|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Semester** | : | I/II | **Year** | : | 2025-26 |
| **Course Title** | : | Basic Electrical and Electronics Engineering | **Course Type** | : | ESC |
| **Course Code** | : | EE1002-2 | **Credits** | : | 03 |
| **Teaching Hours/Week**  **(L: T: P: S)** | : | 3:0:0:0 | **CIE Theory**  **CIE Lab** | :  : | 50 Marks (100% weightage)  Nil |
| **Total Teaching Hours** | : | 40+0+0 | **SEE Marks** | : | 50 |
| **Prepared By** | : |  | **Date** | : |  |
| **Reviewed by** | : | Pradeep Kumar | **Date** | : |  |
| **Updated By** | : | Akshatha NM | **Date** | : |  |
| **Checked by** | : |  | **Date** | : |  |

**Prerequisites:** Nil

**Course Objectives:**

1. To get familiarized with DC circuit analysis.
2. To understand the working principle of transformer and electrical machines.
3. Understand the working of Semiconductor Diodes, Zener Diodes, and its applications.
4. Understand the construction, working and characteristics of diodes, BJT and MOSFET
5. Understand the working of Op-Amp and their applications.

**Course Content**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lecture Hours** | **Topic** | **Textbook/ Ref Book** | **Teaching Methodology** |
|  | **Unit - I**  **Circuit Fundamentals:** Basic mesh analysis excited by independent DC voltage source | 1,2 | BB |
|  | Basic nodal analysis excited by independent DC voltage source | 1,2 | BB |
|  | Power and Energy. Generation of sinusoidal voltage, frequency of generated voltage | 1,2 | BB |
|  | Definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current | 1,2 | BB |
|  | Phasor representation of alternating quantities, analysis of R circuit | 1,2 | BB |
|  | Analysis of L, C circuits, numerical | 1,2 | BB |
|  | Analysis of R-L and R-C series circuits, numerical | 1,2 | BB |
|  | Analysis of R-L-C series circuits, numerical | 1,2 | BB |
|  | Real power, reactive power, apparent power and power factor, numerical | 1,2 | BB |
|  | **Unit - II**  **Transformers and electrical machines**  **Transformers:** Necessity of transformer, principle of operation | 1,2 | BB |
|  | Types and construction of single-phase transformers, EMF equation | 1,2 | BB |
|  | Losses and efficiency, numerical | 1,2 | BB |
|  | **DC Motor:** Principle of operation, back emf and its significance. | 1,2 | BB |
|  | Torque equation and problems | 1,2 | BB |
|  | Characteristics and speed control (armature & field) of DC shunt motor | 1,2 | BB |
|  | Numerical | 1,2 | BB |
|  | **Three-phase induction motors:** Concept of rotating magnetic field, principle of operation | 1,2 | BB |
|  | Constructional features of motor, types – squirrel cage and wound rotor. | 1,2 | BB |
|  | **Unit – III:**  **Diodes, Transistors and their applications:** Semiconductor Diode, Diode equivalent circuits | 3 | BB |
|  | Half wave rectifier | 3 | BB |
|  | Full wave bridge rectifier | 3 | BB |
|  | Numerical | 3 | BB |
|  | Demonstration of Half wave, full wave bridge rectifier |  |  |
|  | Zener diode | 3 | BB |
|  | Zener diode as voltage regulator | 3 | BB |
|  | Numerical problems | 3 | BB |
|  | **Unit – IV**  **Bipolar Junction Transistor:** Construction | 3 | BB |
|  | Operation of BJT | 3 | BB |
|  | BJT as a switch | 3 | BB |
|  | Working of n-channel Enhancement type MOSFET | 3 | BB |
|  | Characteristics of n-channel Enhancement type MOSFET | 3 | BB |
|  | Common source amplifier | 3 | BB |
|  | DC load line analysis | 3 | BB |
|  | Numerical problems | 3 | BB |
|  | MOS inverter | 3 | BB |
|  | Demonstration of BJT as switch |  |  |
|  | **Unit – V**  **Op-Amp and Linear IC Applications:** Introduction, Op-Amp Specifications | 3 | BB |
|  | Differential and Common-Mode operation |  | BB |
|  | Op-Amp applications: Inverting/Non-Inverting Amplifier | 3 | BB |
|  | Summing amplifier | 3 | BB |
|  | Integrator | 3 | BB |
|  | Differentiator and Comparator | 3 | BB |
|  | 555 Timer IC in Astable mode | 3 | BB |
|  | Numerical on 555 timer | 3 | BB |
|  | 78XX series IC Voltage Regulators | 3 | BB |

**Course Outcomes:** At the end of the course, students will be able to

|  |  |
| --- | --- |
| EE1002-1.1 | Analyze DC and AC circuits to determine circuit parameters |
| EE1002-1.2 | Describe the construction, operating principle of transformers, DC and induction motors to study performance characteristics |
| EE1002-1.3 | Analyze characteristics of p-n junction and Zener diode to understand their operation in specific applications |
| EE1002-1.4 | Describe the construction and operation of BJT and FET to operate it as a switch |
| EE1002-1.5 | Describe the basic building blocks of Op-Amp and signal processing circuits to design Op-Amp for timing circuits. |

**Course Outcomes Mapping with Program Outcomes & PSO**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Program Outcomes→**  **↓Course Outcomes** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | **PSO1** | **PSO2** |
| EE1002-1.1 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | - | - | - |
| EE1002-1.2 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | - | - | - |
| EE1002-1.3 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | - | - | - |
| EE1002-1.4 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | - | - | - |
| EE1002-1.5 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | - | - | - |

**1: Low2: Medium 3: High**

**TEXTBOOKS:**

1. Hughes, Edward, “Electrical Technology”, Pearson Education Publications, 10th Edition, 2010
2. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 3rd Edition 2009
3. Robert L Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, PHI, 2016

**Evaluation Scheme (CIE)**

|  |  |
| --- | --- |
| **Theory Assessment** | **Weightage in Marks** |
| Mid Semester Examination (MSE) – I | 15 Marks |
| Mid Semester Examination (MSE) – 2 | 15 Marks |
| Task Consisting of Quiz /Surprise Test/ Assignment\*\* | 20 Marks |
| **Total CIE** | **50 Marks** |

**Task Assessment:**

1. A quiz (Task-1 for 4 Marks) on unit-1 and 2 before MSE-1.
2. A quiz (Task-2 for 4 Marks) on unit-3 and 4 before MSE-2.
3. An assignment (Task-3 for 2 Marks) on unit-3 after completion of half of the unit-5.

**Rubrics for evaluation of Assignment:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Criterion** | **Excellent – 4** | **Very Good – 3** | **Good – 2** | **Average – 1** | **Below Average – 0** |
| Completeness | Addresses all elements in the assignment | Addresses most of elements in the assignment | Addresses some elements in the assignment | Incomplete in most respects; does not address most of the elements of the assignment | Not Submitted |
| Writing Mechanics | Writing with clarity, conciseness, correctness; with relevant data /information; and well-organized | Writing with clarity and conciseness and contains only a few errors; with relevant data /information; and well-organized | Writing lacks clarity or conciseness and contains numerous errors; gives insufficient relevant data /information; lacks organization | Writing is unfocused, rambling, or contains serious errors; lacks relevant data / information; poorly organized |
| Marks Awarded | = | | | | | |

**Rubrics for evaluation of Surprise Test /MCQ**

Surprise quiz will have 08 Questions for 08 Marks and will be evaluated for 4 Marks with following Rubrics

|  |  |
| --- | --- |
| Secured marks (out of 08) | Averaged Marks |
| 07< Marks < 08 | 4 |
| 05< Marks < 06 | 3 |
| 03< Marks < 04 | 2 |
| 01<Marks < 02 | 1 |
| Marks< 01 | 0 |

**Evaluation Scheme (SEE)**

Semester End Examination (SEE) is a written examination of three hours duration of 100 marks with 50% weightage. The pattern of the Question Paper: There will be eight questions with 3 questions from Unit1 and 2 and 2 questions from Unit-3. Answer any TWO questions from units 1 and 2, and any ONE question from unit 3.

**Course Utilization for MSE and SEE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Unit** | **Contents** | **Lecture Hours** | **No. of questions in** | | |
| **MSE 1** | **MSE 2** | **SEE** |
| 1 | **Circuit Fundamentals:** Basic nodal and mesh analysis excited by independent DC voltage sources, Power and Energy. Generation of sinusoidal voltage, frequency, average value, root mean square value, form factor and peak factor of generated voltage, phasor representation of alternating quantities.  Analysis of R, L, C, R-L, R-C and R-L-C series. Phasor Diagrams. Real power, reactive power, apparent power and power factor. | 9 | 2 |  | 2 |
| 2 | **Transformers and Electrical Machines: Transformers:** Necessity of transformer, principle of operation, Types and construction of single-phase transformers, EMF equation, losses and efficiency  **DC Motor:** Principle of operation, back emf and its significance. Torque equation characteristics and speed control (armature & field) of DC shunt motor  **Three-phase induction Motor:** Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel cage and wound rotor. | 9 | 2 |  | 2 |
| 3 | **Diodes, Transistors and Their Applications:** Semiconductor Diode, Diode Equivalent circuits, Half Wave Rectifier, Full wave Bridge Rectifier. Zener Diode and its use in Voltage Regulation. | 9 |  | 2 | 2 |
| 4 | **Bipolar Junction Transistor:** Construction and operation, BJT as a switch, Working and Characteristics of n-channel Enhancement type MOSFET, Common source amplifier, DC load line analysis, MOS Inverter. | 9 |  | 2 | 2 |
| 5 | **Op-Amp and Linear IC Applications:** Introduction, Op-Amp Specifications, Differential & Common-Mode operation, Op-Amp applications: Inverting/Non-Inverting Amplifier, Summing, Integrator, Differentiator, Comparator. 555 Timer IC in Astable mode. 78XX series IC Voltage Regulators. | 9 | - | - | 2 |
|  | | | Answer any **ONE** full question from each unit | Answer any **ONE** full question from each unit | Answer any **FIVE** full questions, selecting any **One** full question from each unit. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom Levels** | **Level of Learning** | **Characteristics of Learning** | **Bloom Action Words** |
| BL1 | Remembering | Recognizing and recalling relevant knowledge from long term memory | List, Identify Outline, Define |
| BL2 | Understanding | Constructing meaning from oral, written and graphic messages through interpreting, classifying, summarizing, inferring, comparing and explaining | Explain, Describe, Interpret, Distinguish |
| BL3 | Applying | Carrying out or using a procedure through executing or implementing | Apply, Calculate, Solve |
| BL4 | Analyzing | Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing | Calculate, Analyze, Compare, Classify, Derive, Explain |
| BL5 | Evaluating | Making judgements based on criteria and standards through checking and critiquing | Determine, Optimize, Evaluate |
| BL6 | Creating | Putting elements together to form a coherent or function whole: recognizing elements into a new pattern or structure through generating, planning or producing | Formulate, Design, Create |

**Bloom’s Taxonomy Levels (BL) Planned in MSE and SEE:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl. No.** | **Bloom’s Taxonomy Levels (BL)** | **MSE 1** | **MSE 2** | **SEE** |
| 1 | Remember | 30% | 30% | 30% |
| 2 | Understand | 40% | 40% | 40% |
| 3 | Apply | 30% | 30% | 30% |

**Unit wise plan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | | **Planned Hours (L-T-P)** | **Teaching Methodology** | |
| **Circuit Fundamentals:** Basic nodal and mesh analysis excited by independent DC voltage sources, Power and Energy. Generation of sinusoidal voltage, frequency, average value, root mean square value, form factor and peak factor of generated voltage , phasor representation of alternating quantities.  Analysis of R, L, C, R-L, R-C and R-L-C series. Phasor Diagrams. Real power, reactive power, apparent power and power factor. | | **9+0+0** | BB | |
| **Learning Outcomes:** At the end of this unit, students will be able to   1. Analyze the circuits using nodal and mess analysis excited by independent voltage sources. 2. Understand the AC circuit fundamentals. 3. Analyze R, L, C, R-L, R-C, R-L-S series circuits. | | | | |
| **Sample MCQ Questions on Unit-I** | | | | |
|  | Form factor is the ratio of \_\_\_\_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | Maximum value to Average value | c. | Maximum value to RMS value | | b. | RMS value to Average value | d. | None of these | | | | |
|  | \_\_\_\_\_\_\_\_\_ is defined as the amount of work a physical system is capable of performing,  that is, the capacity of the system to do work   |  |  |  |  | | --- | --- | --- | --- | | a. | Energy | c. | Power | | b. | Voltage | d. | Current | | | | |
|  | The capacitive reactance of a circuit is measured in \_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | Ohms | c. | Farads | | b. | Mho | d. | Coulomb | | | | |
| **Review questions on Remembering (BTL1)** | | | | |
|  | Define (i) power and (ii) energy | | | 2 |
|  | Define (i) RMS value (ii) Average value | | | 4 |
|  | Define (i) Form factor (ii) Peak factor | | | 2 |
|  | Define Real power, reactive power, apparent power and power factor. | | | 4 |
| **Review questions on Understanding (BTL2)** | | | |  |
|  | Prove that the power consumed by a pure inductor energized by a AC source over a complete cycle is zero. Draw the relevant circuit diagram, phasor diagram and waveform diagram. | | | 6 |
| **Review questions on Applying (BTL3)** | | | |  |
|  | Use mesh analysis to determine the voltage across 40 Ω in the circuit given below: | | | 6 |
|  | A 10 Ω resistor is energized by a voltage source v=14.14 sin 100π t volts. Calculate (i) maximum value of the current (ii) RMS value of the current (iii) frequency of the current (iv) phase difference between the current and the voltage (v) the instantaneous value of the current in that circuit. | | | 5 |
|  | Define average value of an alternating quantity, also derive an expression for average value of current | | | 6 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | | **Planned Hours (L-T-P)** | **Teaching Methodology** | |
| **Transformers and Electrical Machines: Transformers:** Necessity of transformer, principle of operation, Types and construction of single-phase transformers, EMF equation, losses and efficiency  **DC Motor:** Principle of operation, back emf and its significance. Torque equation characteristics and speed control (armature & field) of DC shunt motor  **Three-phase induction Motors:** Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel cage and wound rotor. | | **9+0+0** | BB | |
| **Learning Outcomes:** At the end of this unit, students will be able to  1. Discuss the construction and working principles of transformers and Three phase induction motors.  2. Discuss the working principle of DC motor and the characteristics of shunt DC motors. | | | | |
| **Sample MCQ Questions on Unit-II** | | | | |
|  | The slip of an induction motor is defined as the ratio of   |  |  |  |  | | --- | --- | --- | --- | | a. | Synchronous speed to slip speed | c. | Slip speed to synchronous speed | | b. | Synchronous speed to constant speed | d. | Constant speed to synchronous speed | | | | |
|  | A transformer transfers electrical energy from primary circuit to secondary circuit without change in \_\_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | frequency | c. | voltage | | b. | power | d. | time period | | | | |
|  | For the construction of the armature of a DC machine, the best suited material is   |  |  |  |  | | --- | --- | --- | --- | | a. | Cast iron | c. | Silicon Steel | | b. | Carbon | d. | All of these | | | | |
| **Review questions on Remembering (BTL1)** | | | | |
| 1. | What is back EMF? | | | 2 |
| 2. | Define slip of an induction motor. | | | 2 |
| **Review questions on Understanding (BTL2)** | | | |  |
| 1. | Explain the necessity and principle of operation of transformer | | | 6 |
|  | Explain the construction of single phase transformers | | | 4 |
|  | Identify the differences between the squirrel cage and wound rotor three phase induction motors. | | | 4 |
|  | Discuss the characteristics and applications of DC series and shunt motors | | | 6 |
|  | Explain the working principle of induction motor | | | 6 |
| **Review questions on Applying (BTL3)** | | | |  |
| 1. | Derive the EMF equation of a single phase transformer. | | | 6 |
|  | Derive the torque equation of DC motor | | | 5 |
| 3. | A 125 kVA transformer has a primary voltage of 2000 volts at 50Hz. The number of turns in primary and secondary are 182 and 40 respectively. Neglecting losses, calculate (i) No load secondary EMF and (ii) full load primary and secondary current. | | | 6 |
| 4. | Determine the total torque developed in a 250 V, 4 pole, DC shunt motor with lap winding accommodated in 60 slots each containing 20 conductors. The armature current is50 A and the flux per pole is 23 mWb. | | | 6 |

**MODEL QUESTION FOR MSE-1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |   USN | | | | |
| **NMAM INSTITUTE OF TECHNOLOGY, NITTE** | | | | |
| ***Off-Campus Centre of Nitte (Deemed to be University****)* | | | | |
| **I Sem B.Tech (E&EE) Mid Semester Examinations - I** | | | | |
| **EE1002-1 – Basic Electrical and electronics engineering**  **(For CV, ME Only)** | | | | |
| Duration: 1 Hour Max. Marks: 15 | | | | |
| **Part – A: Multiple Choice Questions** (1\*4 = 4 marks)  *Note: Answer all* ***Four*** *questions in the* ***Answer Book****. Each question carries equal marks.* | | | | |
| **1.** | When a pure resistive circuit is energized by an AC supply, the angle θ between the voltage and its current is | | | |
|  | A) | 90 | B) | 0 |
|  | C) | 0< θ<90 | D) | Θ>90 |
| **2.** | A 10V DC supply is connected across the series combination of 2 Ω and an unknown resistor. The total power consumed by the circuit is 20 W. Then, the value of unknown resistor is \_\_\_\_\_\_\_\_\_\_\_ | | | |
|  | A) | 3 Ω | B) | 5 Ω |
|  | C) | 6 Ω | D) | 9 Ω |
| **3.** | The current drawn by a 120V DC motor of armature resistance 0.5 Ω and back e.m.f. 110V is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ ampere. | | | |
|  | A) | 20 | B) | 220 |
|  | C) | 240 | D) | 5 |
| **4.** | A transformer has 100 primary turns and 400 secondary turns if the primary voltage is 200V then the secondary voltage is \_\_\_\_\_\_\_\_ | | | |
|  | A) | 800V | B) | 80V |
|  | C) | 1600V | D) | 2400V |

**Part – B: Descriptive Answer Questions** (2\*8 = 16 marks)

*Note: Answer any* ***One*** *full question from* ***each Unit.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Unit – I** | **Marks** | **BT\*** | **CO\*** | **PO\*** |
| 1. | a) | Define RMS value of an alternating quantity. Also, establish the relationship between the RMS value and the maximum value of an alternating quantity. | 4 | L2 | 1 | 1 |
|  | b) | A 10 Ω resistor is energized by a voltage source v=14.14 sin 100π t volts. Calculate (i) maximum value of the current (ii) RMS value of the current (iii) frequency of the current (iv) phase difference between the current and the voltage (v) the instantaneous value of the current in that circuit. | 4 | L3 | 1 | 1,2 |
|  |  |  |  |  |  |  |
| 2. | a) | Prove that the average power consumed by a pure inductive circuit over a complete cycle is zero. Draw the associated circuit diagram, phasor diagram and waveform diagram. | 4 | L2 | 1 | 1 |
|  | b) | Use mesh analysis to determine the voltage across 40 Ω in the circuit Fig 2 (b) below:    Fig 2 (b) | 4 | L3 | 1 | 1,2 |
|  |  |  |  |  |  |  |
|  |  | **Unit – II** |  |  |  |  |
| 3. | a) | Derive the EMF equation of a single-phase transformer. Also, list out the various losses in the single-phase transformer. | 4 | L2 | 2 | 1 |
|  | b) | Determine the total torque developed in a 250 V, 4 pole, DC shunt motor with lap winding accommodated in 60 slots each containing 20 conductors. The armature current is50 A and the flux per pole is 23 mWb. | 4 | L3 | 2 | 1,2 |
|  |  |  |  |  |  |  |
| 4. | a) | What is back EMF in a DC motor? Also explain its significance. | 4 | L1 | 2 | 1 |
|  | b) | A 125 kVA transformer has a primary voltage of 2000 volts at 50Hz. The number of turns in primary and secondary are 182 and 40 respectively. Neglecting losses, calculate (i) No load secondary EMF and (ii) full load primary and secondary current. | 4 | L3 | 2 | 1,2 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | | **Planned Hours (L-T-P)** | **Teaching Methodology** | |
| **Diodes, Transistors and their applications:** Semiconductor Diode, Diode Equivalent circuits, Half Wave Rectifier, Full wave Bridge Rectifier. Zener Diode and its use in Voltage Regulation. | | **9-0-0** | BB | |
| **Learning Outcomes:** At the end of this unit, students will be able to   1. Understand the construction of semiconductor diode 2. Explain the working of a half wave rectifier and full wave bridge rectifier 3. Explain the working of Zener diode as voltage regulator | | | | |
| **Sample MCQ Questions on Unit-III** | | | | |
|  | When forward biased, a p-n junction diode \_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | blocks current | c. | conducts current | | b. | has high resistance | d. | none of these | | | | |
|  | Zener diode regulates output voltage only when it is connected in \_\_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | forward bias | c. | reverse bias | | b. | short circuit | d. | open circuit | | | | |
|  | What is rectification?   |  |  |  |  | | --- | --- | --- | --- | | a. | Process of conversion of low ac into high ac | c. | Process of conversion of ac into dc | | b. | Process of conversion of dc into ac | d. | Process of conversion of low dc into high dc | | | | |
| **Review questions on Remembering (BTL1)** | | | | |
|  | How a p-n junction diode is formed? | | | 4 |
|  | What is a zener diode? | | | 2 |
| **Review questions on Understanding (BTL2)** | | | |  |
|  | What is meant by forward biasing and reverse biasing a diode? | | | 4 |
|  | Explain the diode equivalent circuits. | | | 6 |
|  | Explain the I – V characteristics of pn junction diode | | | 6 |
|  | Explain full wave bridge rectifier | | | 6 |
|  | Explain the working of half wave rectifier | | | 6 |
|  | Explain the working of Zener diode as voltage regulator | | | 6 |
| **Review questions on Applying (BTL3)** | | | |  |
|  | An AC supply of 230 V is applied to a half wave rectifier circuit through a transformer of turns ratio 10:1. Find (i) the output DC voltage (ii) the peak inverse voltage. Assume the diode to be ideal. | | | 6 |
|  | The four diodes used in a full wave bridge rectifier have forward resistances which may be considered constant at 1Ω and infinite reverse resistance. The alternating supply voltage is 240 V (RMS) and load resistance is 480 Ω. Calculate (i) mean load current and (ii) power dissipated in each diode. | | | 6 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | | **Planned Hours (L-T-P)** | **Teaching Methodology** | |
| **Bipolar Junction Transistor:** Construction and operation, BJT as a switch, Working and Characteristics of n-channel Enhancement type MOSFET, Common source amplifier, DC load line analysis, MOS Inverter. | | **9-0-0** | BB | |
| **Learning Outcomes:** At the end of this unit, students will be able to  1. Analyze the common emitter and common base characteristics of a BJT  2.Discuss the working of a MOSFET | | | | |
| **Sample MCQ Questions on Unit-IV** | | | | |
| 1. | What type of a device is MOSFET   |  |  |  |  | | --- | --- | --- | --- | | a. | current controlled | c. | voltage controlled voltage source | | b. | voltage controlled | d. | voltage controlled current source | | | | |
| 2. | The DC load line represents:   |  |  |  |  | | --- | --- | --- | --- | | a. | The relationship between the AC input and output in a transistor circuit | c. | The relationship between the collector current (IC) and collector-emitter voltage (VCE) for a given circuit. | | b. | The maximum power dissipation of the transistor | d. | The frequency response of the transistor circuit. | | | | |
| 3. | A transistor has the base current of 0.06 mA and the emitter current of 9.00 mA. Then the value of alpha is \_\_\_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | 9.9 | c. | 1.01 | | b. | 0.99 | d. | 900 | | | | |
| **Review questions on Remembering (BTL1)** | | | | |
|  | - | | | 4 |
|  | - | | | 2 |
| **Review questions on Understanding (BTL2)** | | | |  |
| 1. | Explain the characteristics of a BJT. | | | 6 |
| 2. | Explain the construction and operation of a BJT | | | 6 |
| 3. | Write a note on MOS inverter | | | 6 |
| **Review questions on Applying (BTL3)** | | | |  |
| 1. | Calculate IE in a transistor for which β=50 and IB=20µA | | | 6 |
| 2. | In a transistor, IB=68µA, IE=30mA and β=440. Determine it α (alpha) rating. Also, determine the value of IC using both the α (alpha) and β (beta) ratings. | | | 8 |

**MODEL QUESTION FOR MSE-2**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
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| **NMAM INSTITUTE OF TECHNOLOGY, NITTE** | | | | |
| ***Off-Campus Centre of Nitte (Deemed to be University****)* | | | | |
| **I/II Sem B.Tech (E&EE) Mid Semester Examinations - II** | | | | |
| **EE1002-1 – Basic Electrical and electronics engineering**  **(For CV, ME Only)** | | | | |
| Duration: 1 Hour Max. Marks: 15 | | | | |
| **Part – A: Multiple Choice Questions** (1\*4 = 4 marks)  *Note: Answer all* ***Four*** *questions in the* ***Answer Book****. Each question carries equal marks.* | | | | |
| 1. | The amount of ripples present at the output of half wave rectifier is | | | |
|  | A) | 0.81 | B) | 0.46 |
|  | C) | 1.21 | D) | 0.50 |
| 2. | The DC load current of a half wave rectifier is | | | |
|  | A) | Im/π | B) | 2Idc/π |
|  | C) | 2Im/π | D) | 1.414/π |
| 3. | The enhancement type MOSFET works only with \_\_\_\_\_\_\_. | | | |
|  | A) | Large negative gate voltage | B) | Large negative drain voltage |
|  | C) | Large positive source voltage | D) | Large positive gate voltage |
| 4. | When BJT operates as a switch, it is operated alternately in \_\_\_\_\_\_\_\_\_\_\_\_\_ | | | |
|  | A) | Active and cut-off region | B) | Saturation and active region |
|  | C) | Active and saturation region | D) | Cut-off and Saturation region |

**Part – B: Descriptive Answer Questions** (2\*8 = 16 marks)

*Note: Answer any* ***One*** *full question from* ***each Unit.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Unit – I** | **Marks** | **BT\*** | **CO\*** | **PO\*** |
| 1. | a) | With appropriate circuits, explain the forward and reverse bias operations of a pn – junction diode. | 4 | L2 | 3 | 1 |
|  | b) | A diode having internal resistance Rf = 20 Ω is used for half wave rectification. If the applied voltage v=50 sinωt and the load resistance is RL = 800 Ω, find (i) Im, Idc , Irms (ii) AC power input and DC power output (iii) DC output voltage (iv) efficiency of rectification. | 4 | L3 | 3 | 1,2 |
|  |  |  |  |  |  |  |
| 2. | a) | Explain the different diode equivalent circuits with appropriate graphs. | 4 | L2 | 3 | 1 |
|  | b) | Derive the expressions for Vdc and Vrms of a full wave bridge rectifier. | 4 | L3 | 3 | 1,2 |
|  |  |  |  |  |  |  |
|  |  | **Unit – II** |  |  |  |  |
| 3. | a) | Plot and explain the static V-I characteristic of a zener diode. | 4 | L2 | 4 | 1 |
|  | b) | A transistor has Ib = 0.08mA and IE = 9.60 mA. Determine its collector current Ic, α (alpha) and β (beta). | 4 | L3 | 4 | 1,2 |
|  |  |  |  |  |  |  |
| 4. | a) | With the appropriate diagrams, explain the different currents and voltages of a npn bipolar junction transistor. | 4 | L2 | 4 | 1 |
|  | b) | Draw and explain the input and output characteristics of common base configuration of a BJT. | 4 | L3 | 4 | 1,2 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | | **Planned Hours (L-T-P)** | **Teaching Methodology** | |
| **Op-Amp and Linear IC Applications:**  Introduction, Op-Amp Specifications, Differential and Common Mode Operation, Op-Amp applications:  Inverting/Non-Inverting Amplifier, Summing, Integrator, Differentiator, Comparator, 555 Timer IC in Astable mode. 78XX series IC Voltage Regulators. | | **08+0+0** | PPT,BB | |
|  | |  |  | |
| **Learning Outcomes:** At the end of this unit, students will be able to   1. Understand the differential and common mode operation of the Op-Amp 2. Explain the applications of Op-Amps 3. the working of 555 timer in astable mode and 78XX series ICs as voltage regulators | | | | |
| **Sample MCQ** Explain **Questions on Unit-V** | | | |  |
|  | Which is not the ideal characteristic of an Op-Amp?   |  |  |  |  | | --- | --- | --- | --- | | a. | Input resistance is zero | c. | Bandwidth is infinity | | b. | Output impedance is zero | d. | Open loop voltage gain is infinity | | | | |
|  | A sine wave if 0.5 V peak voltage is applied as an input to a non-inverting amplifier with Ri=12 kΩ and Rf=24 kΩ. The output voltage is \_\_\_\_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | -2.5 V peak | c. | 1.5 V peak | | b. | 10 V peak | d. | -5 V peak | | | | |
|  | The two Op-Amps used in the internal circuit of IC 555 timer function as \_\_\_\_   |  |  |  |  | | --- | --- | --- | --- | | a. | comparators | c. | differentiators | | b. | voltage followers | d. | amplifiers | | | | |
| **Review questions on Remembering (BTL1)** | | | | |
|  | What are the characteristics of an ideal Op-Amp? | | | 4 |
|  | Draw the circuit symbol of an Op-Amp and identify its different terminals. | | | 4 |
|  | Draw the equivalent circuit of an Op-Amp. | | | 4 |
|  | Name the different applications of an Op-Amp. | | | 4 |
|  | Draw the pin configuration of a 555 timer IC. | | | 4 |
|  | What is a voltage regulator? | | | 4 |
| **Review questions on Understanding (BTL2)** | | | |  |
|  | Compare an ideal Op-Amp with a practical Op-Amp. | | | 4 |
|  | With a suitable circuit, explain the working of a summing circuit. | | | 6 |
|  | Explain the working of a non-inverting amplifier and hence derive its gain. | | | 6 |
|  | Explain the architecture of a 555 timer IC. | | | 6 |
|  | Explain the working of 78XX series IC voltage regulators. | | | 6 |
| **Review questions on Applying (BTL3)** | | | |  |
|  | An Op-Amp has a differential voltage gain of 2500 and CMRR of 30000. Calculate the common mode gain. | | | 4 |
|  | Deign a summer circuit using Op-Amp for the output voltage V0=-2(0.1V1 + 0.5V2 + 2 V3). Given the feedback resistor as 10kΩ. Draw the circuit diagram for the same. | | | 6 |
|  | Find the gain and output voltage for a non-inverting amplifier using Op-Amp when input voltage is 0.7VP. The supply voltage is ±15 V. Given Rf=7kΩ and R1=1kΩ. Sketch the waveforms. | | | 8 |
|  | For an IC timer based astable multivibrator, the duty cycle is D=75% with f=1kHz, R2=3.6kΩ and C=0.1µF. Calculate the ON priod TON and the value of R1. | | | 6 |

**Model Semester End Examination Question Paper**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |   USN |
| **NMAM INSTITUTE OF TECHNOLOGY, NITTE** |
| **Off-Campus Centre of Nitte (Deemed to be University***)* |
| **First Semester B.Tech (CBCS) Degree Examinations** |
| December 2025 |
| **EE1002-1 – basic electrical and electronics engineering**  **(For CV and Me)** |
| Duration: 3 Hours Max. Marks: 100 |
| **Note:**  Part – A: Multiple Choice Questions: Answer all **Twenty** questions in the **OMR Sheet** provided. Each question carries equal marks.  Part – B: Descriptive Answer Questions: Answer **Five full** questions choosing **Two full** questions from **Unit – I** &**Unit – II each** and **One full** question from **Unit – III.** |

**PART - A: MULTIPLE CHOICE QUESTIONS 20 Marks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **In case of mesh analysis, the equations for each mesh is written by applying \_\_\_\_\_\_\_\_\_** | | | |
| A) | KCL | B) | KVL |
| C) | KVL and KCL | D) | none of these |
|  | **If a 4 pole, 50 Hz single phase machine generates an induced voltage of 100V, its speed of rotation is \_\_\_\_\_\_\_ rpm** | | | |
| A) | 3000 | B) | 750 |
| C) | 1500 | D) | none of these |
|  | **The angle between the current and the voltage in a pure resistive circuit is \_\_\_\_\_\_ degrees** | | | |
| A) | 90 | B) | 180 |
| C) | 0 | D) | 360 |
|  | **In a pure capacitive circuit, if the frequency is decreased to a very low value, it \_\_\_\_\_\_\_\_** | | | |
| A) | will behave like a short circuit | B) | will have no impact on its impedance |
| C) | will behave like an open circuit | D) | is not possible to determine its behaviour |
|  | **The winding of the transformer with lesser number of turns is \_\_\_\_\_\_** | | | |
| A) | high voltage winding | B) | low voltage winding |
| C) | either high or low voltage winding | D) | none of these |
|  | **A transformer has 100 primary turns and 50 secondary turns if the primary voltage is 200V then the secondary voltage is \_\_\_\_\_\_\_\_ V** | | | |
| A) | 100 | B) | 200 |
| C) | 400 | D) | 1/400 |
|  | **The number of parallel paths in a 4 pole, wave wound DC motor is \_\_\_\_\_\_\_\_** | | | |
| A) | 4 | B) | 2 |
| C) | 8 | D) | 16 |
|  | **The current drawn by a 120 V DC motor of armature resistance 0.5 Ω and back EMF 110 V is \_\_\_\_\_\_ A** | | | |
| A) | 5 | B) | 220 |
| C) | 240 | D) | 20 |
|  | **For correct working of an NPN bipolar junction transistor, the different electrodes should have the following polarities with respect to emitter.** | | | |
| A) | collector +ve, base +ve | B) | collector -ve, base –ve |
| C) | collector +ve, base –ve | D) | collector -ve, base +ve |
|  | **The value of total collector current in a CB circuit is \_\_\_\_\_\_\_** | | | |
| A) |  | B) |  |
| C) |  | D) |  |
|  | **The following relationships between α and β are correct EXCEPT\_\_\_\_\_\_\_** | | | |
| A) |  | B) |  |
| C) |  | D) |  |
|  | **Zener diodes are used primarily as \_\_\_\_\_\_\_\_\_** | | | |
| A) | rectifiers | B) | voltage regulators |
| C) | oscillators | D) | Amplifiers |
|  | **A bipolar junction transistor is a \_\_\_\_\_\_\_\_\_\_** | | | |
| A) | Current controlled device | B) | Voltage controlled device |
| C) | Resistance controlled device | D) | None of these |
|  | **In the breakdown region, Zener diode behaves like a source of \_\_\_\_\_\_\_\_** | | | |
| A) | Constant current | B) | Constant power |
| C) | Constant resistance | D) | Constant voltage |
|  | **When a BJT operates in cut-off \_\_\_\_\_\_\_\_\_\_\_** | | | |
| A) |  | B) |  |
| C) | has the negative value | D) | is maximum |
|  | **The leakage current in a transistor is due to \_\_\_\_\_\_** | | | |
| A) | majority charge carriers | B) | zener effect |
| C) | breakdown | D) | minority charge carriers |
|  | **A simple application of an Op-Amp that can be used to generate a gain of unity is \_\_\_\_\_\_\_\_\_\_\_\_** | | | |
| A) | Differentiator | B) | Integrator |
| C) | Comparator | D) | Voltage follower |
|  | **The pin number 7 in IC 555 timer is assigned as \_\_\_\_\_\_\_\_\_\_** | | | |
| A) | Threshold pin | B) | output pin |
| C) | Discharge pin | D) | None of these |
|  | **An ideal Op-Amp has following characteristics** | | | |
| A) | Ri = , Av = , Ro = | B) | Ri = 0, Av =Ro = 0 |
| C) | Ri = , Av = 0, Ro = | D) | Ri = 0, Av = , Ro = |
|  | **A non-inverting closed loop Op Amp circuit generally has a gain factor \_\_\_\_\_\_\_\_\_** | | | |
| A) |  | B) |  |
| C) |  | D) | None of these |

**PART - B: DESCRIPTIVE ANSWER QUESTIONS**

*Note: Each main question carries 16 Marks, maximum sub questions up to 4 levels.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Unit – I** | **Marks** | **BT\*** | **CO\*** | **PO\*** |
| 1. | a) | Define RMS value of an alternating quantity. Also, establish the relationship between the RMS value and the maximum value of an alternating quantity. | 8 | L2 | 1 | 1 |
|  | b) | Determine the total torque developed in a 250 V, 4 pole, DC shunt motor with lap winding accommodated in 60 slots each containing 20 conductors. The armature current is50 A and the flux per pole is 23 mWb. | 4 | L3 | 2 | 1,2 |
|  | c) | What are the various losses in the single-phase transformer. | 4 | L1 | 2 | 1 |
|  |  |  |  |  |  |  |
| 2. | a) | Use mesh analysis to determine the current passing through the 40 Ω resistor in the circuit Fig 2 (a) below:    Fig 2 (a) | 6 | L3 | 1 | 1,2 |
|  | b) | What is back EMF? Derive an expression for back EMF. | 4 | L2 | 2 | 1 |
|  | c) | Define slip of an induction motor. Explain its significance. | 6 | L1 | 2 | 1 |
|  |  |  |  |  |  |  |
| 3. | a) | Prove that the average power consumed by a pure capacitive circuit over a complete cycle is zero. Draw the associated circuit diagram, phasor diagram and waveform diagram. | 8 | L2 | 1 | 1 |
|  | b) | Explain the concept of rotating magnetic field. | 8 | L2 | 2 | 1,2 |
|  |  |  |  |  |  |  |
|  |  | **Unit – II** |  |  |  |  |
| 4. | a) | With neat diagram and waveforms, explain the working of single-phase full wave rectifier | 08 | L2 | 3 | 2 |
|  | b) | Explain the use of BJT as a switch to ON/OFF an LED. | 08 | L2 | 4 | 2 |
|  |  |  |  |  |  |  |
| 5. | a) | Explain the equivalent circuits of a diode. | 08 | L1 | 3 | 2 |
|  | b) | Derive the equation of emitter current IE for common emitter configuration of BJT. | 08 | L3 | 4 | 2 |
|  |  |  |  |  |  |  |
| 6. | a) | With neat diagram and waveforms, explain the working of single-phase half wave rectifier | 08 | L2 | 3 | 2 |
|  | b) | Explain the working principle of RC coupled amplifier using BJT. | 08 | L2 | 4 | 2 |
|  |  |  |  |  |  |  |
|  |  | **Unit – III** |  |  |  |  |
| 7. | a) | With an appropriate circuit, derive an expression for the gain of a non-inverting amplifier using Op-Amp. | 08 | L2 | 3 | 1,2 |
|  | b) | For the circuit of inverting amplifier shown in Figure 7(b), calculate the following:   1. Closed loop gain Af 2. Output Voltage V­o     Figure 7(b) | 04 | L2 | 5 | 2 |
|  | c) | For the circuit of inverting amplifier shown in Figure 7(c), calculate the following:   1. Closed loop gain Af 2. Output Voltage V­o 3. Input Current I1     Figure 7(c) | 04 | L2 | 5 | 2 |
|  |  |  |  |  |  |  |
| 8. | a) | Explain the architecture of 555 Timer IC. | 08 | L2 | 5 | 2 |
|  | b) | Explain how an Op-Amp can be used as an integrator. | 08 | L2 | 5 | 1,2 |

BT\* Bloom’s Taxonomy, L\* Level; CO\* Course Outcome; PO\* Program Outcome

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