

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY**

School of Electrical Skills

Session: 2019-20 (Summer Semester)

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

Course Code: ELE 1501

Time: 1 Hour

Course Name: Fundamental 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. Depletion layer is caused by:
(a) Doping (b) Recombination (c) Barrier potential (d) Ions
2. Which of the following devices does not belong to the transistor family?
(a) IGBT (b) MOSFET (c) GTO (d) BJT
3. The potential barrier of a silicon diode is:
(a) 0.3 V (b) 0.7 V (c) 1 V (d) 5V
4. The diode current is large for which condition:
(a) Forward bias (b) Inverse Bias (c) Poor Bias (d) Reverse Bias
5. Number of PN Junctions in a Transistor is:
(a) One (b) Two (c) Three (d) Four

Section – B

03X02 = 06 Marks

1. What is the objective of power electronics?
2. What are the applications of power electronics?
3. A single-phase full bridge diode rectifier is supplied from 230V, 50 HZ source. The load resistance of $R=10$ ohm and a large inductance so as to render the load current constant. Determine the average value of output voltage and current.

Section – C

03X03 = 09 Marks

1. Describe Power MOSFET with their circuit symbol.
2. Define rectifier. With neat diagram, explain the operation of half wave rectifier.
3. A full wave rectifier uses a center-tap transformer whose turns ratio to half secondary is 10:1 and is supplied with 230V at 50HZ. The load resistance is 10 ohms; calculate the value of maximum voltage and current.

Set - A

Course Name: Fundamental of Power Electronics

Course code: ELE1501

Section - A

Q1 Ans → (b)

Q2 Ans → (c)

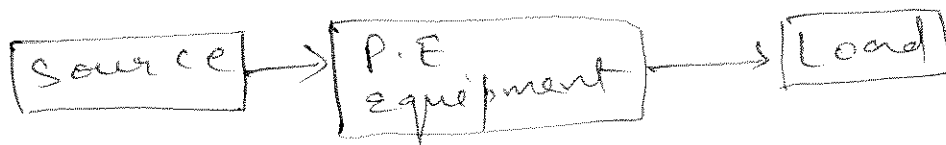
Q3. Ans → (b)

Q4. Ans → (a)

Q5. Ans → (b)

Section - B

Q1 Ans: The goal of power electronics is to control the flow of energy from electric source to electric load.



Q2 Ans:

The following are the applications of P.E.

- (I) Power supplies (both A.C. and D.C.)
- (II) Lighting
- (III) charge controllers
- (IV) electric vehicle.

Q3 Ans: -

It is given $V_{rms} = 230V$, $R_L = 10\Omega$

For full wave rectifier
average value of O/P voltage

$$V_o = \frac{2V_m}{\pi}$$

$$\text{since } V_m = \sqrt{2} \times V_{rms} = \sqrt{2} \times 230V$$

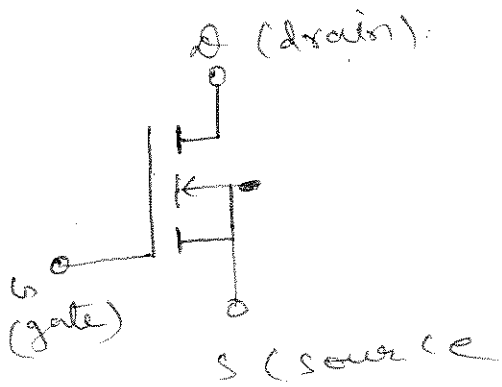
$$\text{So, } V_0 = \frac{2 \times \sqrt{2} \times 230}{\pi} = 207.04 \text{ V}$$

$$I_{0 \text{ avg}} = \frac{V_0}{R_L} = \frac{207.04}{10} = 20.704 \text{ A}$$

So, $V_{0 \text{ avg}} = 207.04 \text{ V}$
 $I_{0 \text{ avg}} = 20.70 \text{ A}$

Section - C

Q1 Ans



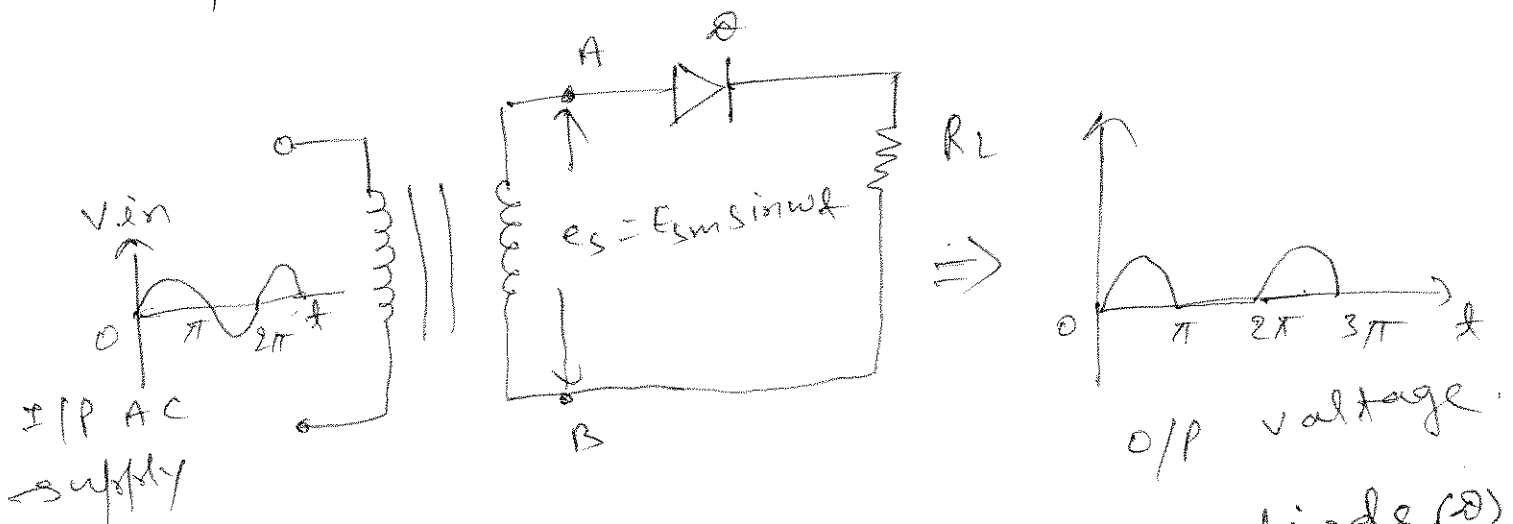
(PMOSFET circuit symbol)

- (i) PMOSFET is a unipolar device
- (ii) PMOSFET has lower switching losses.
- (iii) PMOSFET is a voltage controlled device
- (iv) PMOSFET is used for high frequency applications.

Q2 Ans: -

A rectifier is a device which converts a.c. voltage to pulsating d.c. voltage, using one or more p-n-junction diode.

operation of half wave rectifier:-



In half wave rectifier, diode (D) conducts only during positive half cycle of input a.c. supply. The negative half cycle of a.c. supply is eliminated from the O/P.

Q3 Ans: -

It is given that

$$\frac{E_p(\text{r.m.s.})}{E_s(\text{r.m.s.})} = \frac{10}{1}$$

$$\text{So, } E_s(\text{r.m.s.}) = \frac{E_p(\text{r.m.s.})}{10} = \frac{230}{10} = 23.0 \text{ V}$$

Since

$$E_s(\text{r.m.s}) = \frac{E_m}{\sqrt{2}}$$

$$\text{or } E_m = \sqrt{2} \times 23 = 32.43 \text{ V}$$

$$I_m = \frac{E_m}{R_L} = \frac{32.43}{10} = 3.24 \text{ A}$$

$\text{max}^m. \text{ val. } E_m = 32.43 \text{ V}$ $\text{max}^m. \text{ current } I_m = 3.24 \text{ A}$
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School of Electrical Skills

Session: 2019-20 (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. Earth pit value resistance is measure with which type of meter:
 (a) Insulation megger (b) volt meter
 (c) Earth resistance meter (d) Am meter
2. Which type fire extinguisher is used for electrical fire?
 (a) Water (b) Co2 (c) Foam (d) None of these
3. Which among these types of bus bars can be used outdoor?
 (a) Tubular (b) ACSR (c) AAC (d) All of these
4. Material generally used for bus bar is:
 (a) Copper (b) Aluminium (c) Steel (d) Tungsten.
5. Which of following properties have higher value for aluminium as compared to copper?
 (a) Melting point (b) Specific gravity
 (c) Electrical resistivity (d) Thermal conductivity.

Section – B

03X02 = 06 Marks

1. What is flexible bus?
2. Give the sequence of operation during opening and closing of a circuit.
3. Why are isolators necessarily provided on the supply side of the circuit breakers?

Section – C

03X03 = 09 Marks

1. What are the functions of firefighting equipment in a substation?
2. What are the purpose and advantages of grid synchronization?
3. What are major benefits by establishment of a National Grid?





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Time: 1 Hour

Course Name: Substation Practices and Supervision

Max. Marks: 20

Section – A

05X01 = 05 Marks

1. (c)
2. (b)
3. (d)
4. (b)
5. (c)

Section – B

03X02 = 06 Marks

Ans. 1.

Flexible bus consists of flexible ACSR or all aluminum alloy stranded conductors supported by strain insulators from each end.

Ans. 2.

Sequence of operation of circuit breaker, isolator and earthing switch during opening/closing of a circuit are given below

While opening: open circuit breaker, open isolator and then close earthing switch is provided.

While closing: open earthing switch, close isolator and then close circuit breaker.

Ans. 3. Isolators are necessarily provided on the supply side of the circuit breaker in order to ensure isolation of the circuit breaker from the live parts for the purpose of maintenance.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – C

03X03 = 09 Marks

Ans. 1.

Panels or cubicles in a substation are provided to support the various equipment like meters, relays etc. It saves the horizontal space and facilitates the supervisory staff to record reading easily. All the panels/cubicles are properly grounded.

Special type of fire extinguishers are installed in a substation to quench electric fire in case of a fire accident because ordinary fire extinguishers or water cannot be used to quench electric fire as it is dangerous. They are provided in accessible position and everyone in the substation must know its operation.

Ans. 2.

Synchronization must occur while connecting the generator to a grid. Synchronization can be achieved manually or automatically. The purpose of synchronization is to monitor, access, enable, and automatically take the control action to prevent the abnormalities of voltage and frequency. Advantages:

- ✓ It secures the power of the grid coming from different power stations by detecting the abnormal conditions of frequency and voltage beyond its acceptable range.
- ✓ It prevents the synchronization failure between power grid and feeder.
- ✓ It requires less maintenance and less time for performing the operation of detection.
- ✓ It does not require more expensive parts, so it is low cost, effective and economical model.
- ✓ It is more reliable.

Ans. 3.

(i) It would enable optimal setting, development and utilization of power potential through coal, hydro and other resources, in the overall interest of the Nation.

(ii) It would enable bulk exchange of electricity from one part of the Country to another part.

(iii) It would be beneficial in optimization of generation capacity requirement due to various factors like time diversity, spinning reserves requirements, improvement of hydro-thermal mix of connected regions.

(iv) It would extend economies of scale by enabling setting up of large sized pit-head based power stations and considerably cheaper cost of transmission of power compared to transportation of fuel.

(v) It would enable exchange of power amongst the regions for optimization of generation resources, meeting commercial obligations and meeting emergencies in other regions.

(vi) Improve economy, reliability and quality of power supply.

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School of Electrical Skills

Session: 2019-20 (Summer Semester)

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

Course Code: ELE 1503

Course Name: Electrical Machines

Time: 1 Hour

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

- Star-delta starting of motors is not possible in case of:
(a) single phase motors (b) variable speed motors
(c) low horse power motors (d) high speed motors
- The synchronous speed of an induction motor is defined as:
(a) Natural speed at which a magnetic field rotates (b) The speed of a synchronous motor
(c) The speed of an induction motor at no load (d) None of these
- Which of the following method 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
- 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?
- For an induction motor, given $f=50$ Hz, $N_s=1500$ rpm the number of poles in the machine is:
(a) 1 (b) 2 (c) 3 (d) 4

Section – B

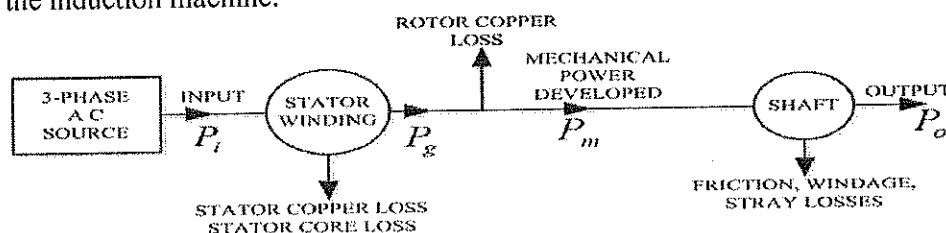
03X02 = 06 Marks

- Explain the variation of speed torque characteristics of an induction motor with rotor resistance.
- Derive the relationship between line voltage and phase voltage, line current and phase current in a star connected system.
- Explain the variation of speed torque characteristics of an induction motor with stator frequency control.

Section – C

03X03 = 09 Marks

- Define following of an induction motor speed torque characteristic?
(i) Blocked Rotor Torque (ii) Pull down torque
- Explain the speed torque characteristics of an induction motor and clearly specify stable and unstable zone with suitable reasons?
- For a 3 phase induction motor draws 80kW from the 3 phase source. Given that Synchronous speed $N_s=1200$ RPM, Rotor speed = 1152RPM, Stator copper loss + stator core loss = 5Kw, Friction + windage + stray losses = 2kW. Find the efficiency of the induction machine.



A



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

Course Code: ELE 1503
Course Name: Electrical Machines

Time: 1 Hour
Max. Marks: 20

Section – A

05X01 = 05 Marks

- 1. (a)
- 2. (a)
- 3. (a)
- 4. (a)
- 5. (d)

Section – B

03X02 = 06 Marks

1. Ans.

Explain the variation of speed torque characteristics of an induction motor with rotor resistance?

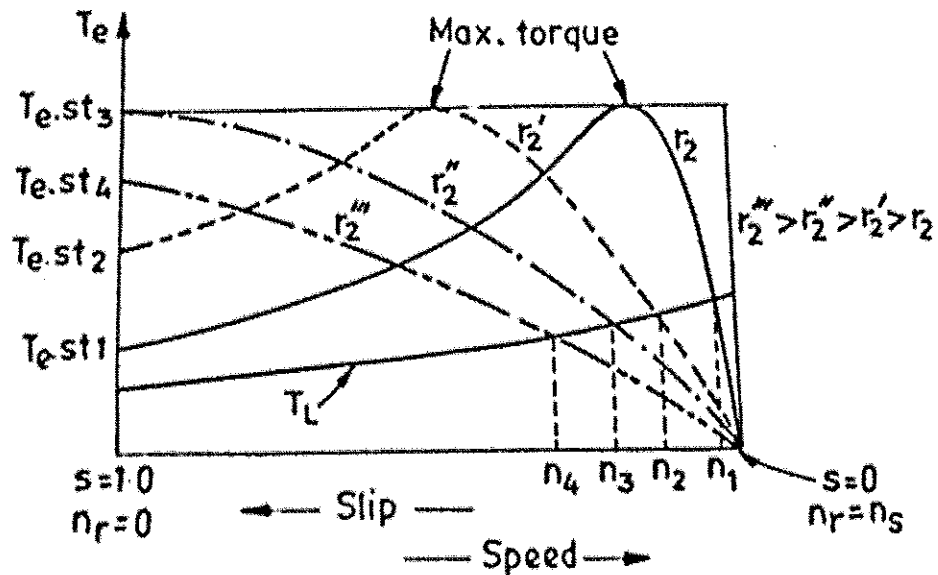
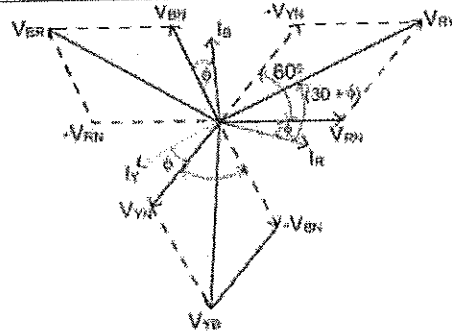


Fig.1

2. Ans.

Derive the relationship between line voltage and phase voltage, line current and phase current in a star connected system.

$$\begin{aligned} \text{Magnitude of } V_{RY} &= \sqrt{V_{RN}^2 + V_{YN}^2 + 2V_{RN}V_{YN} \cos 60^\circ} \\ &= \sqrt{V_{RN}^2 + V_{YN}^2 + 2V_{RN}V_{YN} \cdot \frac{1}{2}} \\ &= \sqrt{V_{RN}^2 + V_{YN}^2 + 2V_{RN}V_{YN}} \\ \text{But } V_{RN} &= V_{YN} = V_{ph} \\ V_{RY} &= V_L \\ V_{RY} &= \sqrt{V_{ph}^2 + V_{ph}^2 + 2V_{ph}V_{ph}} \\ &= \sqrt{3} \cdot V_{ph} \\ \therefore V_{ph} &= \frac{V_{RY}}{\sqrt{3}} = \frac{V_L}{\sqrt{3}} \end{aligned}$$



Similarly
 $V_{YB} = \sqrt{3} V_{ph}$
 $V_{BR} = \sqrt{3} V_{ph}$
 $V_{YB} = V_{BR} = V_L$
 $V_L = \sqrt{3} V_{ph}$
 $V_{ph} = \frac{V_L}{\sqrt{3}}$

3. Ans.

Explain the variation of speed torque characteristics of an induction motor with stator frequency control?

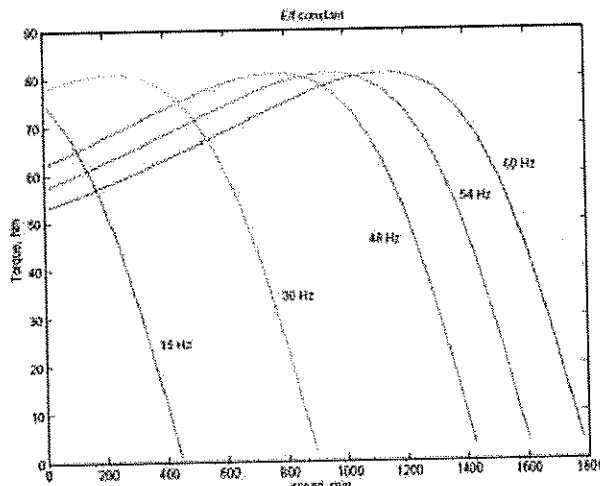


Fig.

S

Section - C

03X03 = 09 marks

Ans. 1.

Define following of an induction motor speed torque characteristic?

- a. Blocked Rotor Torque
- b. Pull down torque

Blocked rotor Torque

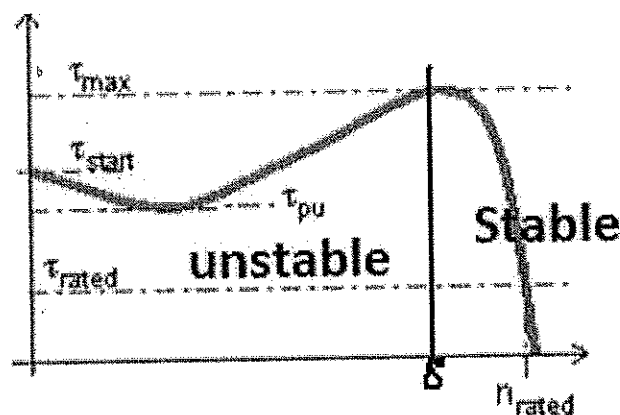
The Blocked Rotor Torque or Starting Torque is the torque an electrical motor develops when starting at zero speed. A lower Starting Torque can be accepted for centrifugal fans or pumps where the start load is low or close to zero.

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.

Ans. 2.

Explain the speed torque characteristics of an induction motor and clearly specify stable and unstable zone with suitable reasons?



The motoring region of the induction machine torque-speed curve is the region of greatest interest. The plots below show a number of different torque speed curves, due to differences in the motor designs. Common features of interest are noted and discussed below.

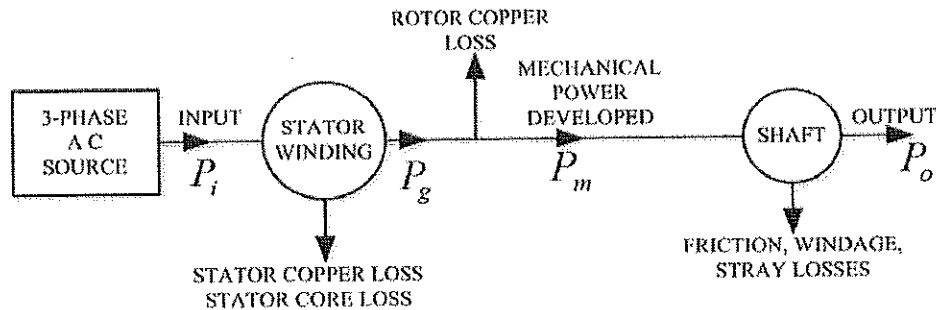
- τ_{rated} τ_{rated} . The rated torque of the machine. This is the design operating point.
- τ_{start} τ_{start} . The start torque of the machine, when the machine is at standstill.
- τ_{max} τ_{max} , or τ_{po} τ_{po} . The maximum torque or pull-out torque, which occurs at the slip $s = s_{po} = s_{po}$. Once a machine has reached rated operating point, this is the maximum torque that can be applied without stalling the machine (pulling out). In reality, since this torque is significantly more than the design rated torque, operation at maximum torque is not possible due to thermal heating issues. (Currents will be above rated values, I^2R losses will be excessive.)

τ_{pu} τ_{pu} . The pull-up torque of the machine. In some machines, the lowest point on the torque speed curve between starting and pullout is not the start torque. In this case it is important to know the pull-up torque. This is the minimum torque that the motor can accelerate up to the desired operating speed.

In steady state operation, an induction motor will operate at the speed where the mechanical load torque equals the torque developed by the motor. At low speeds, the difference between the motor torque and the load torque accelerates the machine. Normal operation is to the right of the maximum torque ($s < s_{po}$). In this region, an increase in the load torque will cause the motor to slow, increasing the motor torque until an equilibrium is reached. To the left of the pullout torque, no such equilibrium can be reached

Ans. 3.

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



$$P_i = 80 \text{ kW}$$

$$\text{So, } P_g = 80 - 5 = 75 \text{ kW}$$

$$P_m = P_g - P_{r\text{loss}}$$

$$P_{r\text{loss}} = P_g - P_m$$

$$P_{r\text{loss}} = T \omega_s - T \omega_r$$

$$= T(\omega_s - \omega_r)$$

$$= T \omega_s (1 - \omega_r / \omega_s)$$

$$= P_g (\omega_s - \omega_r / \omega_s)$$

$$P = P_g * s$$

$$S = (N_s - N_r) / N_s$$

$$S = (1200 - 1152) / 1200$$

$$S = 0.04$$

$$\text{So, } P_{r\text{loss}} = 0.04 * 75$$

$$= 3 \text{ kW}$$

$$\text{Then } P_m = P_g - P_{r\text{loss}}$$

$$= 75 - 3$$

$$72 \text{ kW}$$

$$\text{Then } P_o = P_m - 2 \text{ kW}$$

$$72 - 2$$

$$= 70 \text{ kW}$$

$$\text{Efficiency} = \text{output} / \text{input}$$

$$= 70 \text{ kW} / 80 \text{ kW}$$

$$= 0.875$$

$$87.5\%$$

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY**

School of Electrical Skills

Session: 2019-20 (Summer Semester)

**B. Voc. Program, 5th Semester,
2nd In-Sem. Examination****Course Code: ELE 1504****Time: 1 Hour****Course Name: Solar PV Technology****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

- Which of the following area is preferred for solar power plants?
(a) Coastal areas (b) Hot arid zones
(c) Mountain tops (d) High rainfall zones
- Which of the following is not an application of solar photovoltaic system?
(a) Solar lantern (b) Biogas plant
(c) Solar water heater (d) Solar air heater
- The process of joining of two or more lighter nuclei to form a heavy nucleus is known as:
(a) Nuclear fission (b) Nuclear fusion
(c) Nuclear conjunction (d) Chemical fission
- What is the total output power, if five PV cells of 5V connected in series and a single PV cell produces 1A current?
(a) 1.2 W (b) 0.7 W (c) 25 W (d) 1.5 W
- Pyranometer is an instrument used for measuring:
(a) Temperature (b) Solar radiation
(c) Wind speed (d) Efficiency of solar photovoltaic cell

Section – B

03X02 = 06 Marks

- What are the factor over which electricity generated by solar cell depends?
- Why usually the actual output power from a PV module is less than its rated power?
- What is solar PV lantern?

Section – C

03X03 = 09 Marks

- Explain the concept of on grid solar PV system.
- Explain the working principle of solar cell.
- Calculate the output power of solar cell if its efficiency (in %) is 19, 16 and 12, input power density is 1000 W/m² and area of solar cell is 3 m².

Set-A

Course Name: Solar PV Technology
Course Code: ELE1504

Section-A

Q1 Ans: - (b)

Q2 Ans: - (b)

Q3 Ans: - (b)

Q4 Ans: - (c)

Q5 Ans: - (b)

Section-B

Q4.1 Ans: The amount of electricity generated by solar cell depends upon -

- (i) Amount of sunlight available to it
- (ii) size of module

~~Q4.2 Ans:~~ The higher the intensity of sunlight, the more the electricity generated from it.
The larger the size of the module the higher will be amount of electricity generated.

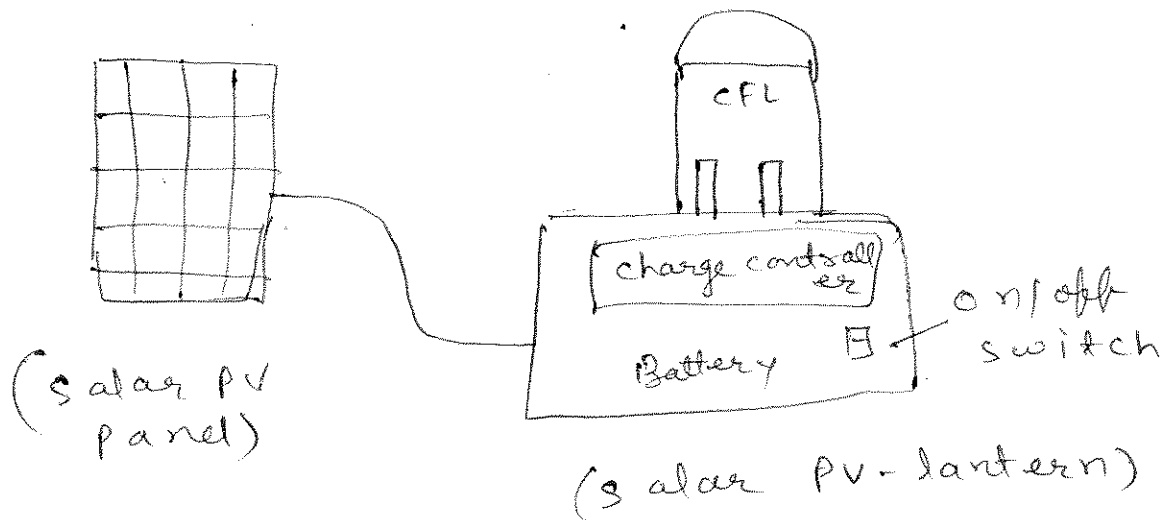
Q4.2 Ans:

The actual output power of PV-module obtain at standard test condition (sun intensity = 1000 W/m^2 , temp = 25°C , AM 1.5).

But in reality amount of solar radiation varies throughout the day, hence sol. cell will give less power than rated power.

Ques Ans:

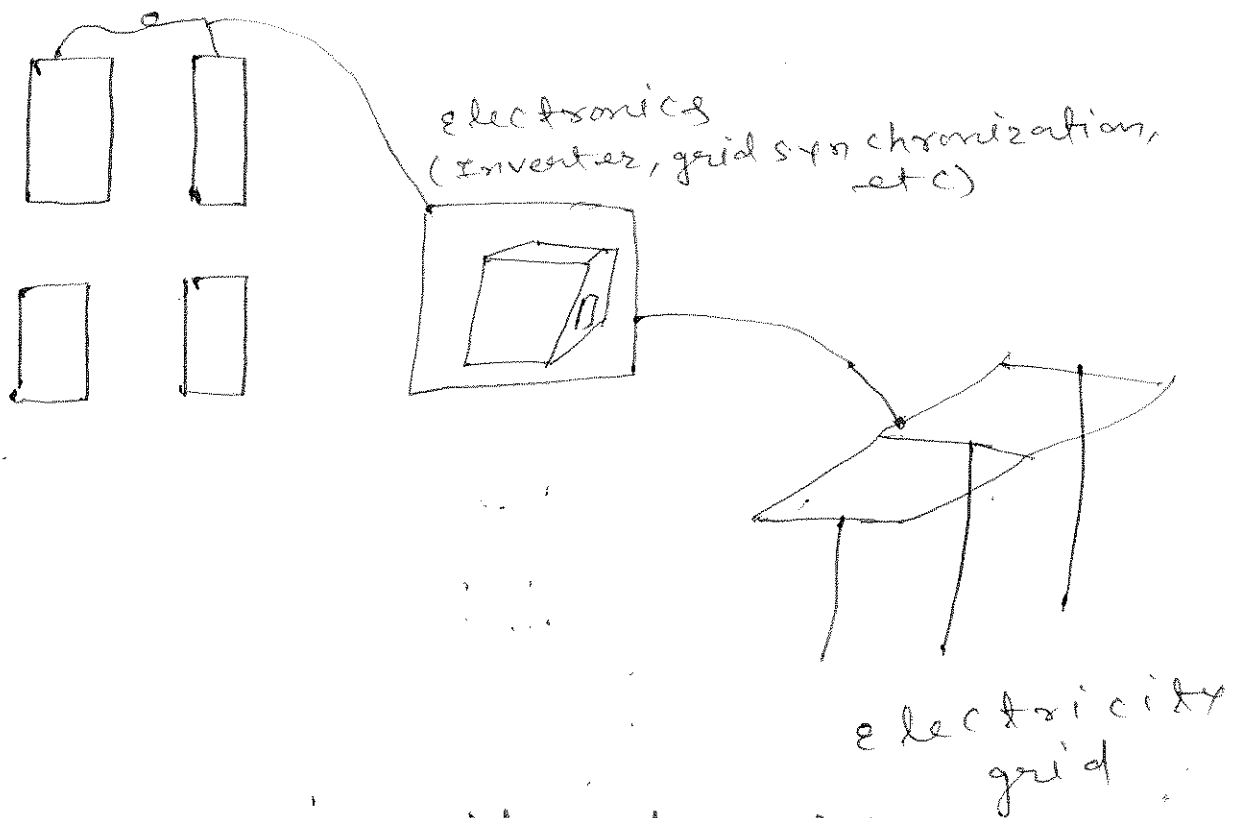
A solar PV lantern is an example of a very simple PV-based system that is used for lighting during darkness.



Section-C

Ques Ans:

The PV-system which are connected to grid are called grid connected PV-system. A grid connected PV-system doesn't store energy in battery, it takes energy from the grid when there is no sunlight.



(Fig: on-grid solar PV system)

Ques Ans:

working principle of solar cell: -

- (i) ^{sun} Light incident on solar cell
- (ii) Absorption of sunlight by solar cell occurs.
- (iii) Generation of electron hole pair occurs.
- (iv) Transportation of charge carriers occurs towards electrodes
- (v) Collection of charge carrier

by electrodes.

or 3 Ans:

given

$\eta\% \rightarrow 19, 16 \text{ and } 12$

I/P power density = 1000 W/m^2

Area of solar cell = 3 m^2

O/P power of solar cell

$$P_{out} = \eta \times P_{in} \times A$$

for $\eta = 19\%$.

$$P_{out} = \frac{19}{100} \times 1000 \text{ W/m}^2 \times 3 \text{ m}^2$$

$$P_{out} = 570 \text{ watt}$$

for $\eta = 16\%$.

$$P_{out} = \frac{16}{100} \times 1000 \text{ W/m}^2 \times 3 \text{ m}^2$$

$$P_{out} = 480 \text{ watt}$$

for $\eta = 12\%$.

$$P_{out} = \frac{12}{100} \times 1000 \text{ W/m}^2 \times 3 \text{ m}^2$$

$$P_{out} = 360 \text{ watt}$$

