


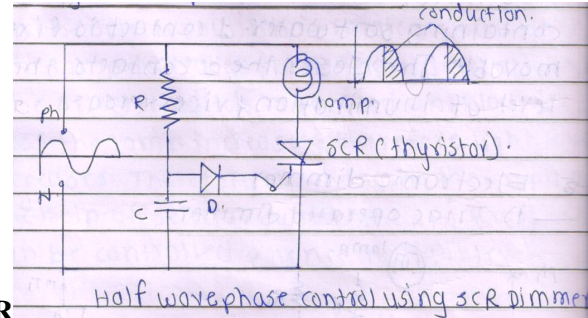
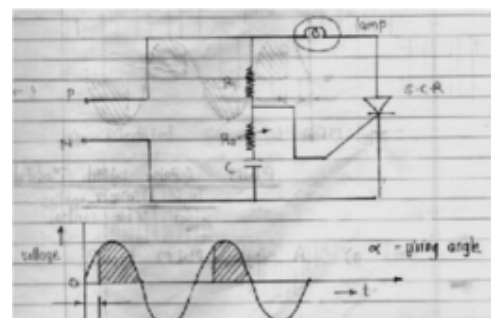


**Important suggestions to examiners:**

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
- 4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

<b>Q.1 A)</b>	<b>Attempt any THREE :</b>	<b>4 x 3 = 12 Marks</b>
<b>a)</b>	<b>Define each of following terms of illumination — lux, lumen, luminous flux, illumination.</b>	
Ans:	<b>( Each Definition; 1 Mark, Total 4 Marks)</b>	
	<b>i) Lux :-</b> It is unit of illumination and it is defined as luminous flux falling per unit area	
	<b>ii) Lumen:</b> It is defined as the luminous flux emitted by a source of one candle power per unit solid angle in all directions <b>OR</b> It is unit of luminous flux. One lumen is defined as luminous flux emitted per unit solid angle from a point source of candle power.	
	<b>iii) Luminous flux (F):-</b> The total energy radiated by a source of light in all directions is called Luminous flux. And its <b>unit is Lumen</b> <b>OR</b> Luminous flux is commonly called light output and is measured in lumens (lm).	
	<b>iv) Illumination:-</b> The illumination is defined as the luminous flux falling on per unit area of the given surface on the working plane. The unit of illumination is lumens/m <sup>2</sup> <b>OR</b> lumens/m <sup>2</sup> = 1 Lux	



<b>b)</b>	<b>Draw neat circuit diagram at tungsten filament bulb and give names for diff. parts.</b>
Ans:	<b>Circuit diagram at tungsten filament bulb:</b> <p style="text-align: right;">( Diagram : 2 Marks &amp; Name of Parts: 2 Marks)</p> <div style="text-align: center;"><p style="text-align: right;"><b>or equivalent figure</b></p></div>
<b>c)</b>	<b>Explain working principle of thyristor control dimmer in electric dimmer system.</b>
Ans:	<b>Thyristor or SCR operated dimmer:-</b> ( Figure : 2 Mark & Explanation: 2 Mark) <div style="display: flex; justify-content: space-around;"></div> <p style="text-align: center;"><b>OR</b></p> <p style="text-align: center;"><b>orequivalent figure</b></p> <p>The SCR is generally used as switching component in electrical system. In the SCR when the anode terminal is +ve cathode is -ve and if the trigger pulse is applied to the gate of the SCR, then at that moment SCR will start conducting.</p> <p>In the present circuit the capacitor is charged through variable resistance R2 so that Charging time constant ( R2C ) will be decided and after that whenever capacitor is fully charged it will discharge through the gate terminal, and SCR will be fired[ON]. The firing period is decided by the value of R2C i.e. why conduction &amp; firing angle will be changed. This firing angle may be vary 0 to 180° i.e. why the fired output voltage can be (variable) available across the lamp. So that light intensity will be changes, By the SCR only +ve half cycle are controlled.</p>



<b>d)</b>	<b>State any six factors on which efficiency of lighting depends.</b>
Ans:	<p><b>Following six factors on which efficiency of lighting depend:</b> ( First Any Two Point: 1 Mark &amp; Other any Four Point : 1/2 Mark Each)</p> <p><b>1) Level of illumination or degree of illumination:</b> It depends on nature of work to be carried out. The degree of level of illumination also depends on following factors.</p> <ul style="list-style-type: none"><li>i) The size of object &amp; its distance from observer.</li><li>ii) If object is moving speedly higher level of illumination is required than stationary object.</li><li>iii) If the objects are required to be seen for long duration of time, higher level of illumination is necessary &amp; for stair cases, corridors less illumination is required.</li></ul> <p><b>2) Glare:</b> The glare causes unnecessary eye fatigue so it must be avoided, it can be prevented by using diffusing glass screen, suitable reflectors &amp; proper mounting height. Reflected glare from the polished surfaces within the line of vision should be avoided.</p> <p><b>3) Shadows:</b> The formation of long and hard shadows must be avoided. The long and hard shadows cause accident. Such shadows can be avoided by</p> <ul style="list-style-type: none"><li>i) Using proper mounting height of the lamps.</li><li>ii) Using more number of lamps &amp; providing indirect lighting.</li><li>iii) Employing wide surface sources of light. Complete absence of shadows is again not recommended as soft shadows are required to identify three dimensional objects.</li></ul> <p><b>4) color rendering:</b> This refers to the ability of the light source to reproduce the original colour of the objects when the object is illuminated by that source.</p> <p><b>5) Lamp fittings:</b> The lamp fittings serve the following functions in good illumination scheme.</p> <ul style="list-style-type: none"><li>i) To diffuse the light ii) To cut off the light at certain angle to avoid glare iii) To give mechanical protection to light source. iv) To increase the aesthetical requirement of the premises. V) To control the level of light (control gear)</li></ul>



**6) Maintenance:**

Regular cleaning of lamps & light fittings is necessary to maintain their efficiency.

The maintenance is necessary against dust, water leakage, dangerous gases which may cause corrosion of light fittings. Hence light fittings should be simple & easy from maintenance point of view.

7) Following factors are considered while designing interior illumination: utilization factor, depreciation factor, Maintenance factor and space to height ratio.

**OR**

**1. Comfortable:** - The energy illumination scheme should be comfortable to everybody.

**2. Pleasant surrounding:**

By the electrical lighting or the electrical illumination scheme the surrounding area of that location should be pleasant.

**3. Long Life:** - The life of the designed illumination should be larger.

**4. Economy:** - The cost of the designed illumination scheme should be low.

**5. Less maintenance:** -

For any type of illumination scheme the maintenance & repairing should be less.

**6. Appearance:** - The appearance of illumination scheme should be good.

**7. less glares:** -

The glare is fatigue to the human eyes. The illumination scheme is designed is such a way that there should be less glare to everyone i.e. Only electrical & mechanical accidents will be less.

**8. less Flickers:** -

The flicker is change in light intensity. This flicker should be always less for any type of illumination scheme. In the flicker there are change of stroboscopic effect at the time of workshop lighting in it is very important.

**9. To avoid hard Shadows:** -

The whole illumination scheme is designing for minimum shadows. At the time of flood light the hard shadows are avoided.

**10. Sufficient lux Level:** - The lux level is decided by the type of application, type of location.



**11. Cleanliness: -**

The illumination scheme should be free from any type of ash, smoke or any other air pollution it should be clean.

**12. Simple Control: -** The illumination scheme designed by the electrical lighting is very simple. The control, multicolour light intensity control is also possible in electrical illumination.

**OR**

1. **Stroboscopic Effect:** Stroboscopic effect should be less

2. **Area of working Plane:** Number of lighting devices depends upon area of working plane

3. **Quality of civil construction works:**

Waste light factor, utilization factors depends upon quality of civil construction work.

4. **Height of lamp fitting:** Lighting efficiency depends upon space to height ratio.

5. **Type of lighting source:**

There are number of lighting source having different illumination efficiency, So lighting efficiency depends upon this type lighting source.

6. **Diffusion factor:** By this factor the actual required lux level on working plane is decided.

7. **Distribution of lux on working plane:**

The lux level on working plane should be uniformly distributed.

**Q.1B) Attempt any ONE :**

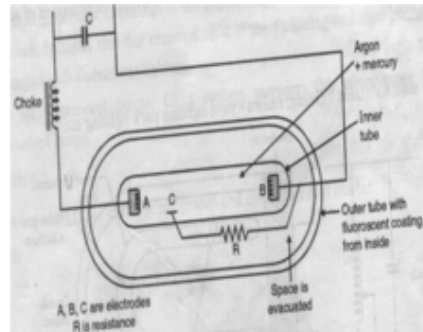
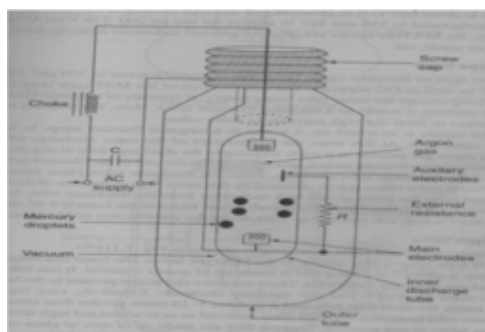
**6 x 1 = 6 Marks**

a) **Explain with neat circuit diagram, low pressure mercury vapour lamp.**

Ans:

( Diagram: 3 Marks , Explanation: 3 Marks)

**Diagram of low pressure mercury vapour lamp:**



**OR**

**or equivalent figure**

**Working:-**

- Whenever 1-ph, 230V, AC Supply is provided to the discharge tube of MVL initially to current will flow from Phase to the choke to the starting electrode to neutral.



- Sometimes the starting electrode or resistance is made by tungsten filament having the more resistance ( 5 to 10 K ohm) so that whenever current flows through the tungsten filament as per the thermal emission the light is emitted through the filament ( tungsten immediately) so that initially colour of light is blue.
- At the same time the rated voltages is applied in between the filament No.1 & filament No.2. Due to this voltage, there will be collision. Of neon gas particles & current will start flow through the discharge tube,
- Whenever temperature surrounding the inner tube increases up to 60<sup>0</sup>C the mercury powder will start vaporizing & the continuous collision process of all inert gases is taking place so that full light is emitted through the discharge tube.
- The colour of light is bluish white. The full light is emitted after 10-15 min.

**OR Student may write**

The construction & connection diagram is as shown in figure. As per this construction there are following components.

- **Choke:** The choke is acting as the ballast. At the time of supply voltage variation of current flowing through the inner tube is maintained constant to keep uniform light intensity. Sometimes choke can be designed for to get the higher voltages & to apply the inner tube of mercury vapour lamp.
- **Starting resistance/limiting resistance:** Whenever current flows through the starting resistance there is a I<sup>2</sup>R loss which is converted into heat. If the temperature of this heat goes near about 600<sup>0</sup>C then there will be heating effect & inert gases ionization will be start.
- **Auxiliary electrode & Main electrode:** It is made by high resistive element. The ionization is taking place through the inert gases whenever current flows from auxiliary electrode to main electrode.
- **Inner Tube:** The various inert gases e.g. Argon, Nitrogen etc with mercury powder are filled in the inner tube at low pressure or high pressure.
- **Outer Tube:** The function of outer tube is to make the vacuum surrounding the inner tube to avoid thermal dissipation or to maintain 60<sup>0</sup>C surrounding the inner tube.
- **Power factor improvement Capacitor:** The function of power factor improvement capacitor is to improve the power factor 0.5 to 0.95



b)	<p><b>Define each of following terms of illumination — Space height ratio, Reduction factor, maintenance factor.</b></p>
Ans:	<p><b>i) Space to height ratio: (2 Mark)</b></p> <p>It is the ratio of horizontal distance between two adjacent lamps to the mounting height of the lamps.</p> <p style="text-align: center;"><b>OR</b></p> $\text{Space height ratio} = \frac{\text{Space between lamps}}{\text{Height of lamps above working plane}}$ <p><b>ii) Reduction Power: (2 Mark)</b></p> <p>It is ratio of mean spherical candle power to the mean horizontal candle power.</p> $\text{Reductio Power (factor)} = \frac{M S C P}{M H C P}$ <p><b>iii) Maintenance factor:- (2 Mark)</b></p> <p>It is the reciprocal of Depreciation factor. <b>OR</b></p> <p>It is defined as the ratio of illumination under normal working conditions to the illumination when everything is clean.</p> <p style="text-align: center;"><b>OR</b></p> $\text{Maintenace Factor} = \frac{\text{illumination uder normal working condition}}{\text{illumination under every thing is clean}}$
Q.2	<p><b>Attempt any TWO : 8 x 2 = 16 Marks</b></p>
a)	<p><b>Draw and explain how one lamp can be controlled by two switch. State application of it.</b></p>
Ans:	<p><b>One lamp can be controlled by two switch:-</b></p> <p><b>(Figure: 2 Marks, Explanation: 4 Marks, Appl: 2 Marks, Total: 8 marks)</b></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="292 1554 795 1890"> <p>Hand-drawn circuit diagram showing a lamp connected to a neutral wire and a phase wire. The phase wire passes through two two-way switches, S1 and S2, in series. The neutral wire goes directly to the lamp.</p> </div> <div data-bbox="812 1554 1364 1890"> <p>Hand-drawn circuit diagram showing a lamp connected to a neutral wire and a phase wire. The phase wire passes through a fuse, then two two-way switches, S1 and S2, in series. The neutral wire goes to the lamp.</p> </div> </div> <p style="text-align: center;"><b>OR</b></p>



	<p><b>or equivalent figure</b></p> <p><b>Explanation:</b></p> <p>This system is commonly used for stair case wiring. It consists of two way switches (the switch operates always in one of the two possible positions) the circuit diagram is as shown in figure above.</p> <p>Assume that the lamp is in between ground floor and first floor with switch <math>S_1</math> is on ground floor and <math>S_2</math> is on first floor. When the position of the switches <math>S_1</math> &amp; <math>S_2</math> is as shown in figure then the lamps is 'ON'. When a person reaches on first floor the lamp is required to be switched 'OFF' so the person will change the position of switch <math>S_2</math> such that the lamp will be switched 'OFF'.</p> <p><b>Application:</b></p> <ol style="list-style-type: none"> <li>1. It is used for Stair case wiring</li> <li>2. It is also used for Bedroom wiring</li> <li>3. It used for corridors.</li> <li>4. It is used for Hospital lighting</li> </ol>						
b)	<p><b>A uniform illumination of 80 lux obtained on the floor of room measuring 15 m x 15 m by arranging electric light suitably. Calculate the no. of lamps and watt rating of each lamp if lamp is 15 lux/watt. Assume and write suitable values required in this calculation.</b></p>						
Ans:	<p><b>NOTE: Marks should be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer</b></p> <p><b>Given Data:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">E = 80 lumen/sqm</td> <td style="width: 50%;">Area of working plane = 15 m x 15m = 225 sq m</td> </tr> <tr> <td>U.F = 0.4 &amp; D.F = 1.2</td> <td>Wattage of Lamps Assumed= 100 watt /200/500 Watt</td> </tr> <tr> <td>Efficiency = 14 lumens/watt</td> <td>assumed: Waste light factor = 1</td> </tr> </table> <p>i) Total Lumens utilized = E x A or -----(1/2 Marks)</p> <p style="text-align: center;">= 80 x 225 = 18000 Lumens -----( 1Marks)</p> <p>ii) Total Lumens given out by the lamp = <math>\frac{\text{Total lumens utilised} \times D.F}{U.F}</math> ----- (1/2 marks)</p> <p style="text-align: center;">= <math>\frac{18000 \times 1.2}{0.4}</math></p> <p style="text-align: center;">= 54000 Lumens ----- (1 Marks)</p>	E = 80 lumen/sqm	Area of working plane = 15 m x 15m = 225 sq m	U.F = 0.4 & D.F = 1.2	Wattage of Lamps Assumed= 100 watt /200/500 Watt	Efficiency = 14 lumens/watt	assumed: Waste light factor = 1
E = 80 lumen/sqm	Area of working plane = 15 m x 15m = 225 sq m						
U.F = 0.4 & D.F = 1.2	Wattage of Lamps Assumed= 100 watt /200/500 Watt						
Efficiency = 14 lumens/watt	assumed: Waste light factor = 1						





	$\frac{\text{Total lumens given out by the lamps}}{\text{luminous efficiency}}$
	<p>iii) Total Wattage = .....(1/2 Marks)</p> $= \frac{54000}{15}$ $= 3600 \text{ Watts} \quad \text{.....(2 Marks)}$
	<p><b>The wattage of lamps is assumed – 100 watt:</b></p>
	$\frac{\text{Total Wattage}}{\text{Wattage of each lamp}}$
	<p>iv) Number of Lamps = .....(1/2 Marks)</p> $= \frac{3600}{100}$ $= 36 \text{ Nos} \quad \text{..... (2 Marks)}$ <p><math>\therefore</math> Numbers of lamps = 36 Nos</p>
c)	<p><b>A room 30 m x 20 m is illuminated 20 no. of 200 W lamps. The MSCP of each lamp is 240. If utilization factor is 0.75 and 1.25 depreciation factor, then find out average illumination produced on floor.</b></p>
Ans:	<p>i) Area of room=A= 30 × 20m= 600 sqmtr.    ii) MSCP of each lamp = 240</p> <p>iii) Depreciation factor=D.F= 1.25    iv) Co-efficient of utilization= U.F=0.75</p> <p>v) Number of lamps = 20    vi) wattage of each lamp = 200 watts</p> <p>Find: Average illumination=E=?</p>
	<p><b>Solution:</b></p> <p>Total lumens given out by all lamps= (MSCP × 4 π) × 20 ..... (1 Mark)</p> $= (240 \times 4 \pi) \times 20$ $= 60318.57 \text{ Lumens.} \quad \text{..... (1 Mark)}$
	<p>Total lumens received on the floor = Total lumens given out by all lamps × <math>\frac{U.F}{D.F}</math> ..... (1 Mark)</p>
	$\text{Total lumens received on the floor} = 60318.57 \times \frac{0.75}{1.25}$



	$= 36191.142 \text{ Lumens.} \text{-----} \text{ (2 Mark)}$ <p>Average illumination on the floor = <math>E_{AV} = \frac{\text{Total lumens recieved on the floor}}{\text{Area}} \text{-----} \text{ (1 Mark)}</math></p> $= \frac{36191.142}{600}$ <p><math>E_{AV} = 60.318 \text{ Lumens per square mtr--- Answer-----} \text{ (2 Mark)}</math></p> <p style="text-align: center;"><b>OR</b></p> <p><math>E_{AV} = 60.318 \text{ Lux--- Answer}</math></p>
<b>Q.3</b>	<b>Attempt any FOUR :</b> <span style="float: right;"><b>4 x 4 = 16 Marks</b></span>
a)	<b>State any four characteristics of flood lighting.</b>
Ans:	<p style="text-align: right;">(Any four point Expected:1 Marks each )</p> <p><b>Following are the specific characteristics of flood lighting:-</b></p> <ol style="list-style-type: none"><li>1. Ideal for landscape and architecture lighting.</li><li>2. Widely used in home for the showroom purpose, office decoration, garden lighting, VIP building lighting parking lighting etc.</li><li>3. For flood lighting the luminous efficiency is high and the span for the life is long with less maintenance</li><li>4. Best thermal management.</li><li>5. Available in various sizes and shapes</li><li>6. Compact design can be possible.</li><li>7. Light intensity can be controlled.</li><li>8. For the flood lighting we can used halogen lamps, metal halide lamp, bunched filament projector lamps. But for the energy saving purpose we can use LED projector lamp.</li><li>9. By using the LED lamps the multicolour shades can be possible.</li><li>10. The initial cost and running for the flood lighting can be minimized by proper selection of flood lighting.</li><li>11. Working nights of flood light can be increased.</li></ol> <p style="text-align: center;"><b>OR</b></p> <p><b>Following are the specific characteristics of flood lighting:-</b></p> <ol style="list-style-type: none"><li>1. <b>Comfortable:</b> - The energy illumination scheme should be comfortable to everybody.</li></ol>



- 2. Pleasant surrounding:** By the electrical lighting or the electrical illumination scheme the surrounding area of that location should be pleasant.
- 3. Long Life:** - The life of the designed illumination should be larger.
- Economy:** - The cost of the designed illumination scheme should be low.
- 5. Less maintenance:** - For any type of illumination scheme the maintenance & repairing should be less.
- 6. Appearance:** - The appearance of illumination scheme should be good.
- 7. less glares:** - The glare is fatigue to the human eyes. The illumination scheme is designed in such a way that there should be less glare to everyone i.e. Only electrical & mechanical accidents will be less.
- 8. less Flickers:** - The flicker is change in light intensity. This flicker should be always less for any type of illumination scheme. In the flicker there are change of stroboscopic effect at the time of workshop lighting in it is very important.
- 9. To avoid hard Shadows:** - The whole illumination scheme is designing for minimum shadows. At the time of flood light the hard shadows are avoided.
- 10. Sufficient lux Level:** - The lux level is decided by the type of application, type of location.
- 11. Cleanliness:** - The illumination scheme should be free from any type of ash, smoke or any other air pollution it should be clean.
- 12. Simple Control:** - The illumination scheme designed by the electrical lighting is very simple. The control, multicolour light intensity control is also possible in electrical illumination.

b)

**State illumination in lux for each of following : Operation theatre, stair, living room, study room.**

Ans:

**illumination in lux for following location:**

**(Given Four points - 1 Mark each, Total 4 Marks)**

S.No	Areas	Recommended illumination level
1	Operation theatre	600 to 1000 lux
2	Stair	60 to 100 Lux
3	Living Room	200 to 300 Lux
4	Study room	300 Lux

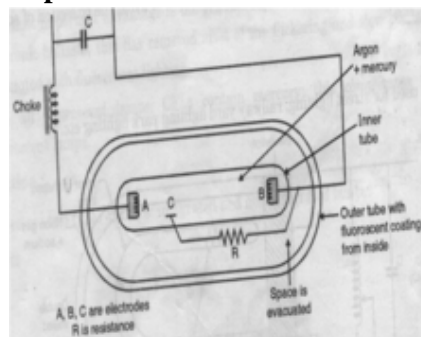
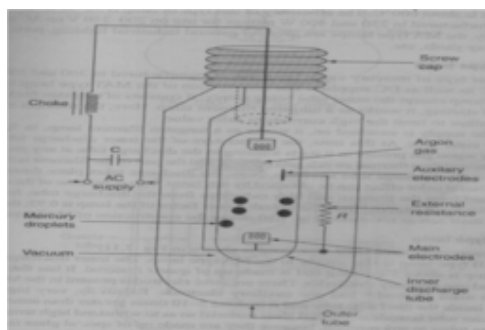


c) Explain with neat diagram 'construction and working of HPMV.

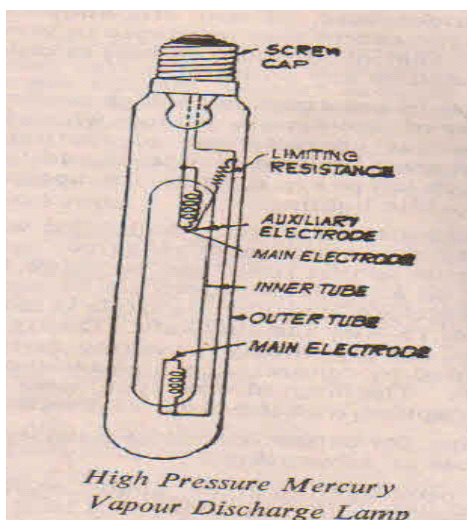
Ans:

(Diagram: 2 Marks, Construction: 1 Mark, Working: 1 Mark)

**Diagram of High Pressure mercury vapour lamp:**



OR



or equivalent figure

**Working of HPMV:-**

- Whenever 1-ph, 230V, AC Supply is provided to the discharge tube of MVL initially to current will flow from Phase to the choke to the starting electrode to neutral.
- Sometimes the starting electrode or resistance is made by tungsten filament having the more resistance ( 5 to 10 K ohm) so that whenever current flows through the tungsten filament as per the thermal emission the light is emitted through the filament ( tungsten immediately) so that initially colour of light is blue.
- At the same time the rated voltages is applied in between the filament No.1 & filament No.2. Due to this voltage, there will be collision. Of neon gas particles & current will start flow through the discharge tube,



	<ul style="list-style-type: none"> <li>➤ Whenever temperature surrounding the inner tube increases up to 60<sup>0</sup> C the mercury powder will start vaporizing &amp; the continuous collision process of all inert gases is taking place so that full light is emitted through the discharge tube.</li> <li>➤ The colour of light is bluish white. The full light is emitted after 10-15 min.</li> </ul> <p style="text-align: center;"><b>OR Student may write</b></p> <p style="text-align: center;">The construction &amp; connection diagram is as shown in figure. As per this construction there are following components.</p> <ul style="list-style-type: none"> <li>➤ <b>Choke:</b> The choke is acting as the ballast. At the time of supply voltage variation of current flowing through the inner tube is maintained constant to keep uniform light intensity. Sometimes choke can be designed for to get the higher voltages &amp; to apply the inner tube of mercury vapour lamp.</li> <li>➤ <b>Starting resistance/limiting resistance:</b> Whenever current flows through the starting resistance there is a I<sup>2</sup>R loss which is converted into heat. If the temperature of this heat goes near about 60<sup>0</sup> C then there will be heating effect &amp; inert gases ionization will be start.</li> <li>➤ <b>Auxiliary electrode &amp; Main electrode:</b> It is made by high resistive element. The ionization is taking place through the inert gases whenever current flows from auxiliary electrode to main electrode.</li> <li>➤ <b>Inner Tube:</b> The various inert gases e.g. Argon, Nitrogen etc with mercury powder are filled in the inner tube at 5 to 7 times of the atmospheric pressure.</li> <li>➤ <b>Outer Tube:</b> The function of outer tube is to make the vacuum surrounding the inner tube to avoid thermal dissipation or to maintain 60<sup>0</sup>C surrounding the inner tube.</li> <li>➤ <b>Power factor improvement Capacitor:</b> The function of power factor improvement capacitor is to improve the power factor 0.5 to 0.95</li> </ul>
d)	<b>A 230 V lamp has a total flux of 2800 lumens and takes current 0.7 Amp. Calculate lumen per watt and MSCP per watt.</b>
Ans:	<p style="text-align: center;">Total MSCP of the lamp = <math>\frac{\text{Total lumens required on working plane}}{4 \pi}</math> ----- (1/2 Mark)</p> <p style="text-align: center;">Total MSCP of the lamp = <math>\frac{2800}{4 \pi}</math> -</p> <p style="text-align: center;">Total MSCP of the lamp = 222.8169 ----- (1/2 Marks)</p> <p style="text-align: center;">Power of the lamp = <math>(V \times I) = 230 \times 0.7 = 161 \text{ watt}</math> ----- (1 Mark)</p>



$$\text{MSCP per Watt} = \frac{222.8169}{161} -$$

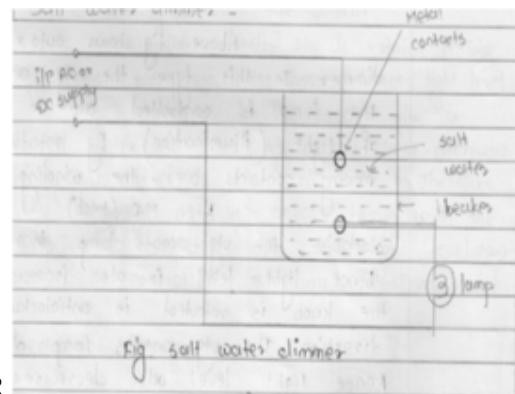
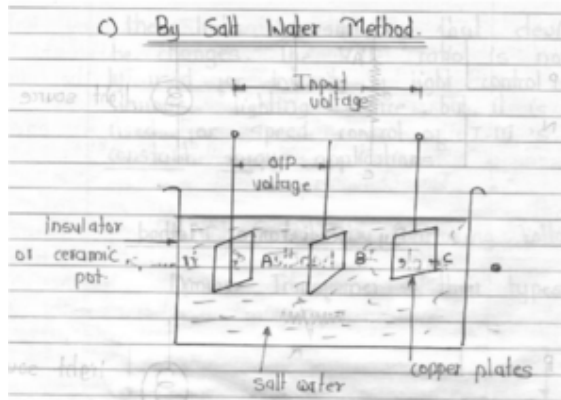
$$\text{MSCP per Watt} = 1.383 \text{ ----- (1 Mark)}$$

$$\text{Lumens per Watt} = \frac{2800}{161} -$$

$$\text{MSCP per Watt} = 17.3913 \text{ ----- (1 Mark)}$$

e) **Explain working of salt water dimmer with the help of diagram.**

Ans: **By salt Water method – ( Figure : 2 Marks & Explanation : 2 Marks)**



OR

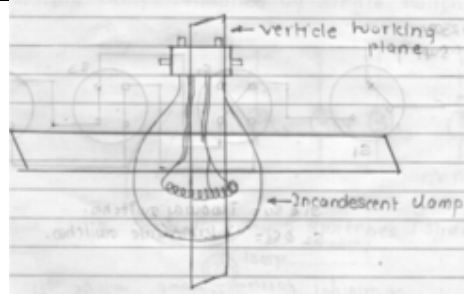
**Or equivalent figure**

- As position of plates in immersed position changes output voltage across Light sources will be changes .So that light intensity also will be changes.
- Distance between plates and quantity of salt immersed in the water and depth of plates decides light intensity.

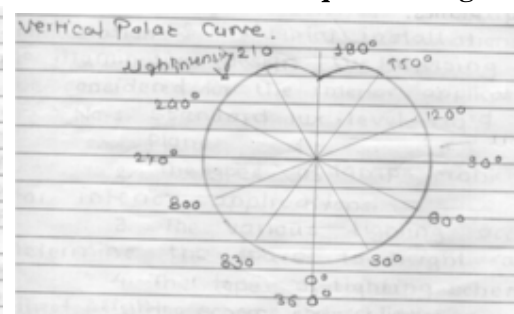
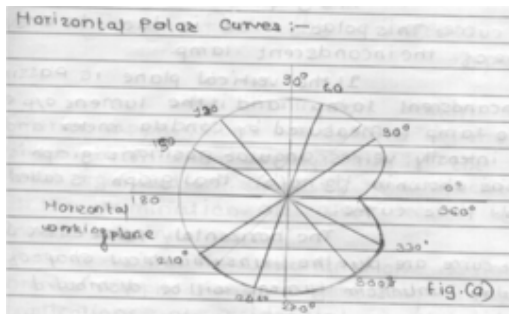
f) **What is polar curve ? Write its use in designing of lamps.**

Ans: **Meaning of Polar Curves:- ( Meaning : 2 Marks & Use : 2 Marks)**

Polar curves are graphical representation of light intensity with respect to angular position in horizontal or vertical plane passing through the light source.



or equivalent figure



**Use of polar curves in illumination Engg:-.**

The polar curves are required to determine the mean horizontal candle power (MHCP) and mean hemispherical candle power (MHSCP). The polar curves are due to limitations of unsymmetrical design shape of the incandescent lamp. The polar curves are required to calculate number of lamps in illumination design.

1. It indicates coverage of lights which helps lighting scheme.
2. To know the intensity of light emitted by the source in different direction

**Q.4 A) Attempt any THREE : 4 x 3 = 12 Marks**

**a) State any four specific requirements of street lighting.**

Ans: **Following specific requirements of street lighting:**

( Any four point expected: 1 Marks each)

1. The street lighting should be such that the object can be seen by driver of any vehicle.
2. The street lighting should be attractive.
3. It should increase the community value.
4. As per the Indian standard, the illumination level required for high traffic density should be 20:30 lux for medium traffic density it should be 8-15 lux & for low traffic density it should be minimum 4 lux.
5. It should be such that a driver of any vehicle sees the object up to 30 mtr.
6. Percentage of glare should be less so there are less chances of accidents, for that angle of reflector should be well maintain.



7. It should be electrical & mechanical safe.
8. The replacement of lighting accessories should be simple
9. The maintenance & repairing should be simple future expansion should be carries out without any difficulty.
10. It should be economical.
11. For high traffic density, generally metal halide lamp, halogen lamps should be used.  
For medium traffic density sodium vapour lamp , mercury vapour lamp should be used & for low traffic density CFL, LED and fluourescent tube should be used.

**OR**

**Main Objectives of street Lighting:**

- 1) To make the road clearly visible.
- 2) To promote safety & convenience to the traffic.
- 3) To make the street more attractive.
- 4) To increase the community value of the street.

**b) Compare commercial lighting and Industrial lighting. (any four point)**

Ans:

( Any Four Point Expected: 1 Mark each : Total : 4 Marks)

S.No	Point of comparison	Commercial lighting	Industrial lighting
1	Initial cost	Less	More
2	Maintenance cost	Less	More
3	Lumens required	Less/medium	Medium/More
4	Appearance	Attractive	Normal
5	Application	In Mall, Shops, Showroom etc	In any type of factory
6	Safety	Medium /high	Medium/high
7	Supply	3-Ph, 400 V	3-ph, 400V or HT Supply
8	P.F. improvement capacitor	Not compulsory	Compulsory
9	ELCB,MCB,MC CB, LA etc protection device	Can be installed as per consumers requirement	Generally it is compulsion.
10	Earth Wire	In normal case 18 SWG Copper or 16 SWG GI wire	Minimum 8 SWG Copper or 6 SWG GI Wire

**c) State any four types of lighting schemes. State their one use.**

Ans:

**lighting scheme adopted:**

1. Direct lighting scheme
2. Indirect lighting Scheme

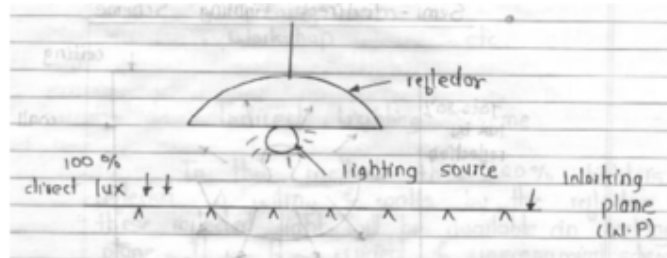




3. Semi direct scheme
4. Semi indirect scheme
4. General lighting scheme

**Explanation :** (Any Four Expected: 1 Mark each, Total 4 Marks)

**i) Direct lighting :**



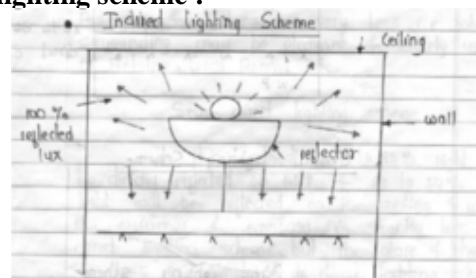
In this method, the reflector is used on the lighting source. The 100% light is reflected by this reflector on the working plane. So efficiency of direct lighting scheme is very high and it is economical also. But limitation of direct lighting scheme is that glare & shadows are more.

The direct lighting scheme is widely used in drawing room, workshop etc.

**Drawbacks of direct lighting system: (Any one point expected)**

1. This scheme is more efficient but it suffers from hard shadows and glare.
2. These light creates tunneling effect i.e ceiling remains dark.

**ii) Indirect lighting scheme :-**

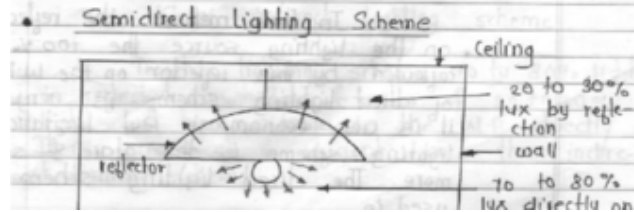


**or equivalent figure**

In this method the 100% light is reflected on ceiling and walls by the reflector and this reflected light will be available on working plane. It is less efficient and uneconomical scheme but glare and shadows are very less. i.e. why surrounding may be pleasant and widely used in hotels, guest room etc.

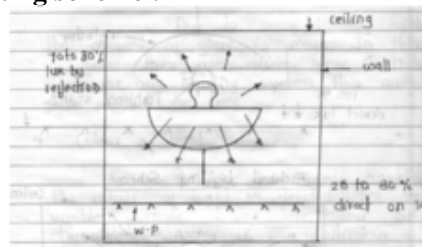


**iii) Semi direct lighting scheme :-**



In this method, the 70 to 80% light will be directly reflected on the working plane and 20 to 30 % light will be reflected on the ceiling and walls. The efficiency and economy is slightly less than direct lighting scheme. But the glare and shadows are less as compare to direct lighting scheme.

**iv) Semi indirect lighting scheme :-**



**or equivalent figure**

In this lighting scheme, 70 to 80% light is reflected on ceiling & walls and 20 to 30% light will be available on the working plane directly. It is economical and efficiency as compared to indirect lighting scheme.

**v) General lighting scheme:-**

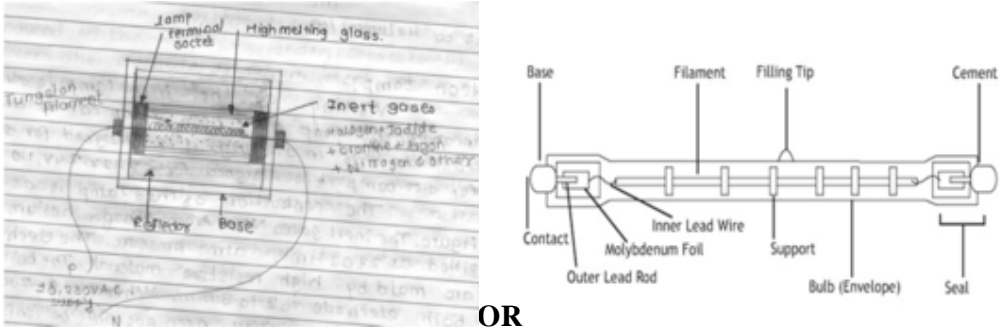
In this lighting scheme, the reflector is not used on the light source, so the lumens emitted by the light source will be reflected on ceiling wall and can be available directly on working plane also.

This method is commonly used in various residential, commercial and industrial installations.

**d) State any four applications of spot lighting.**

- Ans: Applications of Spot Lighting. (Any Four Expected: 1 Mark each, Total 4 Marks)
1. In Shops for showroom purpose
  2. Stage lighting
  3. Illumination monuments
  4. In art gallery
  5. Advertising lighting.



<b>Q. 4B)</b>	<b>Attempt any ONE :</b> <span style="float: right;"><b>6 x 1 = 6 Marks</b></span>
<b>a)</b>	<b>Explain with neat diagram, construction and working of Halogen lamp. State their application.</b>
Ans:	<p><b>Sketch of Halogen Lamp:-</b> <span style="float: right;">( Sketch : 2 Mark)</span></p> <div style="display: flex; justify-content: space-around;"><p style="text-align: center;"><b>OR</b> <b>or equivalent figure</b></p></div> <p><b>Construction and Working of Halogen Lamp:-</b> <span style="float: right;">( Working : 2 Mark)</span></p> <ul style="list-style-type: none"><li>➤ This is one type of incandescent lamp having number of advantages over the ordinary incandescent lamp.</li><li>➤ The life &amp; efficiency of an incandescent lamp is affected by the gradual &amp; evaporation of tungsten and also its operating temperature but the addition of small amount of halogen vapour to the gas in bulb restores.</li><li>➤ The evaporated tungsten vapour back to the filament by means of chemical reaction and the cycle goes on.</li><li>➤ Halogens are a group consisting of the elements chlorine, fluorine &amp; bromine &amp; iodine. As a result halogen lamps have the following advantages.</li><li>➤ There is no blackening of bulb so there is no depression of light output.</li><li>➤ It has 50 % more efficiency than that of an ordinary incandescent lamp.</li><li>➤ It is smaller in size.</li><li>➤ It gives better coloured radiation.</li><li>➤ Halogen lamps are manufacture upto 5KW and are suitable for outdoor illuminations.</li></ul> <p><b>Application of Halogen Lamp:</b> <span style="float: right;">( Application : 2 Mark)</span></p> <ol style="list-style-type: none"><li>1) Hospitality (restaurants, lounges, hotels_)</li><li>2) Museums, galleries and art displays</li><li>3) Retail displays (merchandising, ancient lighting)</li><li>4) Residential, commercial, offices, grocery, food, decorative and decorative</li></ol>





$$\text{Gross Lumens} = \frac{90 \times 2400}{0.48 \times 0.9}$$

$$\text{Gross Lumens} = \frac{21600}{0.432}$$

$$\text{Gross Lumens} = 500000 \text{ lumens} \text{ ----- (1 Marks)}$$

$$\text{Total Wattage required} = \frac{\text{Gross Lumens}}{\text{Luminous efficiency in lumens / watt}} \text{ ----- (1 Marks)}$$

$$\text{Total Wattage required} = \frac{500000}{20}$$

$$\text{Total Wattage required} = 25000 \text{ Watts} \text{ ----- (1 Marks)}$$

**Space/height=1 hence space=6**

$$\text{No. of lamps length wise} = \frac{\text{Length}}{\text{space}} = \frac{80}{8.5} = 9.41 \cong 9 \text{ Nos}$$

$$\text{No. of lamps width wise} = \frac{\text{width}}{\text{space}} = \frac{30}{8.5} = 3.529 \cong 4 \text{ Nos}$$

$$\text{Total No. of lamps} = \text{Length wise} \times \text{width wise} = 9 \times 4 = 36 \text{ Nos} \text{ ----- (1 Marks)}$$

$$\text{Wattage of each lamp} = \frac{\text{Total wattage required}}{\text{No. of lamp}} \text{ ----- (1 Marks)}$$

$$\text{Wattage of each lamp} = \frac{25000}{36}$$

$$\text{Wattage of each lamp} = 694.44 \cong 700 \text{ ----- (2 Marks)}$$

**b) Explain how lighting scheme should be designed of each of the following parking area in mall and digital showroom and Garment shop.**

Ans: Lighting scheme should be deigned according to application of lighting purpose : ( 8 Marks)

**i) Parking area for the malls:**

➤ The lighting scheme designed should be similar to outdoor lighting or flood lighting



**ii) Digital showroom :**

- The lighting scheme designed should be similar to indoor lighting or Spot Lighting

**iii) Garment shop.**

- The lighting scheme designed should be similar to indoor lighting and decorative lighting for showrooms.

**For above applications the designed procedure is as below:**

1. Visit to corresponding site and make the proper survey of every room and its interior or exterior applications. Measure the dimensions of every room (length, width, height). Make the proper plan layout with proper isometric view.
2. Find out application and working plane of every working plane.
3. As per the illumination standard decide proper lux level on that particular working plane.
4. As per quality of civil work and surrounding conditions and colour of walls and ceiling decide waste light factor, utilization factor, depreciation factor etc.
5. Find out total lumens required on working plane.

$$\text{Total lumens required on working plane} = \frac{AIW}{CD}$$

6. Decide the type and wattage of lamp which is to be used for that particular application
7. Assume the proper illumination efficiency of those specific lamps which are to be used on that working plane
8. Find out total no. of lamps/focus lamps, MVL, SVL and tubes etc for that particular working plane and after that find out total no. of lamps & tubes or any other lamps for interior application of commercial installation. By assuming proper space to height ratio make the proper illumination scheme. This procedure is repeated for every working plane in every room.
9. Find out total no. of lamps or tubes for that particular working plane

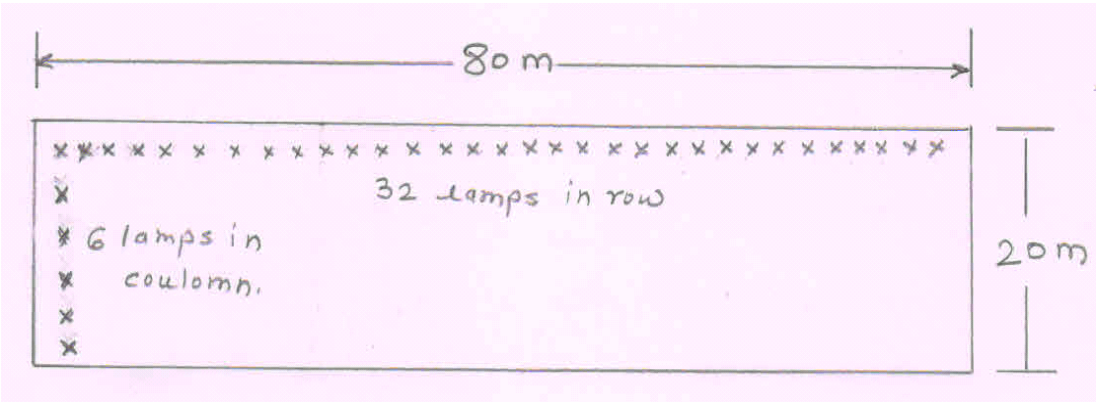
$$\text{Number of Lamps required} = \frac{\text{Total Lumens Required}}{\text{Wattage of each lamp} \times \% \eta \text{ of each lamp}}$$

10. Find out total power consumption of all interior or exterior applications for calculated lamps and tubes.
11. Find out the rated current for all applications.

If 1Ph, 230V supply is provided,  $P = VI \cos \phi$





	<p><b>The wattage of lamps is assumed – 100 watt</b></p> $\text{iv) Number of Lamps} = \frac{\text{Total Wattage}}{\text{Wattage of each lamp}} \text{ ----- (1/2 Marks)}$ $= \frac{19047.619}{100}$ $= 190.476 \approx 190 \text{ Nos ----- (2 Marks)}$ <p><math>\therefore</math> Numbers of lamps = 190 Nos</p> <p><b>Location of lamps: ( 1 Mark)</b></p>  <p style="text-align: center;"><b>OR Equivalent figure</b></p>
<p><b>Q.6</b></p>	<p><b>Attempt any FOUR : 4 x 4 = 16 Marks</b></p>
<p>a)</p>	<p><b>State any four requirements of illumination of shipyards areas.</b></p>
<p>Ans:</p>	<p><b>The requirements of illumination of shipyards areas:-</b></p> <p style="text-align: center;">(Any Four points Expected 1 Marks Each)</p> <ol style="list-style-type: none"> <li>1. The shipyard lighting always depends upon the all surrounding conditions for e.g. wind pressure, rain fall, location of shipyard from the sea-share etc.</li> <li>2. The shipyard lighting always depends upon the type &amp; capacity of alternator which is held in ship for interior applications and the capacity of alternator which is installed in the ship-yard and any other non-conventional sources installed in that particulars area for all outdoor application.</li> <li>3. In the every shipyard there may be limitation conventional sources to over-come these limitations sometimes non-conventional sources for e.g. solar, tidal, wave-let, etc non-conventional energy sources are to b used. At the time of illumination design we have</li> </ol>





	<p>to consider this factor.</p> <ol style="list-style-type: none"><li>4. In the ship-yard after scotching various shipyard is necessary for this case control room, emergency –control, emergency medical centre. Loading and unloading areas etc. are required, at the time of illumination design we have to consider all these applications for its standard lux level.</li><li>5. In the every ship-yard the electrical &amp; mechanical safety is the prime-moto. At the time of illumination design the all safety precautions are to be taken.</li><li>6. The life of the shipyard lighting should be always more.</li><li>7. The cost of the ship-yard lighting should be always economical.</li><li>8. The every ship-yard station should be free from any type of pollution for e.g. water pollution, sound pollution or noise pollution to the commercial communication signals.</li><li>9. At the time of ship-yard lighting for the outdoor applications we have consider total area of water, which is covered by the illumination.</li><li>10. The ship-yard lighting is always at the remote place slightly away from the sea-share, so at the time of ship-yard lighting the wiring &amp; accessories can be replace easily.</li><li>11. The maintenance and the repairing of the shipyard lighting system should be simple &amp; less, at the time of ship-yard lighting the navigation signals and lights are very important to control the various ships at the time of ship-yard lighting we have to consider this factor also.</li><li>12. In the ship-yard lighting the various lamp are used to get the proper lux level and for energy saving purpose also, the some of the lamps are as below-forge, Bollards, foot lamps, solar grass lamps, LED-Solar energy lawn lamps, various focus lamps, metal halide lamps etc.</li></ol>
<b>b)</b>	<b>State any four desirable characteristics of lighting required in stage area.</b>
Ans:	<p style="text-align: center;">(Any Four points Expected: 1 Marks Each)</p> <p><b>The following characteristics with their effects can be obtained by lighting on the stage:</b></p> <ol style="list-style-type: none"><li>1. The activity or programme on the stage should be performed without any disturbance.</li><li>2. The lux level on the stage and light intensity is maintained and controlled as per requirement of activity.</li><li>3. The multi colour effect for particular activity of drama is also possible.</li></ol>



4. The smooth and simple control is also possible.
5. The replacement of lighting accessories should be simple and quick.
6. The maintenance and repairing is less.
7. The all operations in the stage lighting are smoothly and simple controlled.
8. Life of the stage lighting is more and it is more economical.
9. The Power consumption should be less.
10. The surrounding mood on the stage is maintained and improved by the stage lighting.

c) **State any four desirable characteristics required in Aquarium.**

Ans: **Following Characteristics required in Aquariums:-**

(Any Four points Expected: 1 Marks Each)

1. The aquarium lighting depends on the size of the aquarium tank (Length, width and depth). So select proper aquarium size
2. The aquarium lighting depends upon the all surrounding condition e.g. colour and size of the given hall in which the aquarium is placed. So maintain the surrounding condition
3. The aquarium lighting depends on the maintenance schedule of the tank water and other aquarium accessories, So keep proper maintenance
4. The aquarium lighting depends on the surrounding temperature and required temperature of water in the tank. So to keep the proper temperature.
5. In some type of aquarium the ultraviolet lamp are provided for the bacteria killing purpose. So use ultraviolet lamp
6. The aquarium lighting also depends on the various aquarium lighting also depends on the various aquarium accessories used in the tank. So use and maintain the various aquarium accessories.
7. The aquarium lighting should be electrically and mechanically safe to the all type aquatic animals and operator also. So keep safety.
8. The aquarium lighting should be economical.
9. The life of the aquarium lighting should be long.



<b>d)</b>	<b>How decorative lighting is useful for advertising section ?</b>																											
Ans:	<b>besides Decorative lighting advertising is also possible in following cases :</b> (Any four point Expected:1 Mark each) <ol style="list-style-type: none"><li>1. By decoration of ancient and VIP Buildings.</li><li>2. By decoration of gardens.</li><li>3. By increasing the beauty of interior and exterior applications.</li><li>4. To increase the festival mood.</li><li>5. For domestics function.</li><li>6. For various stages.</li><li>7. For advertisement of commercial building.</li><li>8. To improve energy saving, economy, reliability of lighting system</li><li>9. Decorative lighting is always attractive and, multicolour so automatically it will be advertised.</li></ol>																											
<b>e)</b>	<b>Suggest the various illumination levels required in various areas of Healthcare centre and Hospitals.</b>																											
Ans:	<b>i) Recommended illumination level required for any four areas of hospital lighting and Healthcare centre:</b> (Any Four areas required- 1 Mark each) <table border="1"><thead><tr><th>S.No</th><th>Areas</th><th>Recommended illumination level</th></tr></thead><tbody><tr><td>1</td><td>Reception &amp; Nursing</td><td>250 to 300 lux station</td></tr><tr><td>2</td><td>Corridors &amp; circulation</td><td>40 to 60 lux areas</td></tr><tr><td>3</td><td>Patient wards -</td><td>100 to 200 lux</td></tr><tr><td>4</td><td>Operation theatres -</td><td>600 to 1000 lux</td></tr><tr><td>5</td><td>ICU -</td><td>500 to 700 lux</td></tr><tr><td>6</td><td>General ward</td><td>100 to 200 lux</td></tr><tr><td>7</td><td>Special ward</td><td>150 to 250 lux etc</td></tr><tr><td>8</td><td>Gym Section</td><td>200 to 300 lux</td></tr></tbody></table>	S.No	Areas	Recommended illumination level	1	Reception & Nursing	250 to 300 lux station	2	Corridors & circulation	40 to 60 lux areas	3	Patient wards -	100 to 200 lux	4	Operation theatres -	600 to 1000 lux	5	ICU -	500 to 700 lux	6	General ward	100 to 200 lux	7	Special ward	150 to 250 lux etc	8	Gym Section	200 to 300 lux
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<b>f)</b>	<b>Write a note on Horticulture lighting and Agriculture lighting.</b>																											
Ans:	<b>Explanation for agriculture lighting and Horticulture lighting :</b> ( 4 Marks) <ol style="list-style-type: none"><li>1. If any type of agriculture or horticulture premises if the natural sunlight is not available then high pressure sodium lamps and metal halide lamps are to be used.</li><li>2. The requirement of agricultural or horticultural lighting is similar of flood lighting and lighting calculations is also same. Only difference is that basic lux level is decided by</li></ol>																											



the type of applications.

3. In the greenhouse the fluorescent tubes, the CFL are also used for energy saving purpose. The metal halide lamps which are to be used in the green house having the wattage of 75W, 250W and 400W.
4. In any types of green house, the all environmental condition which are required for plant growth these all conditions are artificially provided by the lighting scheme. These all Surrounding conditions may be room temp. Humidity, wind pressure, sunlight and percentage of water.
5. In the green house we can use standard high pressure lamp of 250W, 500W, 1000W etc. In these types of lamps, there may be sodium vapour lamp and mercury vapour lamp.

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