersey


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ADVANCED POWER ELECTRONICS AND DRIVES

| | | | |
|---|---|---|---|
| **Semester :** | **VI** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC60316** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES:**

After completing this Course, the students should be able to:

- Understand the basic working of resonant converters.
- Illustrate the state space modeling of DC-DC Converters.
- Computation of the Dynamic modeling of an Induction motor.
- Analyze the control mechanism of Induction Motor Drive.

## DETAILED SYLLABUS

### UNIT I

**Resonant Converters:** Introduction, Basic resonant circuit concepts, Classification - Load resonant converters, resonant switch converters, zero voltage switching clamped voltage converters, Resonant DC link inverters High frequency link integral half cycle converters, Phase modulated resonant converters, Dual active bridge converters, High gain converters. **RBT Levels: L2.**

### UNIT II

**Modeling of DC-DC Converters:** Basic ac modeling approach, State space averaging, Circuit averaging and averaged switch modeling, Canonical circuit modeling, Converter transfer functions for buck, boost and buck-boost topologies.**RBT Levels: L2.**

### UNIT III

**Theory of Transformations:** Concept of space vector, direct and quadrature axis variables, various types of Krause transformation, condition for power invariance, Expression for power with various types of transformation, Transformations between reference frames, Clarke and Park's Transformations, Variables observed from various frames.

**Dynamic Model of an induction motor:** Inductance matrices of induction motor, Voltage and torque in machine variables, Derivation of dq0 model for a symmetrical induction machine, Voltage and torque equation in arbitrary reference frame variables

**RBT Levels: L3.**

## UNIT IV

**Induction Motor drives:** Principle of vector control of IM, Indirect vector control with feedback, Indirect vector control with feed-forward, Indirect vector control in various frames of reference, decoupling of vector control with feed forward compensation, Direct Torque Control of IM, control of wound rotor induction machine, introduction to five-phase induction motor drives. **RBT Levels: L4.**

## TEXT BOOKS


1. Power Electronics-Circuits, Devices & Applications, M.H. Rashid, Pearson, 2013, 4th Edition
2. Power Electronics: Converters, Applications & Design, N. Mohan, T.M. Undeland, W.P. Robbins, J.Wiley & Sons, 2003, 3rd Edition.


## REFERENCE BOOKS


1. Modern Power Electronics & AC Drives, B.K. Bose, Pearson Education India, 2015, 1st Edition.
2. Electric Motor Drives: Modeling, Analysis and Control, R. Krishnan, Pearson Education India, 2015, 1st Edition.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted. Appropriate marks weightage will be given as per the decision of concerned faculty.

B. **End Sem Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per decision of concerned faculty.

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# ELECTRICAL VEHICLES

| | | | |
|---|---|---|---|
| **Semester :** | **VI** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC60317** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Explain the working of electric vehicles and recent trends.
- Analyze different energy storage systems used for electric vehicle application.
- Develop the electric propulsion unit and its control for application of electric vehicles.
- Design power electronic converters for battery charging in electric vehicles.

## DETAILED SYLLABUS

### UNIT-I

**Electric and Hybrid Electric Vehicles:** Sustainable transportation, Challenges and key technologies in EVs, Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **RBT Levels: L2.**

### UNIT-II

**Energy storage for Electric Vehicles and Hybrid Electric Vehicles:** Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors. **RBT Levels: L2.**

### UNIT-III

**Electric Propulsion:** EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. **RBT Levels: L2.**

## UNIT-IV

**Design of Electric and Hybrid Electric Vehicles:** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design. Power Electronic Converter for Battery Charging. **RBT Levels: L3.**

## TEXT BOOKS


1. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals" 3rd edn., CRC Press, 2021.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory, and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, CRC PRESS,


## REFERENCE BOOKS


1. Allen Fuhs "Hybrid Vehicles and the Future of Personal Transportation" Taylor &Francis Group, CRC Press 2009.
2. Lino Guzzella & Antonio Sciarretta, "Vehicle Propulsion Systems Introduction to Modelling and Optimization", Springer publication 2005.
3. Sandeep Dhameja " Electric Vehicle Battery System", New nens Boston Oxford Johannesburg 2002.
4. John M. Miller "Propulsion Systems for Hybrid Vehicles", Published by The Institution of Engineering and Technology, London, United Kingdom , 2004


## ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ADVANCED CONTROL AND APPLICATIONS OF ELECTRICAL DRIVES

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70406** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

COURSE OUTCOMES:

After completing this Course, the students should be able to:

- Understand the basic working of Resonant converters.
- Illustrate the state space modelling of DC-DC Converters.
- Computation of the Dynamic modeling of an Induction motor.
- Analyze the control mechanism of Induction Motor Drive.

## DETAILED SYLLABUS

### UNIT I

**Resonant Converters:** Introduction, Basic resonant circuit concepts, Classification - Load resonant converters, resonant switch converters, zero voltage switching clamped voltage converters, Resonant DC link inverters High frequency link integral half cycle converters, Phase modulated resonant converters, Dual active bridge converters, High gain converters. **RBT Levels: L2.**

### UNIT II

**Modeling of DC-DC Converters:** Basic ac modeling approach, State space averaging, Circuit averaging and averaged switch modeling, Canonical circuit modeling, Converter transfer functions for buck, boost and buck-boost topologies.**RBT Levels: L2.**

### UNIT III

**Theory of Transformations:** Concept of space vector, direct and quadrature axis variables, various types of Krause transformation, condition for power invariance, Expression for power with various types of transformation, Transformations between reference frames, Clarke and Park's Transformations, Variables observed from various frames.

**Dynamic Model of an induction motor:** Inductance matrices of induction motor, Voltage and torque in machine variables, Derivation of dq0 model for a symmetrical induction machine, Voltage and torque equation in arbitrary reference frame variables

**RBT Levels: L3.**

## UNIT IV

**Induction Motor drives:** Principle of vector control of IM, Indirect vector control with feedback, Indirect vector control with feed-forward, Indirect vector control in various frames of reference, decoupling of vector control with feed forward compensation, Direct Torque Control of IM, control of wound rotor induction machine, introduction to five-phase induction motor drives. **RBT Levels: L4.**

## TEXT BOOKS


1. Power Electronics-Circuits, Devices & Applications, M.H. Rashid, Pearson, 2013, 4th Edition
2. Power Electronics: Converters, Applications & Design, N. Mohan, T.M. Undeland, W.P. Robbins, J.Wiley & Sons, 2003, 3rd Edition.


## REFERENCE BOOKS


1. Modern Power Electronics & AC Drives, B.K. Bose, Pearson Education India, 2015, 1st Edition.
2. Electric Motor Drives: Modeling, Analysis and Control, R. Krishnan, Pearson Education India, 2015, 1st Edition.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# ENERGY STORAGE SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70407** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this Course, the students should be able to:

- Understand the different types of distributed technologies and their working.
- Analyze the integration of distributed generation into grid and their impact.
- Understand the architecture of micro grid and working.
- Analyze the operation and control of Microgrid.

## DETAILED SYLLABUS

### UNIT I

Need of energy storage; Electrical energy and role of energy storage systems, Current status, Future prospect of storage, Introduction to energy storage technology. Characteristic, selection and comparison of energy storage systems. Efficiency of energy storage systems.Stakeholders, Challenges, and Drivers**RBT Levels: L3**

### UNIT II

Structure of energy storage system. Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical and Batteries. Thermal energy Storage: Sensible Heat Storage, Latent Heat Storage. Standards for ESS and their integration.**RBT Levels: L4**

### UNIT III

Electric magnetic Energy Storage Systems: SMES and Super capacitors. Potential and kinetic energy storage: Pumped hydro storage, Flywheel storage, compressed air energy storage. Integration of ESS into power system and its impact on it. Modelling of ESS, control,Cost Models and Economic Analysis.**RBT Levels: L3.**

### UNIT IV

Application of Energy Storage, renewable energy storage, Hydrogen energy storage., G2V, V2G.Hybrid Energy storage systems. Energy Management with storage system. Analysis and simulation of energy storage systems.**RBT Levels: L4.**

## TEXT BOOKS AND REFERENCES


1. Energy Storage for Power Systems,A.G. Ter-Gazarian,The Institution of Engineering and Technology 2nd Edition,2011
2. Energy storage in power systems,Francisco D´ıaz-Gonz´alez,AndreasSumper,OriolGomis-Bellmunt,Wiley,2016.
3. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
4. Energy Storage Systems and Components,Alfred Rufer,CRC Press
5. Thermal Energy Storage Technologies for Sustainability Systems Design, Assessment and Applications,S. Kalaiselvam,R. Parameshwaran,Elsevier,
6. Electrical Energy Storage,White Paper,IEC
7. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
8. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer
9. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press
10. Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide,Jim Eyer and Garth Corey,Sandia report,2010


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# HVDC TRANSMISSION SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **VII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC70408** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- To identify the electrical requirements for HVDC lines.
- Analyze the different modes of operation for six pulse & twelve pulse converter unit in the context of HVDC system.
- Apply the knowledge of HVDC transmission in Power networks.
- Determine the appropriate HVDC transmission line parameters under different physical conditions.

## DETAILED SYLLABUS

### UNIT I

**Analysis of HVDC Converters:** Pulse number – choice of converter configuration – simplified analysis of Graetz circuit – converter bridge characteristics.
**Converter and HVDC system control:** Principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – current and extinction angle control – starting and stopping of DC link power control. **RBT Levels: L3.**

### UNIT-II

**Modeling of HVDC Components:** HVDC Converter model - Converter control - Modeling of DC network - Modeling of AC Network.
**Power flow analysis in AC/DC systems:** Modeling of DC links –Multi terminal DC links-Solution of DC load flow –per unit system for DC qualities – Solution of AC/DC power flow. . **RBT Levels: L4**

### UNIT-III

Transient stability Analysis – Converter model – Converter control models – DC network models – solution methodology – Direct methods for stability Evaluation.
Dynamic Stability and power modulation - Power modulation for damping low frequency oscillations – Basic principles – practical consideration in the application of power modulation controllers – Gamma or reactive power modulation – power modulation in MTDC system – voltage stability in AC/DC system. **RBT Levels: L4.**

### UNIT-IV

**Digital dynamic simulation of converters and DC systems:** Valve model, Gate pulse

generation – generation of control voltage – transformer model – converter model – transient simulation of DC and AC systems. **RBT Levels: L4.**

## TEXT BOOKS

1. K.R. Padiyar, HVDC Power Transmission Systems – Technology & System Interactions, New Age International Publishers, 3rd Edition, 2017
2. S Kamakshaiah and V Kamaraju, HVDC Transmission, Tata Mc Graw Hill, New Delhi, 2nd Edition, 2021.

## REFERENCE BOOKS

1. E.W. Kimbark, Direct current transmission, Wiely Inter Science – New York, 1st Edition, 1971
2. J. Arillaga, HVDC Transmission, Peter Peregrinus Ltd., London UK 2nd Edition.

## COURSE ASSESSMENT

**A. Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted with appropriate marks weightage will be given as per the decision of concern faculty.

**B. End Sem Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per decision of concern faculty.

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# AI APPLICATIONS TO POWER SYSTEM

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80412** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

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

- Describe different AI techniques to power system
- Analyse pattern recognition and fuzzy systems
- Describe artificial neural networks, genetic algorithms, expert systems and hybrid AI techniques
- Apply AI techniques to different power system applications

## DETAILED SYLLABUS

### UNIT-I

**Introduction to AI**: Definition, Applications, Components of an AI program; production system. Problem Characteristics. Overview of searching techniques. Knowledge representation: Knowledge representation issues; and overview. Representing knowledge using rules; procedural versus declarative knowledge. Logic programming, forward versus backward reasoning, matching. Control knowledge.

**Statistical Reasoning**: Probability and Daye's theorem. Certainty factor and rule based systems. Baysian Networks, Dampster Shafer theorem. Semantic nets and frames, Scripts. Examples of knowledge based systems.**RBT Levels: L3.**

### UNIT-II

Pattern Recognition: Introduction, automatic pattern recognition scheme. Design Concepts, Methodologies, Concepts of Classifier, concept of feature selection. Feature selection based on means and covariance. Statistical classifier design algorithms; increment-correction and LMSE algorithms. Applications.

**Fuzzy Systems:** Fuzzy sets, Operation on fuzzy sets, Fuzzy relations, Fuzzy measures, Fuzzy logic, Fuzzy controller.**RBT Levels: L3.**

### UNIT-III

**Artificial Neural Networks**: Biological Neuron, Neural Net, use of neural 'nets, applications, Perception, idea of single layer and multilayer neural nets, back propagation, Hopfield nets, supervised and unsupervised learning.

**Genetic Algorithm:** Basic principle, Evolution of genetic algorithm, Hybrid genetic algorithm

**Expert Systems:** Introduction. Study of some popular expert systems, Expert System building tools and Shells, Design of Expert Systems.**RBT Levels: L3.**

## UNIT IV

**Hybrid Systems:** Different hybrid AI systems
**Applications:** Demand Forecasting, Load flow studies, Identification, Classification, Fault location and fault diagnosis, Stability evaluation, Economic load dispatch, Voltage estimation, state estimation, protection, Schedule Maintenance, and hydro-thermal scheduling. Current Trends in Applied AI. **RBT Levels: L3.**

## TEXT BOOKS


1. Kevin Warwick, Arthur Ekwue, Rag Aggarwal Artificial Intelligence Techniques in Power Systems, IEEE Power Engineering Series.
2. Iraj Dabbaghchi, Richard D. Christie, Gary W. Rosenwald, and Chen-Ching Liu, AI Application Areas in Power Systems
3. Simon Haykin, "Neural Networks: A Comprehensive Foundation," 2nd Edition, Pearson Education


## REFERENCE BOOKS


1. Zimmermann, H. J., "Fuzzy Set Theory and Its Applications," 2nd Edition, Kluwer Academic Publishers.
2. El Hawaray, "Electrical Power Applications with Fuzzy systems AIEEE Press.
3. M. Ganesh, "Introduction to fuzzy sets and fuzzy logic", Prentice Hall India.
4. Berlin Heidelberg ,Intelligent Systems and Signal Processing in Power Engineering, Springer, New York.
5. N. P. Padhy, Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005.
6. Stamations V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002
7. Addison Wesley, GeneticAlgorithms, D.E.Goldberg, 1999.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# DIGITAL CONTROL OF POWER ELECTRONICS

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|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80413** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After completing this course, the students should be able to:

- Describe the differences between analogue and digital controllers.
- Understand the principle of conversion in ADC and DAC.
- Analyze the open-loop and closed-loop stability of PE Converters.
- Illustrate the generation of PWM operation with dSace1104 Controller.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to digital control application**: To power electronic circuits; Structure of Digital Controller; Digital current mode control; Basic digital current control implementation; Digital voltage mode control; Advantages & Disadvantages of Digital control; Analog Control approaches: Linear current control with PI Control: Digital PWM the Uniformly Sampled Implementation. **RBT Levels: L2.**

### UNIT-II

**Basic mathematics of digital control systems:** Basic Modulation Methods:Pulse-Amplitude Modulation,Pulse-Width Modulation, Digital Signals and Coding: Sample-and-Hold Devices (SAH);Analog-To-Digital Conversion (ADC),Digital-To-Analog Conversion (DAC), Reconstruction of Sampled Signals, Filter Characteristics, Data Conversion: The Zero-Order Hold, The First-Order Hold, The Second-Order Hold. **RBT Levels: L2.**

### UNIT-III

**Mathematical Modeling of Digital Power Electronic Converters**: Difference between analog and digital, Analog Stability analysis, Digital system Stability analysis, A Zero-Order Hold (Zoh) For Ac/Dc Controlled Rectifiers, A First-Order Transfer Function For Dc/Ac Pulse-Width-Modulation Inverters, A Second-Order Transfer Function For Dc/Dc Converters,Open-Loop Control for Digital Power Electronics, Closed-Loop Control for Digital Power Electronics, Introduction to Digital Controllers. **RBT Levels: L3.**

## UNIT-IV

**dSpace1104 Controller overview and application in PE:** Introduction, Application Areas, Using Real-Time Interface, Technical Details, Block Diagram, Induction Motor Control, Pwm Example implementation. Latest Digital controllers to control the power electronic converters.
**RBT Levels: L3.**

## TEXT BOOKS


1. Digital Control in Power Electronics, Simone Buso, Paolo Mattavalli.
2. Hamid.A.Toliyat and Steven.G.Campbel "DSP Based Electro Mechanical Motion Control" CRC Press New York, 2004.


## REFERENCE BOOKS


1. Digital Power Electronics and Applications-Fang Lin Luo, Hong Ye, Muhammad H. Rashid, Elsevier Science, 2010.
2. Digital control of Power Electronics- Slobodan N. Vukosavic, Springer US, 2007.


## ONLINE RESOURCES

1. https://www.dspace.com/en/inc/home/products/hw/singbord/ds1104.cfm

## COURSE ASSESSMENT

**A Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted. Appropriate marks weightage will be given as per the decision of concern faculty.

**B End Sem Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per decision of concern faculty.

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# DIGITAL PROTECTION OF POWER SYSTEMS

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80414** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Describe function of digital relay and estimation of phasors
- Analyze different algorithm and techniques used in digital relays
- Analyze digital protection of various power system components
- Describe PMU and wide are monitoring and cyber attacks

## DETAILED SYLLABUS

### UNIT-I

Overview of different relays. Introduction of digital relays; Fundamentals of digital relays; Basic layout and elements of the digital relays, the concept of sampling and aliasing, Sliding window concept. Estimation of phasors different technique, estimation of phasors, estimation of frequency and practical considerations for selection of various algorithms.**RBT Levels: L3**

### UNIT II

Interpolation formulae Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, least squares method, Fourier analysis, Fourier series and Fourier transform Walsh function analysis, Protection of an interconnected system, Link net structure,

**RBT Levels: L4**

### UNIT III

Digital Directional/Non-directional Overcurrent and Earth fault relays; Overcurrent relay coordination in an interconnected power system network, Auto-reclosing and Synchronizing, digital distance protection,Protection of series compensated transmission line using digital distance relays,Digital Protection of transformer, Generator, Induction motors and Busbar, Microgrid protection.

**RBT Levels: L3.**

### UNIT IV

Application of artificial intelligence (AI) in digital relaying; Introduction to Phasor Measurement Unit (PMU); Introduction of IEEE C37.118 standard; Wide area monitoring, control and protection using PMU, Introduction to IEC 61850 standard for substation automation and relay interoperability,Recent

Various cyber-attacks at substation/transmission level for Indian power grid network; Basic concept and application of control switching, Advances in Digital Protection of Power Systems

**RBT Levels: L4.**

## TEXT BOOKS AND REFERENCES

1. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999**.**
2. Anderson, P.M., Power System Protection, IEEE Press, New York, 1999.
3. Blackburn, J.L., Applied Protective Relaying, Westinghouse Electric Corporation, New York, 1982.
4. Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd edition, New Delhi, India, 2018.
5. Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, Tata McGraw Hill, New Delhi, 2010.
6. Phadke, A.G. and J.S. Thorp, Computer Relaying for Power Systems, Research Study Press Ltd, John Wiley & Sons, Taunton, UK, 1988.
7. Bhavesh Bhalja and Vijay H. Makwana, ""Transmission Line Protection Using Digital Technology,"" Springer Science,Business Media Singapore Pte. Ltd; Singapore, January 2016.
8. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006.
9. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014.
10. Digital Power System Protection, Singh, Prentice-Hall of India Pvt. Limited, 2007.
11. Understanding Digital Signal Processing, OrhanGazi, Springer, 2017.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# DISTRIBUTED GENERATION AND MICROGRID

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80415** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Understand the different types of distributed technologies and their working
- Analyze the integration of distributed generation into grid and their impact
- Understand the architecture of micro grid and working
- Analyze the operation and control of microgrid

## DETAILED SYLLABUS

### UNIT-I

Conventional and non Conventional power generation, Energy crises, Restructuring and deregulation of power system, Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Introduction to energy storage.**RBT Levels: L2.**

### UNIT-II

Active distribution network, DG grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues. Electricity market with DG.**RBT Levels: L3**

### UNIT-III

Concept and definition of micro grid, microgrid drivers and benefits, review of sources of microgrids, typical structure, configuration and control of a microgrid, AC, DC and hybrid microgrids, Power Electronics interfaces in microgrids. **RBT Levels: L3**

### UNIT-IV

Modes of operation and control of microgrid, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.**RBT Levels: L3.**

## TEXT BOOKS and REFERENCE BOOKS


1. Integration of distributed generation in the power system, R. Abhari M. El-Hawary O. P. Malik J. Anderson B-M. Haemmerli S. NahavandiG. W. Arnold M. Lanzerotti T. SamadF. Canavero D. Jacobson G. ZobristEEE Press
2. S. Chowdhury, S.P. Chowdhury and P. Crossley Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009
3. Distributed Generation, edited by D N Gaonkar,Intech open
4. Microgrid: Architecture and control by N. Haziargyriou, wiley-IEEE press
5. Power Electronic Converters for Microgrid,Suleiman M. Sharkh,Mohammad A. Abusara,Georgios I. Orfanoudakis,Babar Hussain,IEEE Wiley,2014
6. Integration of Distributed Sources Into Power System, Math Bollen and Fainan Hassan
7. Distributed Generation,N. Jenkins, J.B. Ekanayake and G. Strbac, The Institution of Engineering and Technology,2010
8. Renewable Energy Sources by J.N. Twidell&A.D.Weir, University press, Cambridge.
9. Solar Energy -Principles of Thermal Collection and Storage by S. P. Sukhatme, Tata McGraw-Hill, New Delhi


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# FACTS & CUSTOM POWER DEVICES

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80416** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

**COURSE OUTCOMES**

After the completion of this course, the student will be able to

- Distinguish the performance of Transmission line with and without FACTS Devices.
- Compare the SVC and STATCOM.
- Understand the operation and control of various Static Series Compensators and UPFC.
- Distinguish various power quality issues and how are they mitigated by various FACTS Devices.

## DETAILED SYLLABUS

### UNIT-I

**BASICS OF TRANSMISSION SYSTEM AND FACTS CONTROLLERS:** Reactive power flow control in Power Systems – Control of dynamic power un-balances in Power System. Power flow control - Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation. - Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation. - Shunt and Series compensation principles – Reactive compensation at transmission and distribution level**. RBT Levels: L3.**

### UNIT-II

**SVC AND STATCOM:** Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM -Compensator control. Comparison between SVC and STATCOM. **RBT Levels: L4**

### UNIT-III

**STATIC SERIES COMPENSATION:** TSSC, SSSC -Static Voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation – GCSC, TSSC, TCSC and their Control. **RBT Levels: L1, L2, L3, L4.**

### UNIT-IV

**UNIFIED POWER FLOW CONTROLLER**: SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC. Basic Principle of P and Q control- Independent real and reactive power flow control- Applications. Modeling and analysis of FACTS Controllers. Fundamentals of DVR

**POWER QUALITY ISSUES:** Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality. **RBT Levels: L4.**

## TEXT BOOKS

1. K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, 2007. (Unit-I, II&V)
2. N.G. Hingorani, L. Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001. (Unit-II,III,IV)

## REFERENCE BOOKS

1. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission SystemsModellingandControl”, Springer Verlag, Berlin, 2006.
2. K.S.Suresh Kumar, S.Ashok, “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
3. G. THeydt, “Power Quality”, McGraw-Hill Professional, 2007.
4. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# HIGH POWER MULTI-LEVEL CONVERTERS

| | | | |
|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80417** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After Completion of the course the student should able to

- Design of Space Vector PWM for High Power Multi-Level Converters.
- Analyze the different modes of Cascaded H-Bridge Converters.
- Understand the basic working and operational analysis of MMA.
- Understand the Gate driver circuits for Power Converters.

## DETAILED SYLLBUS

### UNIT-I

Introduction to Power Converters,Half Bridge and Full Bridge Circuit Operation,Sinusoidal Pulse Width Modulation and Three Phase Circuit,Harmonics in Sinusoidal PWM.Third harmonic addition in Sine PWM,Introduction to Space Vectors-Timing Calculation,Switching Sequence,Using Carriers.

### UNIT-II

Introduction to High Power Multilevel Converters, Cascaded H-bridge Multilevel Converters, Output Voltage Waveform Synthesis in CHB Converter and Basic of Asymmetrical CHB Converters, Phase-Shifted PWM, Level-Shifted PWM, Fault Tolerant Operation of Cascaded H-Bridge Converter

### UNIT-III

Modular Multilevel Converter: Topology and Operation, Arm and Cell Voltage Ratings, Arm Currents, Arm Energy Balancing, Different Circuit Topologies, PWM Technique and Capacitor Voltage Balancing, Fault Tolerant Operation and Commercial Production, Design of Components in MMC

### UNIT-IV

Neutral Point Clamped Converter:Mid-point Voltage Fluctuations, Capacitor Voltage Balancing, Higher Level NPC, TNPC and Active NPC, Basics of Gate Driver Circuits, Turn-on and Turn-off Process,Features of Gate Drivers and Basics of Bootstrap Functionality, Other Converter Topologies

## TEXT BOOKS

1. Multilevel Converters for Industrial Applications By Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla · 2017, CRC Press

## REFERENCE BOOKS

1. Wu, B. (2007). High-Power Converters and AC Drives. United Kingdom: Wiley.
2. Du, S., Dekka, A., Wu, B., Zargari, N. (2018). Modular Multilevel Converters: Analysis, Control, and Applications. Germany: Wiley.

## COURSE ASSESSMENT

**A. Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quiz, surprise test, projects, seminars, report etc.… will be conducted with appropriate marks weightage will be given as per the decision of concern faculty.

**B. End Sem Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per decision of concern faculty.

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# INDUSTRIAL LOAD MODELLING AND CONTROL

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| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80418** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

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

- Apply knowledge of engineering science industrial load modelling, control and management.
- Analyze different load control, cooling heating load and their control.
- Design captive power system for industrial load.
- Describe optimal operating strategies for compensation device for load management.

## DETAILED SYLLABUS

### UNIT-I

**Electric energy scenario**: Electric Energy Scenario, Demand Side Management, Industrial Load Management, Load Curves, Load Shaping Objectives, Methodologies, Barriers, Classification of Industrial Loads, Continuous and Batch Processes, Load Modeling. **RBT Level , L3**

### UNIT-II

**Direct load control interruptible load control:** Direct load control, interruptible load control, bottom-up approach, scheduling, formulation of load models, optimization and control algorithms, case studies, reactive power management in industries, controls power quality impacts, application of filters, energy saving in industries. **RBT Level L3**

### UNIT-III

**Cooling and heating loads load profiling**: Cooling and heating loads, load profiling, modeling, cool storage, types. Control strategies, optimal operation, problem formulation, case studies.

**Captive power units:** Captive power units, operating and control strategies, power pooling, operation models, energy banking, industrial cogeneration. **RBT Levels: L3.**

### UNIT-IV

**OPTIMAL OPERATING STRATEGIES:** Selection of schemes, optimal operating strategies, peak load saving, constraints problem formulation, case study, integrated load management for industries.**RBT Levels: L3.**

## TEXT BOOKS AND REFERENCE BOOKS


1. CO Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1stEdition, 1989.
2. CW Gellings and S NTalukdar, “Load management concepts,” IEEE Press, New York, 2nd Edition, 1986.
3. Y. Manichaikul and F.C. Schweppe, "Physically based Industrial load", IEEE Trans. on PAS,April, 2ndEdition, 1981.
4. H. G. Stoll, "Least cost ElectricityUtility Planning”, Wiley Interscience Publication, USA, 2ndEdition, 1989.
5. I.J.Nagarath and DPKothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi,1stEdition, 1995.
6. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective Planning in Industrial facilities”, IEEE Inc,USA.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)
- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)
- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# SOLAR AND WIND ENERGY SYSTEMS

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|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80419** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

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

- Understand the basics of wind energy, wind turbines, solar energy and grid integration.
- Explain and classify wind turbines, instruments for measuring solar radiation, solar collectors, solar cell and solar MPPT techniques.
- Analyze different types of wind generators, solar cell and solar collectors.
- Outline about integration of solar and wind energy systems.

## DETAILED SYLLABUS

### UNIT-I

**Solar Thermal**: Physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data. Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.**RBT Levels: L3.**

### UNIT-II

**Solar photovoltaic:** Photovoltaic energy conversion, solar cell fundamentals, solar cell classification- Amorphous, mono-crystalline, polycrystalline, performance of solar cell, V-I characteristics of a PV panel, Maximum Power Point Tracking (MPPT) algorithm. **RBT Levels:3**

### UNIT-III

**Wind energy Basics:** History of wind power, Indian and Global statistics, Characteristics of Wind, principles of wind energy conversion, components of wind energy conversion system, classification of wind turbines- horizontal axis and vertical axis, Betz limit ratio, advantages and disadvantages of wind energy system.**RBT Levels: L3.**

### UNIT-IV

**Wind turbine technologies**: Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Squirrel-cage Induction generator, Wound rotor motor induction generators, Doubly Fed Induction Generator, Synchronous Generators, Permanent Magnet Synchronous Generators and their characteristics. Integration of solar and wind Energy. **RBT**

**Levels: L3.**

**TEXT BOOKS AND REFERENCE BOOKS**

1. Wind and Solar Power Systems- Mukund R. Patel. CRC Press Boca Raton-London-New York, Washington, D.C. 1999
2. Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 5th edition,2014.
3. Wind Energy Theory and Practice by Siraj Ahmed publisher PHI learning Pvt Ltd ,3rd edition, 2016
4. Renewable Energy Sources and Emerging Technologies by D.P Kothari, K.C Singal,RakeshRanjan , PHI learning Pvt Ltd, 2nd edition ,2012
5. Solar Photo Voltaics Fundamentals, Technology and application by Chetan Singh Solanki, publisher PHI learning Pvt Ltd, 3rd edition,2019
6. Renewable Energy Resources by John Twidell and Tony Weir , publisher Taylor and Francis, 2nd edition 2006
7. Grid integration of wind energy conversion systems. H. Siegfried and R. Waddington. John Wiley and Sons Ltd., 2006. 2. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
8. Solar Cells from Basics to Advanced Systems, Chenming Hu and Richard M. White, Tata McGraw Hill Education Private Limited.
9. Wind Electrical Systems, S.N. Bhardra, D.Kastha and S.Banerjee, Oxford University Press.
10. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004
11. Solar PV and Wind Energy Conversion Systems. An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques’ S. Sumathi , L. Ashok Kumar & P. Suresh. Springer
12. Grid integration of wind energy conversion systems. H. Siegfried and R. Waddington. John Wiley and Sons Ltd., 2006.
13. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
14. Solar Cells from Basics to Advanced Systems, Chenming Hu and Richard M. White, Tata McGraw Hill Education Private Limited
15. K. Sukhatme, S.P. Sukhatme, Solar Energy, 2nd Edition, Tata McGraw Hill, 1996.
16. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

**COURSE ASSESSMENT**

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

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|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80420** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

After the completion of this course, the student will be able to

- Develop mathematical models for DC motors for transient state analysis.
- Use reference frame theory to transform three phase to two phase.
- Develop a dynamic model for a three phase induction motor in stator and rotor reference frames.
- Develop mathematical models of single phase transformers.
- Model synchronous machine using Park's transformation for the analysis of steady state operation.

## DETAILED SYLLABUS

### UNIT-I

**Basic Concepts of Modelling:** Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations. **DC Machine Modelling:** Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations. **RBT Levels: L3.**

### UNIT-II

**Reference Frame Theory:** Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence.

**Dynamic Modelling of Three Phase Induction Machine:** Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation**. RBT Levels: L3.**

## UNIT-III

**Small Signal Modelling of the Induction Machine:** Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor. **Transformer Modelling:** Introduction, single phase transformer model, three phase transformer connections, per phase analysis, normal systems, per unit normalization, per unit three phase quantities, change of base, per unit analysis of normal system, regulating transformers for voltage and phase angle control, auto transformers, transmission line and transformers. **RBT Levels: L3.**

## UNIT-IV

**Modelling of Synchronous Machines:** Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation, Dynamic Analysis of Synchronous Machines. **RBT Levels: L3.**

## TEXT BOOKS


1. Generalized Theory of Electrical Machines, P.S.Bimbra, Khanna Publications, 5th Edition, 1995.
2. Electric Motor Drives - Modelling, Analysis & Control, R. Krishnan, PHI Learning Private Ltd, Indian Edition, 2009.
3. Analysis of Electrical Machinery and Drive Systems, P.C.Krause, et al, Wiley, 2nd Edition, 2010.


## REFERENCE BOOKS


1. Power System Analysis, Arthur R Bergen and Vijay Vittal, Pearson, 2nd Edition, 2009.
2. Power System Stability and Control, Prabha Kundur, Mc Graw Hill, 1st Edition, 1994. Sandeep Dhameja " Electric Vehicle Battery System", New nens Boston Oxford Johannesburg 2002.

## ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in

## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.

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# SMART GRID

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|---|---|---|---|
| **Semester :** | **VIII** | **Internal Assessment :** | **30** |
| **Course Code :** | **UEETC80420** | **End Sem. Exam :** | **45** |
| **Teaching Hours/Week (L:T:P) :** | **3:0:0** | **Exam Duration (Hours) :** | **02** |
| **Credits : 03** | | | |

## COURSE OUTCOMES

- Understand the Smart Grid architecture and development.
- Analyze the various metering and monitoring technologies in Smart Grid architecture.
- Comprehend the applications of PMU's
- Illustrate WAMS technology in Smart Grid.

## DETAILED SYLLABUS

### UNIT-I

**Introduction to smart grid :** Introduction, Overview of smart grid, Architecture of smart grid , Distributed generation and microgrid, Transmission and distribution networks, Energy storage systems, Control, interoperability and flexibility, Fundamental components of smart grids, Smart sensors and sensor networks, Phasor measurement units, Smart meters, Wireless sensor networks. **RBT Levels: L4.**

### UNIT-II

**Smart metering and smart monitoring systems:** Introduction, Smart metering concept and systems, Smart meters, Hardware and accurate metering, Communication interface, Remote control features, Demand side management, Theft and fraud control, Advanced metering infrastructure, AMI protocols and standards, AMI security, PMU applications in smart grids, Smart monitoring systems. **RBT Levels: L4.**

### UNIT-III

**Phasor Measurement Units and Phasor Data Concentrators:** Introduction, A Generic PMU, The Global Positioning System, Hierarchy for Phasor Measurement Systems, Communication Options for PMUs, Standards. **RBT Levels: L4.**

## UNIT-IV

**Protection Systems with Phasor Inputs:** Introduction, Differential Protection of Transmission Lines, Distance Relaying of Multiterminal Transmission Lines, Adaptive Protection, Adaptive Out-of-Step Protection, Security Versus Dependability, Transformer, Adaptive System Restoration, Control of Backup Relay Performance, Hidden Failures, Intelligent Islanding, Supervisory Load Shedding.
**RBT Levels: L4.**

## TEXT BOOKS AND REFERENCEBOOKS


1. "Smart Grid to Internet of Energy",Academic Press (2019) by Ersan Kabalci, Yasin Kabalci .
2. "Synchronized Phasor Measurements and Their Applications", by Arun G. Phadke, James S. Thorp,Springer International Publishing (2017).
3. "Power Generation, Operation, and Control", 2nd edition, John Wiley and Sons, INC.Allen J. Wood and Bruce F. Woollenberg.
4. "Modern Power System Analysis ", D. P. Kothari and I J Nagarath, McGraw Hill.
5. "Power System Stability and Control", Prabha Kundur, Tata McGraw-Hill edition.


## COURSE ASSESSMENT

A. **Continuous Assessment** (Weightage **30 Marks**)

- Two internal assessment tests, assignments, quizzes, surprise tests, projects, seminars, reports, etc.… will be conducted. Appropriate marks weightage will be given as per the decision of the concerned faculty.

B. **End Semester Examination** (Weightage **45 Marks**)

- End semester examination will be conducted by giving proper weightage for all units as per the decision of the concerned faculty.