# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**
Dundigal, Hyderabad -500 043

## INFORMATION TECHNOLOGY

## COURSE DESCRIPTOR

| | | | | | |
|---|---|---|---|---|---|
| **Course Title** | FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING | | | | |
| **Course Code** | AEE001 | | | | |
| **Programme** | B. Tech | | | | |
| **Semester** | II | CSE \| IT | | | |
| **Course Type** | Foundation | | | | |
| **Regulation** | IARE - R16 | | | | |
| **Course Structure** | **Theory** | | | **Practical** | |
| | **Lectures** | **Tutorials** | **Credits** | **Laboratory** | **Credits** |
| | 3 | 1 | 4 | 3 | 2 |
| **Chief Coordinator** | Mr. K Lingaswamy, Assistant Professor, EEE | | | | |
| **Course Faculty** | Dr. V. C. Jagan Mohan, Professor, EEE<br>Mr. S Srikanth, Assistant Professor, EEE | | | | |

## I. COURSE OVERVIEW:

This course introduces the concepts of basic electrical engineering parameters, quantities, analysis of a DC circuits. The course teaches the fundamentals of faraday-laws, ohms laws, Kirchhoff laws and different electrical concepts. They will be able to analyze network graphs and circuit theorems like Voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer theorem. It also describes introduction to three phase circuits and the concept of semiconductor diodes, bipolar junction transistors and their applications.

## II. COURSE PRE-REQUISITES:

| Level | Course Code | Semester | Prerequisites | Credits |
|---|---|---|---|---|
| UG | AHS006 | I | Engineering Physics | 4 |

## III. MARKS DISTRIBUTION:

| Subject | SEE Examination | CIA Examination | Total Marks |
|---|---|---|---|
| Fundamentals of Electrical and Electronics Engineering | 70 Marks | 30 Marks | 100 |

## IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ✔ | Chalk & Talk | ✔ | Quiz | ✔ | Assignments | ✘ | MOOCs |
| ✔ | LCD / PPT | ✔ | Seminars | ✘ | Mini Project | ✘ | Videos |
| ✘ | Open Ended Experiments | | | | | | |

## V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

**Semester End Examination (SEE):** The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

| | |
|---|---|
| 50 % | To test the objectiveness of the concept. |
| 50 % | To test the analytical skill of the concept OR to test the application skill of the concept. |

**Continuous Internal Assessment (CIA):**
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

| **Component** | **Theory** | | **Total Marks** |
|---|---|---|---|
| **Type of Assessment** | CIE Exam | Quiz / AAT | |
| **CIA Marks** | 25 | 05 | 30 |

**Continuous Internal Examination (CIE):**
Two CIE exams shall be conducted at the end of the 8$^{th}$ and 16$^{th}$ week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

**Quiz / Alternative Assessment Tool (AAT):**
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

## VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

| Program Outcomes (POs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PO 1 | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. | 3 | Seminar |
| PO 2 | **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. | 2 | Seminar |
| PO 3 | **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. | 2 | Presentation on real-world problems |
| PO 6 | **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. | 2 | Assignment |

**3 = High; 2 = Medium; 1 = Low**

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

| Program Specific Outcomes (PSOs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PSO 1 | **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer - based systems of varying complexity. | - | - |
| PSO 2 | **Software Engineering Practices:** The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success. | 2 | Seminar |
| PSO 3 | **Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies. | - | - |

**3 = High; 2 = Medium; 1 = Low**

## VIII. COURSE OBJECTIVES (COs):

| The course should enable the students to: | |
|---|---|
| I | State the Ohms law, Kirchhoff's laws associated with electrical network to study its characteristics and understand concept of mutual inductance. |
| II | Apply network reduction technique ,network theorems , graph theory to solve complex electrical network |
| III | Analyse the behaviour of RLC circuit with sinusoidal input and summarise futures of three phase supply |
| IV | Illustrate the V-I characteristics of various diodes and bi-polar junction transistor. |

## IX. COURSE LEARNING OUTCOMES (CLOs):

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| AEE001.01 | CLO 1 | Understand the concept of circuit, classification of elements and types of energy sources. | PO 1, PO2, PO 3 | 3 |
| AEE001.02 | CLO 2 | State different laws associated with electrical circuits. | PO 1, PO 2 | 2 |
| AEE001.03 | CLO 3 | Explain Energy due to mutual induction and constraint on mutual inductance. | PO 1 | 3 |
| AEE001.04 | CLO 4 | Determine mesh currents, node voltages using network reduction techniques and define the various nomenclature related with network topology. | PO 2, PO 3 | 2 |
| AEE001.05 | CLO 5 | Prove the law of conservation of energy, Superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitations. | PO 2 | 2 |
| AEE001.06 | CLO 6 | Summarize the procedure of Thevenin's, Norton's and Milliman's theorems to reduce complex network into simple equivalent network. | PO 1, PO 2, PO 3 | 3 |
| AEE001.07 | CLO 7 | Explain the steps of compensation, zero current and voltage shift theorem to predict constraints of electrical networks. | PO 1, PO 3 | 2 |
| AEE001.08 | CLO 8 | Identify the alternating quantities with it instantaneous, average and root mean square values. | PO1 | 3 |
| AEE001.09 | CLO 9 | Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation. | PO 2, PO 3, PO 6 | 2 |
| AEE001.10 | CLO 10 | Explain balance and unbalanced three phase circuits. | PO 3 | 2 |
| AEE001.11 | CLO 11 | Illustrate the operation and biasing of PN junction diode, Zener diode. | PO 1, PO2, PO6 | 2 |
| AEE001.12 | CLO 12 | Compare the operation of half wave, full wave and bridge rectifiers. | PO 1 | 2 |
| AEE001.13 | CLO 13 | Demonstrate the Zener diode as a voltage regulator. | PO 1, PO 2 | 2 |
| AEE001.14 | CLO 14 | Compare different configurations of Transistor | PO 1 | 2 |
| AEE001.15 | CLO 15 | Summarize the DC load line and characteristics of BJT | PO 2 | 2 |
| AEE001.16 | CLO 16 | Operate the transistor as an amplifier | PO 1,PO 6 | 2 |
| AEE001.17 | CLO 17 | Process the knowledge and skills for employability and to succeed national and international level competitive examinations. | PO 1,PO 2, PO 3,PO 6 | 2 |

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## X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

| CLOs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CLO 1 | 3 | 2 | 2 | | | | | | | | | | | | |
| CLO 2 | 2 | 2 | | | | | | | | | | | | 2 | |
| CLO 3 | 3 | | | | | | | | | | | | | | |

| CLOs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CLO 4 | | 2 | 2 | | | | | | | | | | | 2 | |
| CLO 5 | | 2 | | | | | | | | | | | | | |
| CLO 6 | 3 | 2 | 2 | | | | | | | | | | | | |
| CLO 7 | 2 | 2 | | | | | | | | | | | | | |
| CLO 8 | 3 | | | | | | | | | | | | | 2 | |
| CLO 9 | | 2 | 2 | | | 2 | | | | | | | | | |
| CLO 10 | | | 2 | | | | | | | | | | | | |
| CLO 11 | 2 | 2 | | | | 2 | | | | | | | | 2 | |
| CLO 12 | 2 | | | | | | | | | | | | | | |
| CLO 13 | 2 | 1 | | | | | | | | | | | | | |
| CLO 14 | 2 | | | | | | | | | | | | | | |
| CLO 15 | | | | | | | | | | | | | | | |
| CLO 16 | 2 | | | | | 2 | | | | | | | | | |
| CLO 17 | 2 | 2 | 2 | | | 2 | | | | | | | | 2 | |

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## XI. ASSESSMENT METHODOLOGIES – DIRECT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CIE Exams | PO 1, PO 2, PO 3 | SEE Exams | PO 1, PO 2, PO 3 | Assignments | PO 6 | Seminars | PO 1, PO 2 |
| Laboratory Practices | PO 1, PO 2, PO3, PO 6 | Student Viva | - | Mini Project | - | Certification | - |
| Term Paper | - | | | | | | |

## XII. ASSESSMENT METHODOLOGIES - INDIRECT

| | | | |
|---|---|---|---|
| ✔ | Early Semester Feedback | ✔ | End Semester OBE Feedback |
| ✘ | Assessment of Mini Projects by Experts | | |

## XIII. SYLLABUS

| UNIT-I | ELECTRIC CIRCUIT ELEMENTS |
|---|---|
| Electric circuit elements: Voltage and current sources, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual | |

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| inductor and constraint on mutual inductance. | |
| **UNIT-II** | **NETWORK ANALYSIS AND THEOREMS** |
| Network analysis: Nodal analysis with independent and dependant sources, modified nodal analysis, mesh analysis, notion of network graph, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages; Network theorems: Voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer theorem | |
| **UNIT-III** | **AC CIRCUITS** |
| RLC circuits: Natural, step and sinusoidal steady state responses, series and parallel RLC circuits.<br>AC signal measurement: Complex, apparent, active and reactive power, power factor.<br>Introduction to three phase supply: Three phase circuits, star-delta transformations, balance and unbalanced three phase load, power measurement, two wattmeter method. | |
| **UNIT-IV** | **SEMICONDUCTOR DIODE AND APPLICATIONS** |
| P-N junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator. | |
| **UNIT-V** | **BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS** |
| DC characteristics, CE, CB, CC configurations, biasing, load line, Transistor as an amplifier. | |
| **Text Books:** | |
| 1. A. Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2004.<br>2. K. S. Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013.<br>3. William Hayt, Jack E. Kemmerly S. M. Durbin, "Engineering Circuit Analysis", Tata Mc Graw Hill, 7th Edition, 2010.<br>4. S. Salivahanan, N Suresh kumar, "Electronic Devices and Circuits", McGraw-Hill, 4th Edition. | |
| **Reference Books:** | |
| 1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition.<br>2. R. L. Boylestad , Louis Nashelsky,"Electronic Devices and Circuits", PEI/PHI, 9th Edition, 2006.<br>3. David A.Bell,"Electric Circuits**",** Oxford University Press, 9th Edition, 2016.<br>4. M. Arshad,"Network Analysis and Circuit**s**", Infinity Science Press, 9th Edition, 2016.<br>5. A. Bruce Carlson,"Circuit**s**", Cengage Learning, 1st Edition, 2008. | |

## XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

| Lecture No | Topic/s to be covered | CLOs | Reference |
|---|---|---|---|
| 1 | Understand the Ohms' law, the basic circuit components resistors inductors, and capacitors. | CLO 1 | T1:1.1, R1:1.1 |
| 2 | Learn the voltage and current sources | CLO 1 | T1:1.5, R1:1.10 |
| 3 | Discuss the Linear, non linear, active and passive elements. | CLO 1 | T1:1.2, R1:1.10 |
| 4-7 | Demonstrate the types of sources, resistive networks, inductive networks, capacitive networks. | CLO 1 | T1:1.3, R1:1.9 |
| 8-10 | Discuss the Kirchhoff's laws, elements in series and parallel, superposition in linear circuits. | CLO 2 | T1:2.1, R1:2.1 |
| 11-15 | Describe the Controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance. | CLO 3 | T1:1.5, R1:1.10 |

| Lecture No | Topic/s to be covered | CLOs | Reference |
|---|---|---|---|
| 16-17 | Demonstrate Nodal analysis with independent and dependant sources | CLO 4 | T1:2.5, R1:2.11 |
| 18-20 | Examine nodal analysis, mesh analysis, notion of network graph, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages. | CLO 4 | T1:16.1, R1:2.12 |
| 21-25 | Prove the law of conservation of energy, Superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitations. | CLO 5 | T1:3.1, R1:7.4 |
| 26-27 | Summarize the procedure of Thevenin's, Norton's and Milliman's theorems to reduce complex network into simple equivalent network. | CLO 6 | T1:3.5, R1:7.5 |
| 28 | Explain the steps of compensation, zero current and voltage shift theorem to predict constraints of electrical networks. | CLO 7 | T1:3.6, R1:3.10 |
| 29 | Understand the concept of alternating quantities | CLO 8 | T1:4.1, R1:3.10 |
| 30-32 | Learn the RLC circuits, Natural, step and sinusoidal steady state responses, series and parallel RLC circuits. | CLO 9 | T1:4.4, R1:3.10 |
| 33-35 | Demonstrate the Complex, apparent, active and reactive power, power factor. | CLO 10 | T1:6.3, R1:3.4 |
| 36-38 | Understand the Three phase circuits, star-delta transformations. | CLO 10 | T1:7.3, R1:3.17 |
| 39-44 | Discuss the balance and unbalanced three phase load, power measurement, two wattmeter method | CLO 10 | T1:7.4, R1:3.17 |
| 45 | Understand the concept of P-N junction diode, symbol | CLO 11 | T5:5.2, R2:3.17 |
| 46 | Learn the V-I characteristics of P-N junction diode, | CLO 11 | T5:5.6, R2:1.3 |
| 47-48 | Discuss the concept of half wave rectifier and full wave rectifier | CLO 12 | T5:6.1, R2:1.10 |
| 49-51 | Understand the bridge rectifiers and filters | CLO 12 | T5:6.4, R2:2.1 |
| 52-53 | Discuss the concept of diode as a switch, Zener diode as a voltage regulator | CLO 13 | T5:6.5, R2:2.4 |
| 54-55 | Know the concept of Transistors and Understand the configurations.. | CLO 14 | T5:7.1, R2:1.15 |
| 56–57 | Understand the DC characteristics of transistor | CLO 15 | T5:7.2, R2:3.1 |
| 58-59 | Understand the biasing and load line analysis. | CLO 15 | T5:8.2, R2:3.5 |
| 60 | Discuss how transistor acts as an amplifier. | CLO 16 | T5:7.18, R2:3.6 |

## XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

| S No | Description | Proposed actions | Relevance with POs | Relevance with PSOs |
|---|---|---|---|---|
| 1 | Voltage Current relationship for passive elements for different input signals – ramp and, saw tooth and triangular. | Seminars / Guest Lectures / NPTEL | PO 1 | PSO 2 |

**Prepared by:**
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**HOD, FRESHMAN ENGINEERING**