BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Electrical Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, Vth Semester,

2nd In-Sem. Examination

Course Code: ELE1501 **Time: 1 Hour**

Course Name: Fundamentals of Power Electronics **Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. PN junction behave as a short circuit in: -
   (a) Reverse biased (b)Forward biased
   (b)Unbiased (d)None of these
2. Silicon Controlled Rectifier is a _____ device: -
   (a)Unidirectional (b) Bidirectional
   (c)Uncontrollable (d) None of these
3. The Full form of GTO is: -
   (a)Gate turn-Off Thyristor (b)Global technology operation
   (c)Gas tube only (d)None of these
4. The transistor operates as an amplifier in _____ region: -
   (a)Cut-off (b)Saturation
   (c)Active (d)None of these
5. The _____MOSFET requires the Gate-Source voltage to switch the device "OFF".
   (a)Depletion type (b)Enhancement type
   (c)Both A and B (d)None of these

Section – B

03X02 = 06 Marks

1. List the various applications of SCR.
2. Write the names of four possible triggering modes of operation of TRIAC.
3. Describe the following components with their symbols: -
   (a) BJT (b) Power Diode

Section – C

03X03 = 09 Marks

1. Explain the mode of operations of the SCR.
2. Explain the different types of BJT configurations (CB, CE& CC).
3. Write in brief about the IGBT with its symbol & applications.

A

Answer Key Set – A (ELE 1501)

School of Electrical Skills
Session: 2020-21 (Summer Semester)
B. Voc. Program, Vth Semester,
2nd In-Sem. Examination

Course Code: ELE1501 **Time: 1 Hour**
Course Name: Fundamentals of Power Electronics **Max. Marks: 20**

Section – A

05X01 = 05 Marks

1. PN junction behave as a short circuit in: -
   (b)Forward biased
2. Silicon Controlled Rectifier is a _____ device: -
   (a)Unidirectional
3. The Full form of GTO is: -
   (a) Gate turn-Off Thyristor
4. The transistor operates as an amplifier in _____ region: -
   (c) Active
5. The _____MOSFET requires the Gate-Source voltage to switch the device "OFF".
   (a) Depletion type

Section – B

03X02 = 06 Marks

1. List the various applications of SCR

Ans.

Applications of SCR

- The silicon controlled rectifier (SCR) is used in AC voltage stabilizers.
- The silicon controlled rectifier (SCR) is used as switch.
- It is used in choppers.
- The silicon controlled rectifier (SCR) is used in inverters.
- The silicon controlled rectifier (SCR) is used for power control.
- It is used for DC circuit breaker.
- Silicon control rectifier (SCR) is used in battery charger.
- It is used to Adjust light dimmer.
- It is used to control motors speed.
- The SCR is used in pulse circuit.
- It is used for AC power control with relay.

2. Write the names of four possible triggering modes of operation of TRIAC.

Ans.

A triac has four possible triggering modes of operation as follows.

- I + Mode = MT_2 current positive (+ve), Gate current positive (+ve)
- I – Mode = MT_2 current positive (+ve), Gate current negative (-ve)
- III + Mode = MT_2 current negative (-ve), Gate current positive (+ve)
- III – Mode = MT_2 current negative (-ve), Gate current negative (-ve)

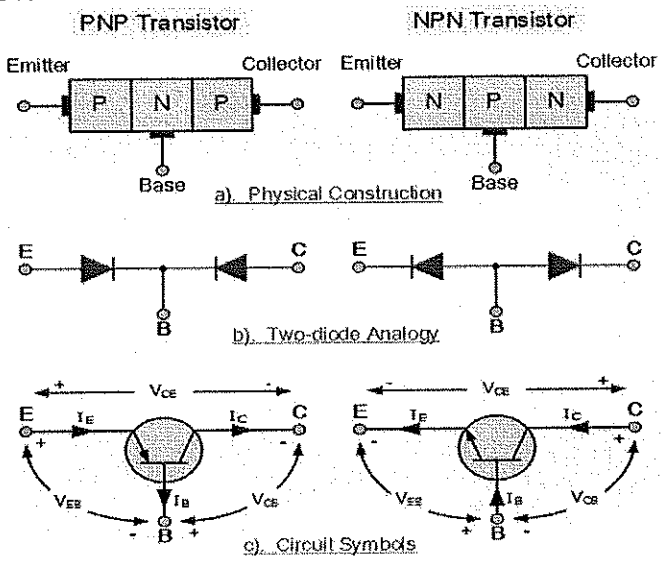
3. Describe the following components with their symbols: -
   (a)BJT (b)Power Diode

Ans.

(a)BJT:

- The Bipolar Junction Transistor is a semiconductor device which can be used for switching or amplification.

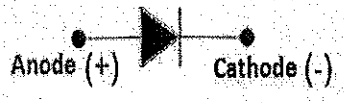
➢ Symbol of BJT:



(b)Power Diode:

➢ Power Diodes are such semiconductor devices used in rectifier circuitries to rectify higher value current.

➢ This diode has a larger area of PN junction then other diodes, due to this ability is used to rectifier higher value current and voltage, like hundred amperes and thousand kilovolts.



Section – C

03X03 = 09 Marks

1. Explain the mode of operations of the SCR.

Ans.

Modes of operation

There are three modes of operation for an SCR depending upon the biasing given to it:

1. Forward blocking mode (off state)
2. Forward conduction mode (on state)
3. Reverse blocking mode (off state)

1. Forward blocking mode

➢ In this mode of operation, the anode (+) is given a positive voltage while the cathode (−) is given a negative voltage, keeping the gate at zero (0) potential i.e. disconnected. In this case junction **J1**and **J3** are forward-biased, while **J2** is reverse-biased, allowing only a small leakage current from the anode to the cathode. When the applied voltage reaches the breakover value for **J2**, then **J2** undergoes avalanche breakdown. At this breakover voltage **J2** starts conducting, but below break-over voltage **J2** offers very high resistance to the current and the SCR is said to be in the off state.

2. Forward conduction mode

➢ An SCR can be brought from blocking mode to conduction mode in two ways: Either by increasing the voltage between anode and cathode beyond the breakover voltage,

or by applying a positive pulse at the gate. Once the SCR starts conducting, no more gate voltage is required to maintain it in the **ON** state. The minimum current necessary to maintain the SCR in the **ON** state on removal of the gate voltage is called the latching current.

- There are two ways to turn it **off**:
- Reduce the current through it below a minimum value called the holding current, or
- With the gate turned **off**, short-circuit the anode and cathode momentarily with a push-button switch or transistor across the junction.

3. Reverse blocking mode

- When a negative voltage is applied to the anode and a positive voltage to the cathode, the SCR is in reverse blocking mode, making J1 and J3 reverse biased and J2 forward biased. The device behaves as two reverse-biased diodes connected in series. A small leakage current flows. This is the reverse blocking mode. If the reverse voltage is increased, then at critical breakdown level, called the reverse breakdown voltage (V_{BR}), an avalanche occurs at J1 and J3 and the reverse current increases rapidly. The typical application for a reverse blocking SCR is in current-source inverters.

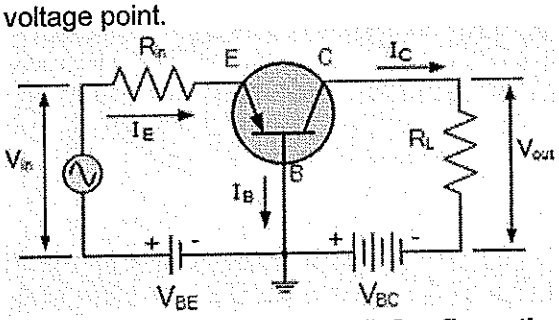
2. Explain the different types of BJT configurations(CB,CE&CC).

Ans.

Bipolar Transistor Configurations

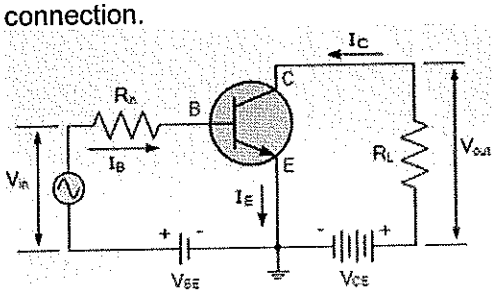
1. The Common Base (CB) Configuration

As its name suggests, in the **Common Base** or grounded base configuration, the BASE connection is common to both the input signal AND the output signal. The input signal is applied between the transistors base and the emitter terminals, while the corresponding output signal is taken from between the base and the collector terminals as shown. The base terminal is grounded or can be connected to some fixed reference voltage point.



2. The Common Emitter (CE) Configuration

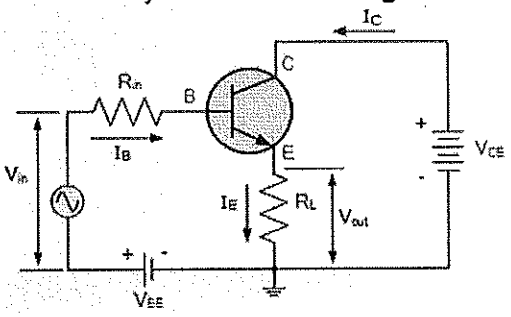
In the **Common Emitter** or grounded emitter configuration, the input signal is applied between the base and the emitter, while the output is taken from between the collector and the emitter as shown. This type of configuration is the most commonly used circuit for transistor based amplifiers and which represents the "normal" method of bipolar transistor connection.



3. The Common Collector (CC) Configuration

In the **Common Collector** or grounded collector configuration, the collector is connected to ground through the supply, thus the collector terminal is common to both the input and

the output. The input signal is connected directly to the base terminal, while the output signal is taken from across the emitter load resistor as shown. This type of configuration is commonly known as a **Voltage Follower** or **Emitter Follower** circuit.

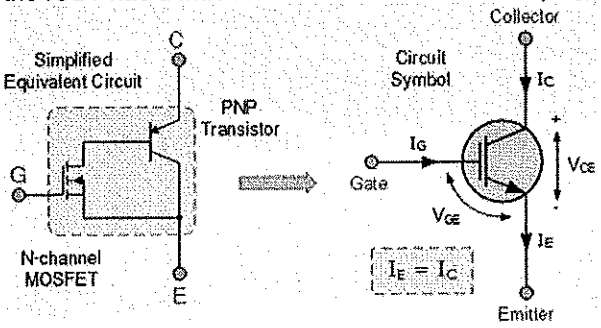


3. Write in brief about the IGBT with its symbol & applications.

Ans.

Insulated Gate Bipolar Transistor(IGBT)

- The IGBT is a power switching transistor which combines the advantages of MOSFETs and BJTs for use in power supply and motor control circuits.
- The Insulated Gate Bipolar Transistor also called an IGBT for short, is something of a cross between a conventional Bipolar Junction Transistor, (BJT) and a Field Effect Transistor, (MOSFET) making it ideal as a semiconductor switching device.
- The Insulated Gate Bipolar Transistor, (IGBT) combines the insulated gate (hence the first part of its name) technology of the MOSFET with the output performance characteristics of a conventional bipolar transistor, (hence the second part of its name).
- The result of this hybrid combination is that the "IGBT Transistor" has the output switching and conduction characteristics of a bipolar transistor but is voltage-controlled like a MOSFET.
- The advantage gained by the insulated gate bipolar transistor device over a BJT or MOSFET is that it offers greater power gain than the standard bipolar type transistor combined with the higher voltage operation and lower input losses of the MOSFET. In effect it is an FET integrated with a bipolar transistor in a form of Darlington type configuration as shown.
- As a result the terminals are labelled as: **Collector**, **Emitter** and **Gate**. Two of its terminals (C-E) are associated with the conductance path which passes current, while its third terminal (G) controls the device.
- The **Insulated Gate Bipolar Transistor** can be used in small signal amplifier circuits in much the same way as the BJT or MOSFET type transistors. But as the IGBT combines the low conduction loss of a BJT with the high switching speed of a power MOSFET an optimal solid state switch exists which is ideal for use in power electronics applications
- the IGBT has a much lower "on-state" resistance, R_{ON} than an equivalent MOSFET.



Applications of IGBT

Some of the important applications of IGBT are

- Switching mode power supplies (SMPS).
- UPS systems (IGBT based inverters).
- AC motor controllers.
- Choppers.
- Inverters.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.:.....

School of Electrical Skills
Session: 2020-21 (Summer Semester)
B. Voc. Program, 5th Semester,
2nd In-Sem. Examination

Course Code: ELE-1502 **Time: 1 Hour**
Course Name: Substation Practices and Supervision **Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. What is a load curve?
   (a) A plot of load vs current (b) A plot of load vs time
   (c) A plot of load vs duration of time (d) Total number of units generated vs time
2. The highest point on the daily load curve represents:
   (a) Peak load (b) Maximum demand (c) Both (a) & (d) (d) None of these
3. Diversity factor is define as:
   (a) A ratio of kWh generated to the product of plant capacity and the number of hours for which the plant is in operation.
   (b) The ratio of sum of individual maximum demands to the maximum demand on power stations.
   (c) The ratio of actual energy produced to the maximum possible energy.
   (d) The ratio of maximum demand on the power station to the connected load.
4. The salaries of operating labour is a part of operating cost.
   (a) False (b) True
5. Rate of return is a part of operating Costs.
   (a) False (b) True

Section – B

03X02 = 06 Marks

1. List the various components of annual fixed cost of the power plant.
2. Define the terms: Demand factor, maximum demand and connected load.
3. Discuss the effect of load factor on unit energy cost?

Section – C

03X03 = 09 Marks

1. A residential consumer has the following connected; 8 bulbs of 100 W each, 2 fans 60 W each and 2 light plug points of 100 W each. His use of electricity during a day is as under:

12 midnight to 5 am	One fan
5 am to 7 am	Two fans and one light point
7 am to 9 am	NIL
9 am to 6 pm	Two fans
6 pm to midnight	Two fans and four bulbs

Find (a) connected load (b) maximum demand (c) demand factor.

2. Find out the energy consumed during 24 hours and energy consumed in 24 hours if all devices are used all the day for the residential consumer of question 1.

3. A steam station has two 110 MW units. The cost data is as under:

Unit 1	Unit 2
UC_1 = Rs. 18000 per kW	UC_2 = Rs. 30000 per kW
FCR_1 = 10 %	FCR_2 = 10 %
CF_1 = 0.55	CF_2 = 0.60
Fuel consumption = 0.7 kg / kWh	Fuel consumption = 0.65 kg / kWh
Fuel cost = Rs. 1500 per 1000 kg	Fuel cost = Rs. 1500 per 1000 kg
OM_1 = 20 % of annual fuel cost	OM_2 = 15% of annual fuel cost
Utilization factor = 1	Utilization factor = 1

Calculate:
(a) Annual plant cost and generation cost of unit 1.
(b) Annual plant cost and generation cost of unit 2.
(c) Overall generation cost of the station.

Set-A

Answer Key Set –A

School of Electrical Skills, Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester, 2nd In-Sem. Examination

Course Code: ELE-1502, Course Name: Substation Practices and Supervision

Registration No.:.....

Section – A

05X01 = 05 Marks

1 What is a load curve?

a. A plot of load vs current.

b. A plot of load vs time.

c. A plot of load vs duration of time.

d. Total number of units generated vs time.

2 What does the highest point on the daily load curve represents?

a. Peak load.

b. Maximum demand.

c. Both (a) & (d).

d. None of these.

3 What is the diversity factor??

a. A ratio of kWh generated to the product of plant capacity and the number of hours for which the plant is in operation.

b. The ratio of sum of individual maximum demands to the maximum demand on power stations.

c. The ratio of actual energy produced to the maximum possible energy.

d. The ratio of maximum demand on the power station to the connected load.

4 The salaries of operating labour is a part of operating cost

a. False

b. True

5 Rate of return is a part of operating Costs.

a. False

b. True

Section – B

03X02 = 06 Marks

1 What are the components of annual fixed cost of the power plant?

Ans: The annual fixed costs of a plant consists of interest, taxes, insurance, depreciation, management and general maintenance costs and rate of return.

2. Define the terms: demand factor, maximum demand and connected load.

Ans: Demand factor is the ratio of the maximum demand to the connected load.

Maximum demand of a consumer means the maximum power that his circuit is likely to draw at any time.

Connected load of a consumer means the sum of the continuous ratings of all the devices and outlets installed on his distribution circuit.

3. What is the effect of load factor on unit energy cost?

Ans: As load factor decreases, the unit energy cost increases. As load factor increases, the unit energy cost decreases.

Answer Key Set –A
School of Electrical Skills, Session: 2020-21 (Summer Semester)
B. Voc. Program, 5th Semester, 2nd In-Sem. Examination
Course Code: ELE-1502, Course Name: Substation Practices and Supervision
Section – C

03X03 = 09 Marks

1. A residential consumer has the following connected ; 8 bulbs of 100 W each , 2 fans 60 W each and 2 light plug points of 100 W each . His use of electricity during a day is as under:

12 midnight to 5 am	One fan
5 am to 7 am	Two fans and one light point
7 am to 9 am	NIL
9 am to 6 pm	Two fans
6 pm to midnight	Two fans and four bulbs

Find (a) connected load (b) maximum demand (c) demand factor

Solution. (a) Connected load = 8 × 100 + 2 × 60 + 2 × 100 = 1120 W

(b) Total wattage at different times is

12 midnight to 5 am	60 W
5 am to 7 am	2 × 60 + 1 × 100 = 200 W
7 am to 9 am	NIL
9 am to 6 pm	2 × 60 = 120 W
6 pm to midnight	2 × 60 + 4 × 100 = 520 W

The maximum demand is 520 W

(c) Demand Factor = 520/1120 = 0.464

2. Find out the energy consumed during 24 hours and energy consumed in 24 hours if all devices are used all the day for the residential consumer of question 1.

Ans: (a) Energy consumed

12 midnight to 5 am	60 × 5 = 300 Wh
5 am to 7 am	220 × 2 = 440 Wh
7 am to 9 am	NIL
9 am to 6 pm	120 × 9 = 1080 Wh
6 pm to midnight	520 × 6 = 3120 Wh

Total energy consumed during 24 hours = 300 +440 + 1080 + 3120 = 4940 Wh = 4.94 kWh

(b) If all devices are used throughout the day, the energy consumed is = 1120 × 24 = 26880 Wh = 26.88 kWh

3. A steam station has two 110 WW units. The cost data is as under:

Unit 1	Unit 2
UC_1 = Rs. 18000 per kW	UC_2 = Rs. 30000 per kW
FCR_1 = 10 per cent	FCR_2 = 10 per cent
CF_1 = 0.55	CF_2 = 0.60
Fuel consumption = 0.7 kg / kWh	Fuel consumption = 0.65 kg / kWh
Fuel cost = Rs. 1500 per 1000 kg	Fuel cost = Rs. 1500 per 1000 kg
OM_1 = 20 per cent of annual fuel cost	OM_2 = 15 per cent of annual fuel cost
Utilization factor = 1	Utilization factor = 1

Calculate:

(a) Annual plant cost and generation cost of unit 1
(b) Annual plant cost and generation cost of unit 2
(c) Overall generation cost of the station.

Solution:

(a) AFC_1 = Rs. (10/100) (18000) (110×10^3) = Rs. 198×10^6
E_1 = 8760 (.55) (110×10^3) = 52998×10^4 kWh
Annual fuel consumption of unit 1 = $52998 \times 10^4 \times 0.7 = 37098.6 \times 10^4$ kg
FC_1 = (37098.6×10^4) (1500 / 1000) = Rs. 556479×10^3
OM_1 = 0.2 (556479×10^3) = Rs 111295.8×10^3
AOC_1 = Rs. ($556479 \times 10^3 + 111295.8 \times 10^3$) = Rs. 667774.8×10^3
APC_1 = Rs. ($198 \times 10^6 + 667774.8 \times 10^3$) = Rs. 865774.8×10^3
GC_1 = (865774.8×10^3) / (52998×10^4) = Rs. 1.6336 / kWh

(b) AFC_2 = Rs. (10/100) (30000) (110×10^3) = Rs. 330×10^6
E_2 = 8760 (.60) (110×10^3) = 57816×10^4 kWh
Annual fuel consumption of unit 2 = $57816 \times 10^4 \times 0.65 = 375804 \times 10^3$ kg
FC_2 = (375804×10^3) (1500 / 1000) = Rs. 563706×10^3
OM_2 = 0.15 (563706×10^3) = Rs 845559×10^2
AOC_2 = Rs. ($563706 \times 10^3 + 845559 \times 10^2$) = Rs. 6482619×10^2
APC_2 = Rs. ($330 \times 10^6 + 6482619 \times 10^2$) = Rs. 9782619×10^2
GC_1 = (9782619×10^2) / (57816×10^4) = Rs. 1.692 / kWh

(c) OGC = (865774800 + 978261900) / ($52998 \times 10^4 + 57816 \times 10^4$) = Rs. 1.664 / kWh

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

5st Semester, 2nd In-Sem. Examination

B. Voc. Program, Summer Semester (2020-21)

Course Code: ELE 1503 **Time: 1 Hour**

Course Name: Electrical Machines – II **Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. Three-phase induction motor is mainly suitable for which of the following application.
   (a) For running different machine tools where several speeds are required
   (b) For running paper machine requiring exact speed control
   (c) For running rolling mills needing exact speed control
   (d) None of these

2. Ns is the synchronous speed and s the slip, then actual running speed of an induction motor will be:
   (a) Ns (b) s.N (c) (l-s)Ns (d) (Ns-l)s

3. Which of the following methods is easily applicable to control the speed of the squirrel-cage induction motor?
   (a) By changing the number of stator poles
   (b) Rotor rheostat control
   (c) By operating two motors in cascade
   (d) By injecting e.m.f. in the rotor circuit

4. It is advisable to avoid line-starting of induction motor and use starter because:
   (a) motor takes five to seven times its full load current
   (b) it will pick-up very high speed and may go out of step
   (c) it will run in reverse direction
   (d) starting torque is very high rotor runs at a speed?

5. For an induction motor, given f=50 Hz, Ns=1500 rpm the number of poles in the machine is:
   (a) 1 (b) 2 (c) 3 (d) 4

Section – B

03X02 = 06 Marks

1. Explain the variation of speed torque characteristics of an induction motor with rotor resistance.
2. Draw and explain the equivalent circuit of an induction motor.
3. Draw the equivalent circuit of transformer.

Section – C

03X03 = 09 marks

1. Define following of an induction motor speed torque characteristic.
   i. Blocked Rotor Torque
   ii. Pull down torque
2. On what speed an induction motor can run, why?
3. For a 3 phase induction motor draws 80kW from the 3 phase source. Given that Synchronous Speed Ns= 1200 RPM, Rotor speed =1152RPM, Stator copper loss+ stator core loss =5Kw, Friction + windage +stray losses = 2kW. Find the efficiency of the induction machine.

Set - A

Answer Key Set – A

Course Code: ELE 1503 Course Name: Electrical Machines - II

School of Electrical Skills, 5st Semester, 2nd In-Sem. Examination

B. Voc. Program, Summer Semester (2020-21)

Section – A

05X01 = 05 Marks

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   (d) None of these

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   (a) Ns (b) s.N **(c) (I-s)Ns** (d) (Ns-I)s

3. Which of the following methods is easily applicable to control the speed of the squirrel-cage induction motor?
   (a) By changing the number of stator poles
   (b) Rotor rheostat control
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5. For an induction motor, given f=50 Hz, Ns=1500 rpm the number of poles in the machine is:
   (a) 1 (b) 2 (c) 3 **(d) 4**

Section – B

03X02 = 06 Marks

1. Explain the variation of speed torque characteristics of an induction motor with rotor resistance. Ans.

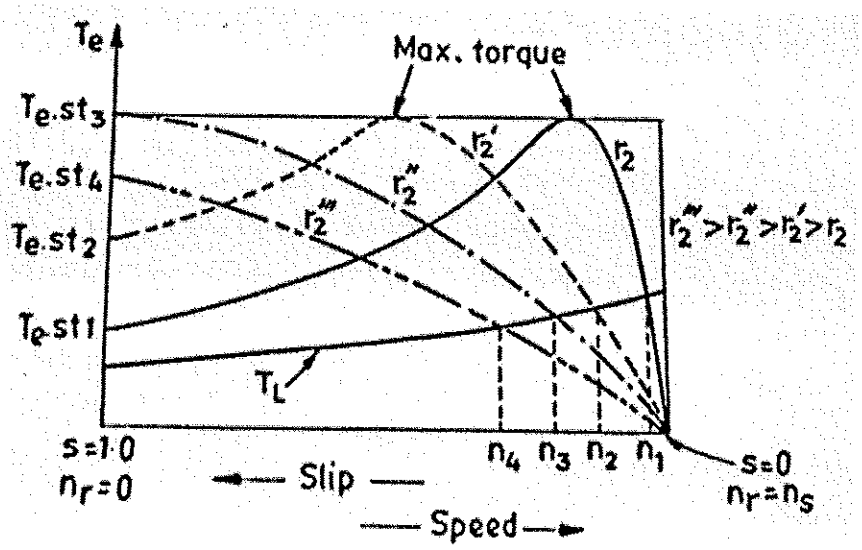


Fig.1

Answer Key Set – A

Course Code: ELE 1503 Course Name: Electrical Machines - II

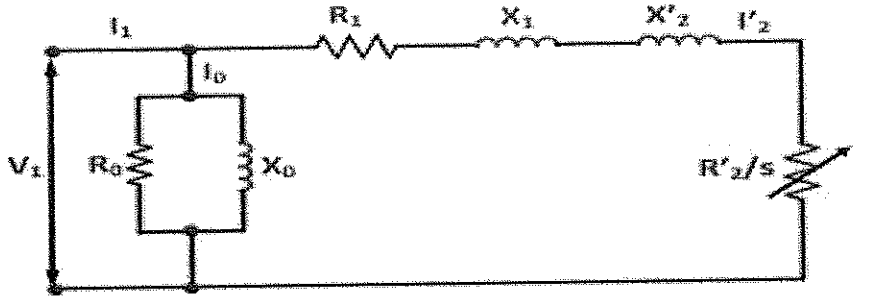
School of Electrical Skills, 5st Semester, 2nd In-Sem. Examination

B. Voc. Program, Summer Semester (2020-21)

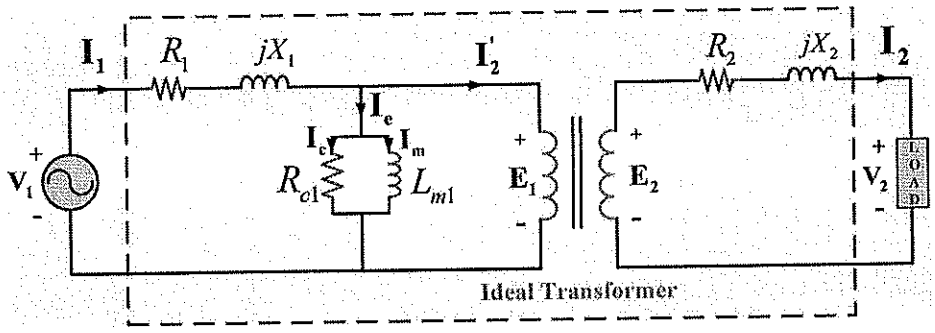
N= 1455 rpm

2. Draw and explain the equivalent circuit of an induction motor.

Ans.



3. Draw the equivalent circuit of transformer



Section – C

03X03 = 09 marks

1. Define following of an induction motor speed torque characteristic.
   a. Blocked Rotor Torque
   b. Pull down torque

Blocked rotor Torque

The Blocked Rotor Torque or Starting Torque is the torque an electrical motor develops when starting at zero speed. A lower Starting Torque can be accepted for centrifugal fans or pumps where the start load is low or close to zero.

Pull down torque

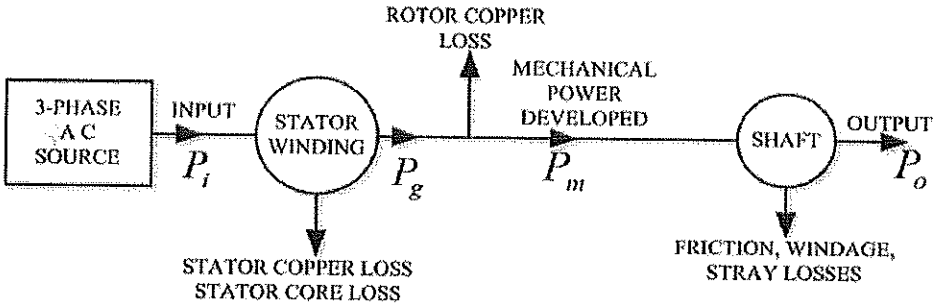
When the motor starts and begins to accelerate the torque in general decrease until it reach a low point at a certain speed - the pull-up torque - before the torque increases until it reach the highest torque at a higher speed - the break-down torque - point.

2. On what speed an induction motor can run, why?

Less than Synchronous Speed. If rotor runs at the synchronous speed, which is the same speed of the rotating magnetic field, then the rotor will appear stationary to the rotating magnetic field and the rotating magnetic field will not cut the rotor. So, no

induced current will flow in the rotor and no rotor magnetic flux will be produced so no torque is generated and the rotor speed will fall below the synchronous speed. When the speed falls, the rotating magnetic field will cut the rotor windings and a torque is produced

3. For a 3 phase induction motor draws 80kW from the 3 phase source. Given that Synchronous speed Ns= 1200 RPM, Rotor speed =1152RPM, Stator copper loss+ stator core loss =5Kw, Friction + windage +stray losses = 2kW. Find the efficiency of the induction machine.



Pi=80kW

So, Pg=80-5=75kW

Pm=Pg-Prloss

Prloss=Pg-Pm

Prloss= Tws-TWr

=T(ws-wr)

=Tws(1-wr/ws)

=Pg(ws-wr/ws)

P=Pg*s

S=(Ns-Nr)/Ns

S=(1200-1152)/1200

S =0.04

So, Prloss=0.04*75

=3kW

Then Pm=Pg-prloss

=73-3

70kW

Then Po=Pm-2kW

72-2

=70kW

Efficiency =output/input

=70kW/80kW

=.875

87.5%

Registration No. .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

5st Semester, 2nd In-Sem. Examination

B. Voc. Program, Summer Semester (2020-21)

Course Code: ELE1505 **Time: 1 Hour**

Course Name: Advance Automation & Control **Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. Full form of the DOL starter is:
   (a) Direct Online Starter (b) Dual Online Starter
   (c) Direct Overload starter (d) None of these
2. Scan time is a function of:
   (a) Speed of processor (b) Length of ladder program
   (c) Type of instruction (d) All of these
3. The time required to make a single scan of PLC program:
   (a) 1 ms to 150 ms (b) 1 ms to 20 ms
   (c) 1 ms to 100 ms (d) None of these
4. The_____mode is used to operate or monitor the user program without energizing any outputs.
   (a) Run mode (b) Program mode
   (c)Test mode (d) None of these
5. The _____ are drawn as horizontal lines and connect the rails to the logic expressions.
   (a) Rungs (b) Logic Expressions
   (c) Comments (d) Address Notation

Section – B

03X02 = 06 Marks

1. Explain Sinking and Sourcing types of input with suitable diagram.
2. Explain the Grounding system of PLC.
3. Explain the various steps involved in the Fault diagnosis technique and Troubleshooting

Section – C

03X03 = 09 Marks

1. Explain the scan cycle of single rung program with diagram.
2. Explain Modes of operation of PLC.
3. Explain the working of PLC with block diagram.

Set-A

Answer Key Set – A

School of Electrical Skills, Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester, 2nd In-Sem. Examination

Course Code: ELE1505, Course Name: Advance Automation & Control

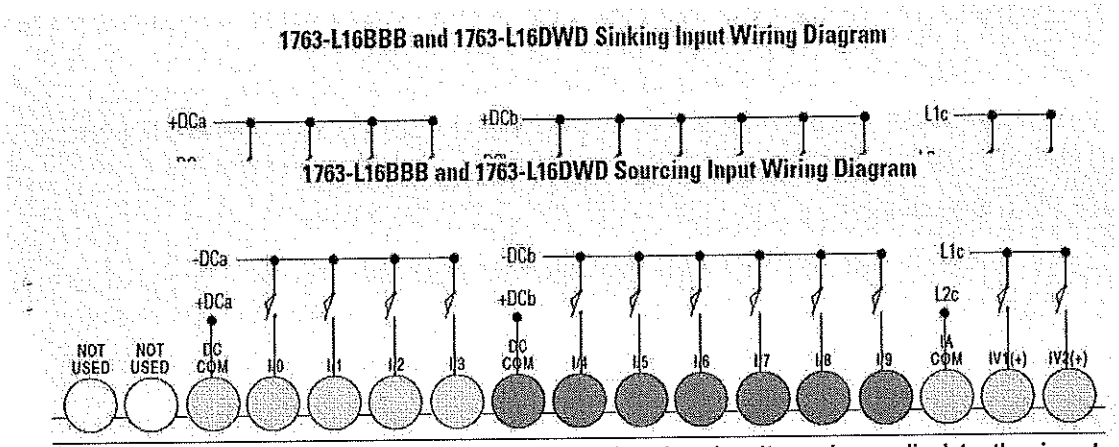
Section A

05X01 = 05 Marks

1. Full form of the DOL starter is: -
   (A)Direct Online Starter
2. Scan time is a function of: -
   (D) All of these
3. The time required to make a single scan of PLC program: -
   (b) 1 ms to 20 ms 4.
4. The_____mode is used to operate or monitor the user program without energizing any outputs.
   (c)Test mode
5. The _____ are drawn as horizontal lines and connect the rails to the logic expressions.
   (a) Rungs

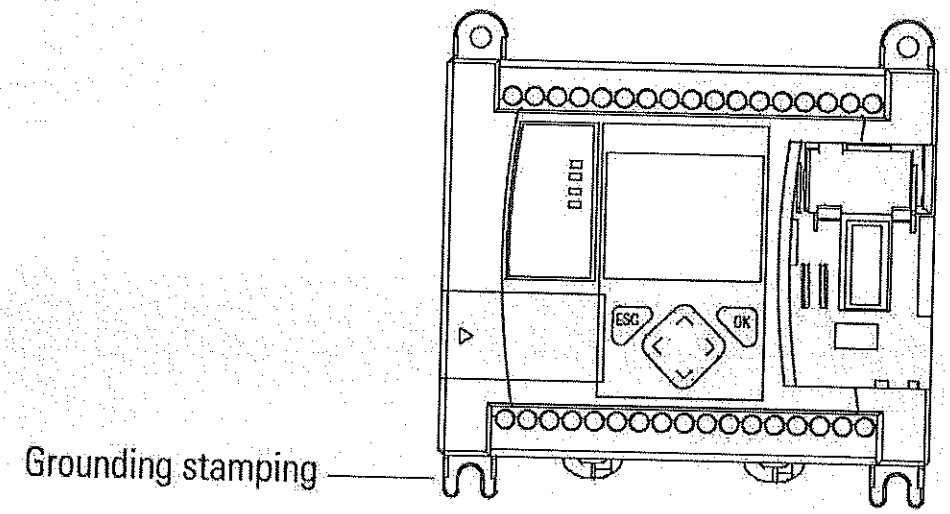
Section B

1. **Sinking Input:** The input energizes when high-level voltage is applied to the input terminal (active high). Connect the power supply VDC (-) to the input group's COM terminal.



Sourcing Input: The input energizes when low-level voltage is applied to the input terminal (active low). Connect the power supply VDC (+) to the input group's COM terminal.

2. **Grounding:** In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the controller to the ground bus prior to connecting any devices. Use AWG #14 wire. For AC powered controllers, this connection must be made for safety purposes.



3. Explain the various steps involved in Fault diagnosis technique and Troubleshooting

The 5 Step Troubleshooting Approach consists of the following:

1. Preparation

- Before you begin to troubleshoot any piece of equipment, you must be familiar with your organization's safety rules and procedures for working on electrical equipment. These rules and procedures govern the methods you can use to troubleshoot electrical equipment (including your lockout/ tagout procedures, testing procedures etc.) and must be followed while troubleshooting.

2. Observation

- Most faults provide obvious clues as to their cause. Through careful observation and a little bit of reasoning, most faults can be identified as to the actual component with very little testing.

3. Define Problem Area

- Starting with the whole circuit as the problem area, take each noted observation and ask yourself "what does this tell me about the circuit operation?" If an observation indicates that a section of the circuit appears to be operating properly, you can then eliminate it from the problem area. As you eliminate each part of the circuit from the problem area, make sure to identify them on your schematic. This will help you keep track of all your information.

4. Identify Possible Causes

- Once the problem area(s) have been defined, it is necessary to identify all the possible causes of the malfunction. This typically involves every component in the problem area(s).

5. Determine Most Probable Cause

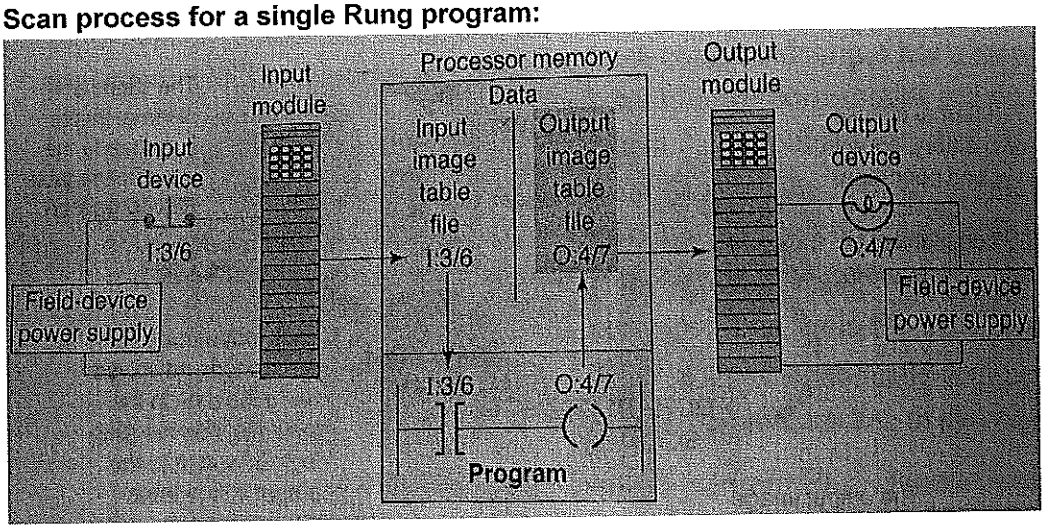
- Once the list of possible causes has been made, it is then necessary to prioritize each item as to the probability of it being the cause of the malfunction.

6. Test and Repair

- Testing electrical equipment can be hazardous. The electrical energy contained in many circuits can be enough to injure or kill. Make sure you follow all your companies safety precautions, rules and procedures while troubleshooting.

Section C

1. Scan process for a single Rung program:



The operation of scan process can be summarized as follows:

- If the input device connected to address I:3/6 is closed, the input module circuitry senses electrical continuity and a 1 (ON) condition is entered into the input image table bit I:3/6.
- During the program scan, the processor examines bit I:3/6 for a 1 (ON) condition.
- In this case, because input I:3/6 is 1, the rung is said to be TRUE or have logic continuity.
- The processor then sets the output image table bit O:4/7 to 1.
- The processor turns ON the output O:4/7during the next I/O scan, and the output device(light) wired to this terminal become energized.
- This process is repeated as long as the processor is in the RUN mode.
- If the input device is opens, electrical continuity is lost and a 0 would be placed in the input image table. As a result the rung is said to be FALSE due to loss of logic continuity.
- The processor would then set the output image table bit O:4/7 to 0, causing the output device to turn off.

2. Mode of operations of PLC

Some common operating modes of PLC are explained as follows:

1. Program Mode: The program mode is used to enter a new program, edit or update an existing program, upload files, download files, document (print out) programs, or change any software configuration file in the program. When the PLC is switched into the program mode, all output are forced off regardless of their rung logic status, and the ladder I/O scan sequence is halted.

2. Run Mode: The Run Mode is used to execute the user program. Input devices are monitored and output devices are energized accordingly. After all instructions have been entered in a new program or all changes made to existing program, the processor is put in the run mode.

3. Test Mode: The test mode is used to operate or monitor the user program without energizing any outputs. The processor still reads inputs, executes the ladder program, and update the output status table files, but without energizing the output circuit. This feature is often used after developing or editing a program to test the program execution before allowing the PLC to operate real-world outputs.

4. Remote Mode: In the Run position, all logic is solved and I/O is enabled. In the program position, all logic solving is stopped and the I/O is disabled. The remote position allows the PLC to be remotely changed between program and run mode by personal computer connected to the PLC processor. The remote mode may be beneficial when the controller is in a location that is not easily accessible.

3. Working of PLC:

The input sources convert the real time analog electric signals to suitable digital electric signals and these signals are applied to the PLC through the connector rails. These input signals are stored in the PLC external image memory in locations known as bits. This is done by the CPU

The control logic or the program instructions are written onto the programming device through symbols or through mnemonics and stored in the user memory.

The CPU fetches these instructions from the user memory and executes the input signals by manipulating, computing, processing them to control the output devices.

The execution results are then stored in the external image memory which controls the output drives.

The CPU also keeps a check on the output signals and keeps updating the contents of the input image memory according to the changes in the output memory.

The CPU also performs internal programming functioning like setting and resetting of the timer, checking the user memory.