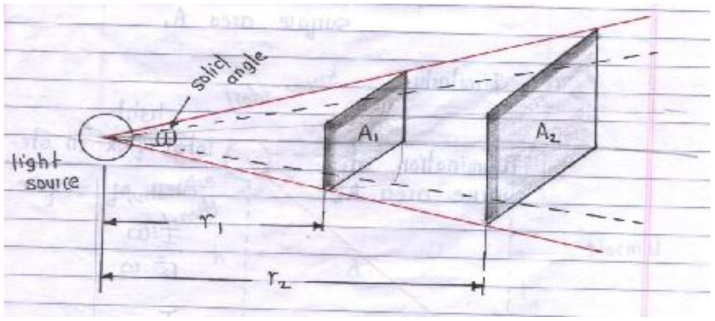
Important suggestions to examiners:

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.

Q.1 A)	**Attempt any THREE of the following :**	**12 Marks**
a)	**State and describe laws of illumination with figure.**	
Ans:	**Inverse square law:-**	**(2 Marks)**

This law state that " the illumination of a surface is inversely proportional to the square of distance between source of light & surface area and it is also directly proportional to the luminous intensity (I) or candle power of the lamp in that direction.

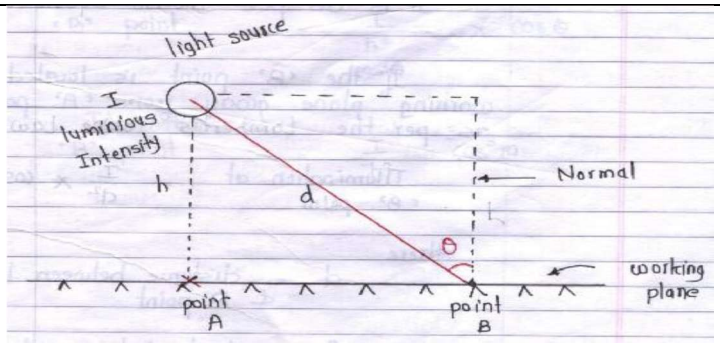
Illumination at A point = I / r^2



2) Lambert's cosine law:- **(2 Marks)**

This law states that "the illumination E at any point on a surface is directly proportional to the cosine of the angle between the normal at that point and the line of flux.

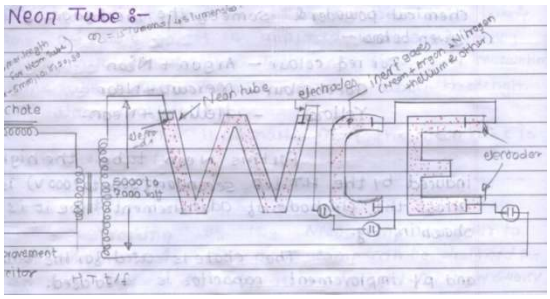
Illumination at B point = $I/d^2 \times \cos\theta$



b) Describe working principle and construction of neon lamp with the help of diagram.

Ans: **working principle and construction of neon lamp(Tube)** **(4 Marks)**

i) Neon tubes:-



or equivalent

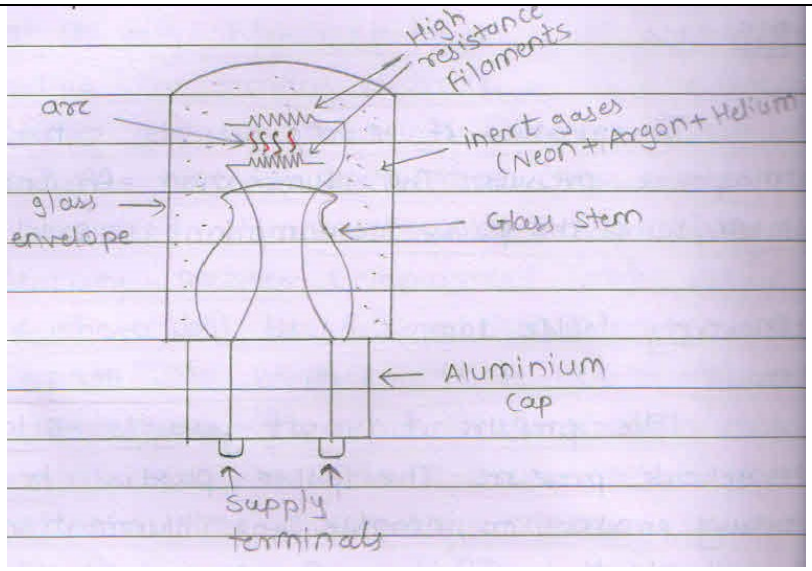
The construction & circuit diagram for neon tube is as shown in fig. Basically neon tube is used for advertisement or decoration purpose. The maximum length of tube is 8m. The available diameter for neon tubes are 5mm,10mm,15mm, 20mm, 30mm, etc.

In the neon tube we can achieve various colours with addition of the chemical powders & some of the inter gases. For this neon tube the high voltage induced by H.T. transformer secondary (5000 to 7000V) is applied across the electrodes of advertisement tube.

- The choke is used for ballast & power factor improvement capacitor is also used. For the neon tube the continuous high voltage is required, so that following precautions should be taken.
- The neon tube should be installed by government authorized supervisor.
- The metal body of the HT transformer must be earthed separately.
- Caution notice of danger board is required.
- **Working principle**;- single phase 230 V supply is provided to the input of H.T. Transformer then by H.T. Transformer very high voltages (5000 to 7000V) is provide across the electrodes due to high voltages Neon gas will be ionized and light will be emitted through the Neon tube. Colour of light depends upon combination of inert gases and chemical power.

OR

Figure of Neon lamp:



or equivalent figure

Construction of Neon lamp:

- It is as shown in figure it works on ac as well as dc supply, for dc supply neon lamp works on 3V, 6V, 12V, 24V and for AC supply it works on 230V, 400V
- The construction is as shown in figure, the inert gases (neon, argon, helium etc) are filled at low pressure. 2 to 3 mm gap is provided in between two electrodes. Which are made by high resistive material.

Working of Neon lamp:

- Whenever ac or dc voltage is provided to the supply terminals, the arc will induced in between the two electrodes due to high resistive material there is more I^2R loss, Due this more thermal energy arc will induced in between the electrodes and light will be emitted through the neon lamp.
- By adding the chemical powders the colour of light can be changed.

c) Explain difference between dimming control and ON/OFF control in lighting control.

Ans: **(Any Four Point Expected : 1 Mark each, Total 4 Mark)**

S.No	Dimming control	ON/OFF control
1	To turn ON or OFF the lamps by Dimmer	To turn automatically light ON by switch when a room becomes occupied.
2	Stroboscopic effect is less	Stroboscopic effect is more

3	By changing volt we can achieve control on light	By just simple switching ON/OFF lamp
4	For dimming, the dimming control permits to keep required lux level on working plane by adjustment of controlling device.	To keep the light ON without interruption while the controlled space is occupied
5	For changing the lighting levels according to need or desired of the owner or as per the applications	To turn the lights OFF within a preset time period after the space has been vacant.
6	For energy saving purpose dimmer can be used for light intensity control.	By lux control method light intensity can be controlled and energy saving is possible.
7	To increase the life of lighting source dimming control can be used.	To increase the life of lighting source one way or two way switch controlled can be used
8	In some types of industrial or automation there is need of lighting control by dimmer	For street lighting and domestic installation by ON/OFF control energy saving will be possible.

d) State the meaning of polar curve and give two application of it.

Ans: **Meaning of Polar Curves:-** **(Meaning : 2 Marks & Application : 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.

Applications of polar curve: (Any Two point expected)

1. It indicates coverage of lights which helps lighting scheme.
2. To know the intensity of light emitted by the source in different direction.
3) In illumination design to determine MHCP and MSCP.

Q.1B) Attempt any ONE of the following : 06 Marks

a) Compare filament lamp and fluorescent lamp on the basis of following : (i) Quality of light (ii) Capital & running cost (iii) Lamp efficiency (iv) Life of Lamp (v) Voltage regulation (vi) Lumen output

Ans: **(Each Point : 1 Mark, Total 6 Marks)**

S.No.	Points of comparison	filament Lamp	Fluorescent Lamp
i)	Quality of light	Good	Best
ii)	Capital and	Capital cost is less and	Capital cost is more and

	Running cost	Running cost is more as life is less	Running cost is less as life is more
iii)	Lamp efficiency	Less (12 to 15 lm/w)	More (40 to 60 lm/w)
iv)	Lamp Life	less	More
v)	Voltage regulation	Yes, light intensity changes with change in voltage	No, light intensity does not changes with change in voltage
vi)	lumen output	Less	More

b) State the features and advantages of good illumination scheme.

Ans: **Following features and advantages of good illumination scheme:**

(Any Six point expected-1 Mark each, Total: 6 Marks)

1. Good illumination scheme encourage the personnel for better working.
2. In commercial, correctly planned scheme promote the sale.
3. In a factory lighting arrangements are planned to increase productivity & to improve the quality of production.
4. Correct & good illumination scheme avoid the accidents.
5. Adequate & glare free illumination provides pleasant atmosphere for staff.
6. Good lighting in schools & colleges helps in raising the average grades of the students.
7. In short good illumination scheme increases overall efficiency.
8. By proper illumination scheme energy saving will be effective & with cost saving also.
9. It should have sufficient light.
10. It should not strike the eyes.
11. It should not produce glare.
12. It should be installed at such a place that it gives uniform light.
13. It should be of correct type as needed.
14. It should have suitable sets, reflectors.

OR **(Any Six point expected-1 Mark each)**

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 large

	4. **Economy:** The cost of the designed illumination scheme be low. 5. **Less Maintenance:** For only type of illumination scheme the maintenance and repairing should be less. 6. **Appearance:** The appearance of illumination scheme should be good. 7. **Less glare:** The glare is fatigue to the human eyes. The illumination scheme is designed in such away that there should be less glare to everyone i.e only electrical & mechanical accidents will be less. 8. **Less flicker:** The flicker is change in light intensity. This flicker should be always less for any type of illumination scheme. In the flicker there are changes of stroboscopic effect at the time of workshop lighting it is very imp. 9. **To avoid hard shadows:** The whole illumination scheme is designed 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 applications, type of location & their countries standard 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, multicolor light intensity control is also possible in electrical illumination.
Q.2	**Attempt any TWO of the following : 16 Marks**
a)	**Describe different methods used for lighting control as energy saving tool.**
Ans:	**The following methods can be used for lighting control as energy saving tool:** 1. By changing the light intensity of the light source: **(3 Marks)** a) By changing voltage : dimmer transformer, regulators can be used b) By changing current: Choke and ballast can be used. c) By changing frequency : By inverters and oscillators frequency can be changed d) By changing V/f ratio: By changing voltage and frequency. 2. By using ON/OFF controllers: **(3 Marks)** a) For street lighting control using timing mechanism, No. of lighting sources are controlled to get energy saving application. b) For automatic traffic intensity control.

OR

- **ON/OFF control technique** :

A most common type of lighting control is ON/OFF toggle switch other types of lighting control include occupancy sensors, day light sensors, a variety of manual & automatic dimming devices and centralized controls.

Occupancy sensors including passive infrared, ultrasonic and dual technology sensors served three basic functions.

i) To turn automatically light ON when a room becomes occupied.
ii) To keep the light ON without interruption whiles the controlled space is occupied.
iii) To turn the lights OFF within a preset time period after the space has been vacant.
iv) Lux method for light intensity control can be used.
v) One and Two way switch used for controlling from two different places.

- **Dimming Control:**

i) Light intensity of lighting source is controlled smoothly.
ii) Simple to control and handle.
iii) Light in weight
iv) Compact in size as compare to electric dimmer
v) Light intensity can be controlled by controlling voltage, current and frequency.
vi) Due to simple in operation can be used for stage lighting, garden lighting etc.

3. By using various sensors like motion sensor, occupancy sensor energy saving is possible.

(1 Marks)

4. For poor power factor lighting devices: power factor improvement capacitor or by using any other method energy saving is possible. **(1 Marks)**

b) An illumination on the working plane of 75 lux is required in a room 72 m x 15 m in size. The lamp are required to be hung 4 meter above the work bench. Assuming a suitable space height ratio, a utilisation factor of 0.5, lamp efficiency of 14 lumens/watt and maintenance factor 0.8. Estimate the number of lamps, rating of lamp and disposition of lamps.

Ans:

"Note:- If students have attempted assuming appropriate values for constants, give appropriate stepwise marks"

Given Data:

E = 75 Lux
Area of working plane = 72 m x 15 m = 1080 m^2
U.F = 0.5 & D.F = 0.8
Assume Wattage of each lamp = 200 watt
Efficiency of lamp = 14 lumens/watt

Determine: 1) Number of lamps if luminous efficiency of 14 lumens/watt

Solution:

$$Gross\ \ Lumens = \frac{A \times E}{U.F \times D.F}$$ ---------- **(1 Marks)**

$$Gross\ \ Lumens = \frac{1080 \times 75}{0.5 \times 0.8}$$ ---------- **(1 Marks)**

$$Gross\ \ Lumens = \frac{81000}{0.4}$$

$$Gross\ \ Lumens = 202500$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ \ required = \frac{Gross\ \ Lumens}{Wattage\ of\ each\ lamp \times efficiency\ of\ each\ lamp}$$ --**(1 Marks)**

$$Number\ of\ Lamps\ \ required = \frac{202500}{200 \times 14}$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 72.32 \approx 72\ Lamps$$ ---------- **(1 Marks)**

Their disposition: -------- **(2 Mark)**

Space to height ratio may be different (like 1)therefore rows and columns will be different

- Assume space to height ratio = 3:4 = 0.75
- Number of lamps lengthwise (No of rows) $= \frac{Length\ (L)}{Space\ (S)} = \frac{75}{3} = 25$
- Number of lamps widthwise (No of columns) $= \frac{Width\ (W)}{Space\ (S)} = \frac{15}{5} = 3$

---------- L= 72 Meters ----------

5M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M	3M
5M																								
5M																								

Fig: Dispositions of lamps (at each cross or Junction of 3 lines there is one lamp except 1st columns)

Total number of lamps as per illumination design = 24 x 3 = 72 Nos

c)	**A building 50 m x 15 m is to be illuminated by flood light projector situated 25 m away; if illumination is 100 lux, coefficient of utilization 0.5, depreciation factor 1.5 and waste light factor 1.2. Estimate the number, size and angle of the projector assuming 1000 watts lamp having 17 lumens/watt luminous efficiency.**

Ans:

Given Data:

E = 100 Lux Area of working plane =50 m x 15 m = 750 m^2

U.F = 0.5& D.F = 1.5Waste light factor = 1.5

Wattage of Lamps Assumed= 1000 watt Efficiency = 17 lumens/watt

Distance of Projector from building = 25 mtr

$$Number\ of\ Lamps = \frac{illumination\ level \times Area \times waste\ light\ factor \times D.F}{Wattage\ each\ lamp \times\ lamp\ efficiency \times U.F}$$

(1 Marks)

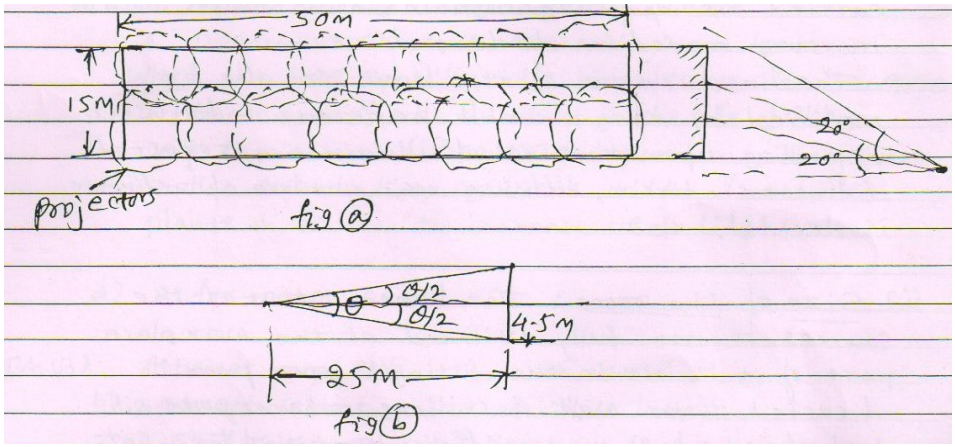
$$Number\ of\ lamps = \frac{100 \times 750 \times 1.2 \times 1.5}{1000 \times\ 17 \times 0.5}$$

$$Number\ of\ Lamps = 15.88 \approx 16$$ (16 Lamp in single projector)

(3 Marks)

- In order to get uniform illumination. Overlapping of illuminated circles is essential. As such in equal squares we will have 8 illuminated circles length wise, we will therefore need 16 projectors knowing the diameters of thr illuminated circles & distance of the projector from the surface (Fef fig. b) we can find out the angle of spread (Q) as follows

Size of the projector : **(2 Mark)**



- **Angle of Projector** : **(2 Mark)**

Angle of spread $= \theta = 2 \tan^{-1}(\frac{4.5}{25}) = 20^0$ (Re f $Fig.\ b$) Hence 16 projectors of 1000 watt each with beam angle of 20^0 will be required.

OR student may write this way

$$Gross\ Lumens = \left(\frac{A \times I \times W \times D.f}{C}\right)$$ ---------- **(1 Marks)**

$$Gross\ Lumens = \left(\frac{50 \times 15 \times 100 \times 1.2 \times 1.5}{0.5}\right)$$

$$Gross\ Lumens = 270000\ lumens$$ ---------- **(1 Marks)**

$$Total\ Watage = \left(\frac{Gross\ \ lumens}{efficiency\ of\ \ each\ lamp}\right)$$ ---------- **(1 Marks)**

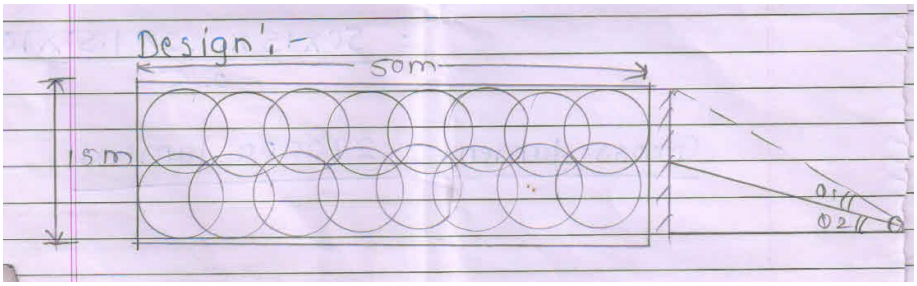
$$Total\ Watage = \left(\frac{270000}{17}\right)$$

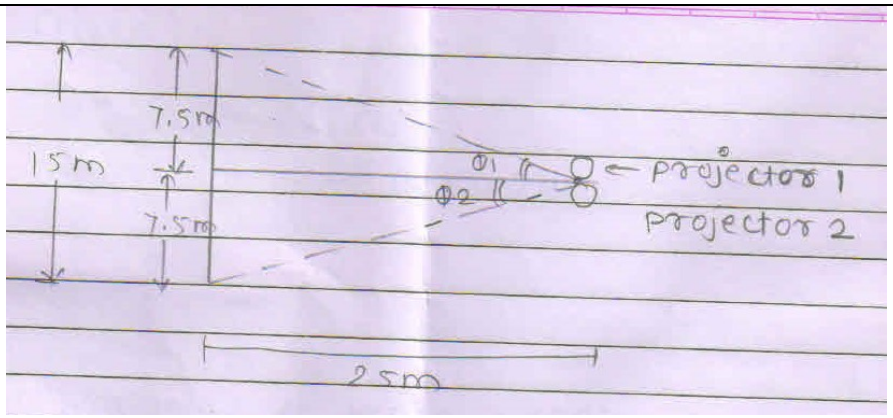
$$Total\ Watage = 15882.35\ watt$$ ---------- **(1 Marks)**

$$Total\ No.\ of\ \ lamp\ required = \left(\frac{Total\ \ wattage}{wattage\ of\ \ each\ lamp}\right)$$ ---------- **(1 Marks)**

$$Total\ No.\ of\ \ lamp\ required = \left(\frac{15882.35}{1000}\right)$$

$$Total\ No.\ of\ \ lamp\ required = 15.88 = 16\ lamps$$ ---------- **(1 Marks)**





➢ **Angle of Projector:** **(2 Marks)**

Hence for 16 lamps we will use 2 projectors. To get uniform illumination overlapping of light is necessary. Hence we will consider squares of equal length of these 16 lamp.

Angle of spread $= \theta = \tan^{-1}\left(\frac{7.5}{25}\right) = 16.69^0$ (Re f *Fig.* b) for single projector

Total spread angle : 2 x16.69^0 = 33.39^0 for two projector

Hence 16 lamps is single projectors of 1000 watt each with beam angle of 16.69^0 and total spread angle 33.39^0

Q.3	**Attempt any FOUR of the following :**	**16 Marks**
a)	**State the specific requirement for (i) Factory Lighting (ii) Sport Lighting**	

Ans:

(i) Factory lighting:

The following specific requirements should be considered for factory lighting:-

(Any four point expected– 1/2 Marks each, 2 Mark)

1) The type of industry or factory.
2) The total premises area of the whole factory in m^2.
3) The location of the factory.
4) The surrounding conditions. e.g. wind pressure, natural sun light, rainfall, etc.
5) The type of product which are manufactured in the factory.
6) The total indoor & outdoor area of the given factory.
7) The necessary lux level for the outdoor locations to increase the beauty of the factory at night, and pleasant working conditions.

8) The working plane required for the indoor application whether it is a ground surface or above ground surface.

9) The application of every room in the given factory. e.g. office, workshop, Research & development centre, testing centre, maintenance & repairing department, quality control department, sales department, commissioning department, showroom, guest room etc.

10) The required lux level for indoor premises in the given factory is decided as per application of department. e.g. In Workshop - 200 lux, e.g. In Showroom - 350 lux Above lux level is assumed.

11) As per civil construction work, the colour of ceiling walls & machines. The waste Light factor, utilization factor & depreciation factor is decided.

12) To minimize the stroboscopic effect & to minimize the glare the combination of various types of lighting source are selected.

13) The location & mounting of light source are selected in such a way that electrical & mechanical accident will be less.

14) The maintenance and repairing work for the whole illumination scheme should be less.

15) The overall cost of the illumination scheme should be less.

16) The lighting sources are selected in such a way that the overall power consumption will be less.

17) The lighting sources are selected and the illumination scheme is designed in such a way that the replacement of lighting accessories will be simple.

18) If expansion is required then it should be possible in present illumination scheme.

OR Student may write this way

1. The operation of factory lighting and its control should be simple.
2. At the time of factory lighting, the surrounding conditions inside the factory should be pleasant to every worker & officer to increase their work efficiency.
3. The all safety precautions are to be consider at the time of factory lighting to avoid the chances of electrical & mechanical accidents and danger of fire hazard.
4. The maintenance, repairing and expansion in the factory lighting should be less and simple.
5. The replacement of any lighting device or accessories should be so simple.

6. The cost of factory lighting for indoor and outdoor applications should be less.
7. The indoor and outdoor applications the life of the factory lighting should be high.
8. The percentage of glare in the factory lighting should be less.
9. The stroboscopic effect and Shadows due to the lighting in the workshop should be very less.
10. The overall power consumption of indoor and outdoor applications of factory lighting should be less. In that case energy saving lamp are to be used.
11. Sometimes, Direct lighting scheme or indirect lighting scheme is also used for the factory lighting
12. For the particular factory, I there is showroom, in that case the various clolour effects by using the focus lamps are used.
13. For factory lighting for indoor applications, we can use fluorescent tube, incandescent lamp, CFL and LED etc, but for outdoor applications we can used focus lamp of halogen or metal halide lamps.
14. For the factory lighting, for the indoor applications the illuminations design procedure is regular but depreciation factor, waste factor are changed.
15. Sometimes for the factory lighting the factory building surface is to be illuminated by flood lights.

ii) Sports Ground lighting design can be done by considering following specific requirements: **(Any four point Expected-1/2 Mark each, 2 mark)**

1) Types of sports –indoor or outdoor.
2) Illumination level required for that sport.
3) Time of sports whether it is day or night.
4) Area of illumination which is to be illuminated.
5) Surrounding conditions of the ground.
6) Height of the tower for the flood light which is installed near to or surrounding the ground.
7) At the time of sports light regular designing factor for example, working plane area, utilization factor waste light factor depreciation factor etc. are to be considered.
8) Power required and available should be also taken into account.
9) Maintenance and repairing cost should be also less.
10) Life of the projector & bunched filament lamp should be high.

b) Explain the stepwise procedure for designing illumination scheme for commercial unit.

Ans: **The stepwise procedure for designing illumination scheme for commercial unit:**

(Any four point expected 1- Mark each, Total 4 Mark)

1. Visit to corresponding site and make the proper survey of every room and its interior 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 room.
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 and tubes 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

$$Number\ of\ Lamps\ \ required = \frac{Total\ \ Lumens\ \ \text{Re}quired}{Wattage\ of\ \ each\ \ lamp\ \ \%\,\eta\ of\ each\ \ lamp}$$

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

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

    If 3ph, 400V supply is provided, $P = \sqrt{3}\ VI\cos\phi$

12. Determine size of wire or cable required for whole residential or commercial installation. The size of wire is decided by the starting current, which is 1.5 times rated current, for momentary overload S.C. future expansion and starting surge.

OR Student may write this way

The stepwise procedure for designing illumination scheme for commercial unit:

(Any Four point expected: 1 Mark each)

1) Find out the type of load and total electrical load for the given commercial premises.
2) Differentiate this total electrical load in lighting load and power load.
3) Make the no. of lighting sub circuit for lighting load.

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ Electrical\ lighting\ load}{800\ W}$$

OR

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ No.of\ \ lighting\ \ point}{10}$$

4) Make the no. of power sub circuits for power load.

$$No.\ of\ \ power\ Sub\ circuits = \frac{Total\ electrical\ \ power\ load}{2000\ W\ or\ 3000\ W}$$

OR

$$No.\ of\ \ power\ Sub\ circuits = \frac{Total\ \ No.of\ \ power\ \ points}{2000\ W\ or\ 3000\ W}$$

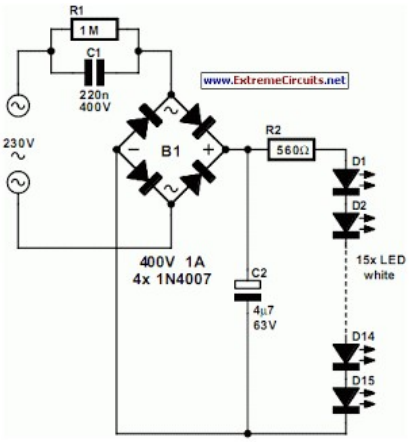
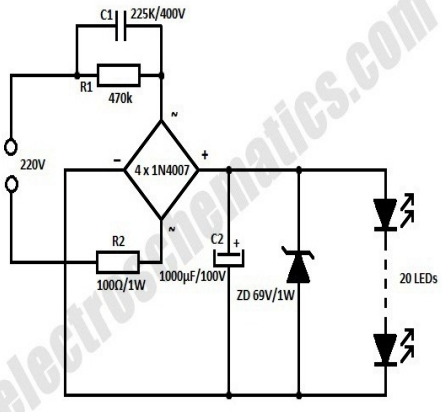
5) Find out total power consumption of every lighting and power sub circuits.
6) Find out rated Input current for every lighting and power sub circuit.

$P = V1 \cos\phi$ P = Input power for every sub circuit

V = voltage = 230 V

I = Input current for every sub circuit

7) Determine the size of wire required for every sub circuit by considering overload starting surge and future expansion.
8) Draw the single line diagram.
9) Mark the batten on plan layout.
10) Find out the total length of battenrequired for every sub circuit and whole commercial premises.
11) Find out the total length and size of wire required for every sub circuit.
12) List out the material required for whole commercial premises.
13) Find out cost of material and labour in estimation chart.
14) Find out the total cost of estimation with profit margin and contingencies charges.
15) Find out per point charges.
16) Draw the circuit diagram.

c)	**A 250 V lamp has a total flux of 1500 lumens and take a current of 0.4 A. Calculate (i) Lumen per watt (ii) M.S.C.P. per watt.**
Ans:	$Total\ MSCP\ of\ the\ lamp = \frac{Total\ lumens\ required\ on\ working\ plane}{4\pi}$ ---------- **(1/2 Marks)** $Total\ MSCP\ of\ the\ lamp = \frac{1500}{4\pi}$ $Total\ MSCP\ of\ the\ lamp = 119.3662$ ---------- **(1/2 Mark)** $Power\ of\ the\ lamp\ = V \times I = 250 \times 0.4 = 100\ watt$ ---------- **(1 Mark)** $i)\ Lumens\ per\ Watt\ = \frac{1500}{100} = 15$ ---------- **(1 Mark)** $ii)\ MSCP\ per\ Watt\ = \frac{119.366}{100} = 1.19366$ ---------- **(1 Mark)**
d)	**Draw and explain typical circuit diagram of LED Lamp.**
Ans:	**Typical circuit diagram of LED lamp:** **(Diagram: 2 Mark & Explanation: 2 Marks)**  OR  **OR**  or equivalent figure

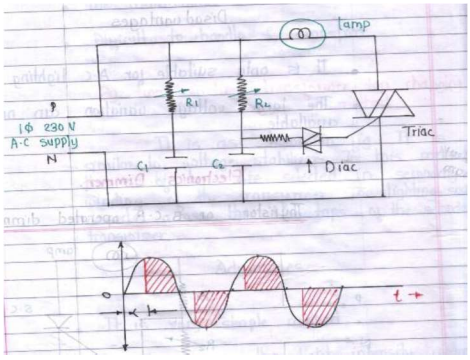
LED Lamp explanation of construction & working:-

The working principle of LED is similar to diode (P-N junction) whenever DC current flows through the light emitting diode, if the current path is from anode to cathode there will be voltage drop across the diode. Ti is 1.5V to 2.1V then light will be emitted through this diode.

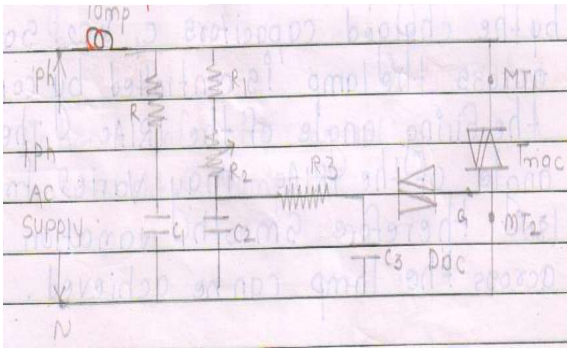
- The LED lamps are energy saving lamps,
- The power consumption of the single LED is very less. It is in mw. So by using series & parallel combination of LED.
- The LED lamp is manufactured the available wattage for the LED lamps are 1W,2W 3W, 5W etc.
- The LED lamp is available is various colours and diameter. The life of LED lamp is very high minimum 10000 working hours.

e) Explain TRIAC operated dimmer for light control.

Ans: **TRIAC operated dimmer for light control –** **(Figure: 2 Mark & Explanation: 2 Mark)**



OR



or equivalent figure

In this method, the limitation of thyristor operated dimmer is overcome. The triac is nothing but two SCR connected back to back and gate terminal is common. It will conduct +ve or –ve half cycles.

Whenever capacitor C1 & C2 are charged through the resistance R1 & R2 for +ve half cycle, capacitor C2 will be discharged through the gate terminal i.e. why the firing angle or conduction angle is decided by this R2C2 values.

But for the –ve half cycles the capacitor C1 is charged & discharged through the R1 & firing angle is decided by this R1C1 values.

In this way both half cycles are controlled by using triac type dimmer. To get the unidirectional pulse diac is used in series with the gate.

This method is commonly used for light intensity control and other application also e.g. fan regulator.

Q.4 A) Attempt any THREE of the following : 12 Marks

a) State the recommended illumination level required for any four area of residential premises.

Ans:

(Any Four point expected: Each Point : 1 Mark, Total 4 Marks)

S.No	Places of residential Purpose	illumination level in lux
i	Living Room	300 Lux
ii	Bedroom	200 Lux
iii	Kitchen	150-250 Lux
iv	Stairs	80-100 Lux
v	Dining Room	150 Lux
vi	Dressing table	200 Lux
vii	Bathroom mirror	70 Lux
viii	Study table	300 Lux

b) Explain any four factor that govern the design consideration for industrial premises.

Ans:

Factors while designing industrial premises:-

(Any Four points expected, each point -1 Mark, Total 4 Marks)

1) The type of industry or factory.
2) The total premises area of the whole factory in m^2.
3) The location of the factory.
4) The surrounding conditions. e.g. wind pressure, natural sun light, rainfall, etc.
5) The type of product which are manufactured in the factory.
6) The total indoor & outdoor area of the given factory.
7) The necessary lux level for the outdoor locations to increase the beauty of the factory at night, and pleasant working conditions.
8) The working plane required for the indoor application whether it is a ground surface or above ground surface.
9) The application of every room in the given factory. e.g. office, workshop, Research &

development centre, testing centre, maintenance & repairing department, quality control department, sales department, commissioning department, showroom, guest room etc.

10) The required lux level for indoor premises in the given factory is decided as per application of department. e.g. In Workshop - 200 lux, e.g. In Showroom - 350 lux Above lux level is assumed.

11) As per civil construction work, the colour of ceiling walls & machines. The waste Light factor, utilization factor & depreciation factor is decided.

12) To minimize the stroboscopic effect & to minimize the glare the combination of various types of lighting source are selected.

13) The location & mounting of light source are selected in such a way that electrical & mechanical accident will be less.

14) The maintenance and repairing work for the whole illumination scheme should be less.

15) The overall cost of the illumination scheme should be less.

16) The lighting sources are selected in such a way that the overall power consumption will be less.

17) The lighting sources are selected and the illumination scheme is designed in such a way that the replacement of lighting accessories will be simple.

18) If expansion is required then it should be possible in present illumination scheme.

OR

(Any Four points expected, each point -1 Mark, Total 4 Marks)

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 large
4. **Economy:** The cost of the designed illumination scheme be low.
5. **Less Maintenance:** For only type of illumination scheme the maintenance and repairing should be less.

6. **Appearance:** The appearance of illumination scheme should be good.
7. **Less glare:** The glare is fatigue to the human eyes. The illumination scheme is designed in such away that there should be less glare to everyone i.e only electrical & mechanical accidents will be less.
8. **Less flicker:** The flicker is change in light intensity. This flicker should be always less for any type of illumination scheme. In the flicker there are changes of stroboscopic effect at the time of workshop lighting it is very imp.
9. **To avoid hard shadows:** The whole illumination scheme is designed 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 applications, type of location & their countries standard
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, multicolor light intensity control is also possible in electrical illumination.

OR

1) Level of illumination or degree of illumination: It depends on nature of work to be carry out. The degree of level of illumination also depends on following factors.

i) The size of object & its distance from observer.

ii) If object is moving higher level of illumination is required than stationary object.

iii) If the objects are required to be seen for long duration of time, higher level of illumination is necessary & for stair cases, corridors less illumination is required.

2) Glare: The glare causes unnecessary eye fatigue so it must be avoided, it can be prevented by using diffusing glass screen, suitable reflectors & proper mounting height. Reflected glare from the polished surfaces within the line of vision should be avoided.

3) Shadows: The formation of long and hard shadows must be avoided. The long and hard shadows cause accident. Such shadows can be avoided by

i) Using proper mounting height of the lamps. ii) Using more number of lamps & providing indirect lighting.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.

4) color rendering: 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.

5) Lamp fittings: The lamp fittings serve the following functions in good illumination scheme.

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)

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 consider while designing interior illumination: utilization factor, deprecation factor, Maintenance factor and space to height ratio

OR

The stepwise factors while designing the illumination for industrial premises:

(Any Four points expected, each point -1 Mark, Total 4 Marks)

2. Visit to corresponding site and make the proper survey of every room and its interior 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 room.
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
13. Find out total no. of lamps and tubes 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.

14. Find out total no. of lamps or tubes for that particular working plane

$$Number\ of\ Lamps\ \ required = \frac{Total\ \ Lumens\ \ \text{Re}quired}{Wattage\ of\ \ each\ \ lamp\ \ \%\,\eta\ of\ each\ \ lamp}$$

15. Find out total power consumption of all interior applications for calculated lamps and tubes.
16. Find out the rated current for all applications.

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

If 3ph, 400V supply is provided, $P = \sqrt{3}\ VI\cos\phi$

12. Determine size of wire or cable required for whole residential or commercial installation. The size of wire is decided by the starting current, which is 1.5 times rated current, for momentary overload S.C. future expansion and starting surge

c) State the requirement of illumination scheme for shipyard.

Ans: **Following requirements of illumination scheme for a shipyard:**

(Any Four requirement are expected: 1 Mark each, Total 4 Marks)

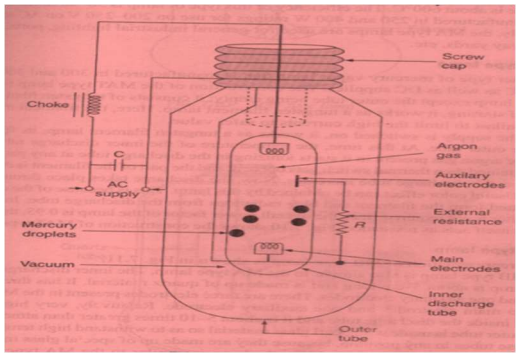
1. The shipyard lighting always depends upon the all surrounding conditions for e.g. wind pressure, rain fall, location of shipyard from the sea-share etc.
2. The shipyard lighting always depends upon the type & capacity of alternator which is held in ship for interior applications and the capacity of alternator which is installed in the ship-yard and any other non-conventional sources installed in that particulars area for all outdoor application.
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 to consider this factor.
4. In the ship-yard after scotching various shipyard is necessary for this case control room, emergency –control, emergency medical centre. Loading and loading areas etc. are required, at the time of illumination design we have to consider all these applications for its standard lux level.
5. In the every ship-yard the electrical & mechanical safety is the prime-moto. At the time of illumination design the all safety precautions are to be taken.
6. The life of the shipyard lighting should be always more.
7. The cost of the ship-yard lighting should be always economical.

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.
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.
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 every wiring & can be replace easily.
11. The maintenance and the repairing of the shipyard lighting system should be simple & 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.
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.

d) Explain with neat sketch the working of HPMV lamp and state its application.

Ans: **(Diagram: 2 Marks, Working: 1 Mark and application: 1 Mark, Total 4 Mark)**

Diagram of High Pressure mercury vapour lamp:



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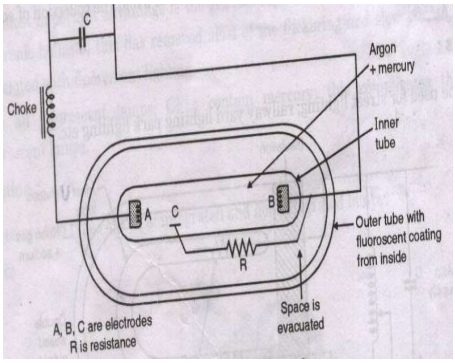
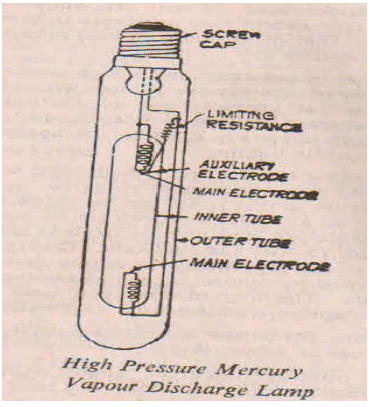




or equivalent figure

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,
- Whenever temperature surrounding the inner tube increases up to 60^0 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 I2R loss which is converted into heat. If the temperature of this heat goes near about 60^0 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 5 to 7 times of the atmospheric pressure.
- **Outer Tube:** The function of outer tube is to make the vacuum surrounding the inner tube to avoid thermal dissipation or to maintain 60^0C 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

Application of HPMV Lamp: (Any two point expected)

1. For street lighting
2. Factory lighting
3. Car parking area
4. Gardens

Q.4 B)	**Attempt any ONE of the following :**	**06 Marks**
a)	**List the various indoor lighting scheme and describe any two of them.**	

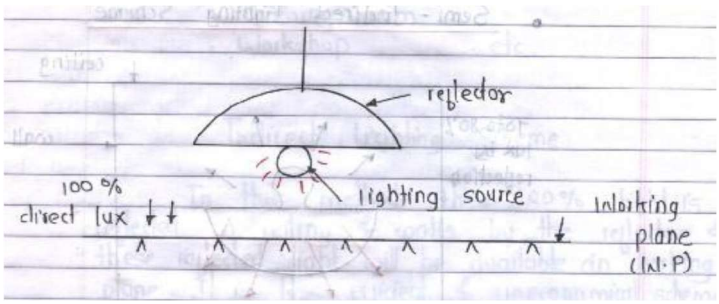
Ans:

List the various indoor lighting: **(Any Two Schemes expected: 1 Mark each, 2 Mark)**

1. Direct Lighting Scheme
2. Indirect lighting scheme
3. Semi direct Lighting Scheme
4. Semi indirect lighting Scheme
5. General Lighting Scheme

Explanation : **(Any TWO explanation Expected: Figure; 1 Mark & Explanation: 1 Mark, Total 4 Mark,)**

i) Direct lighting :

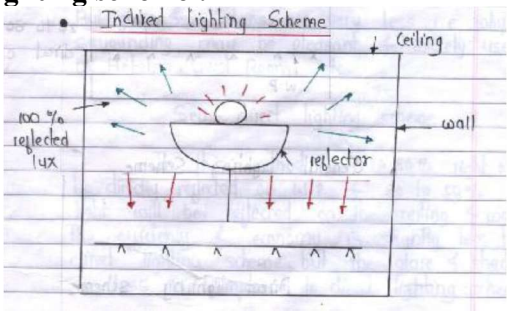


In this method, the reflector is used on the lighting source. The 100% light is reflected by this reflector on the working plane. So efficiency of direct lighting scheme is very high and it is economical also. But limitation of direct lighting scheme is that glare & shadows are more. The direct lighting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

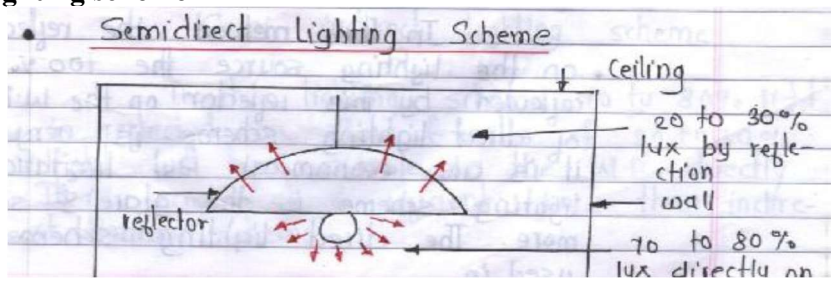
ii) Indirect lighting scheme :-



or equivalent figure

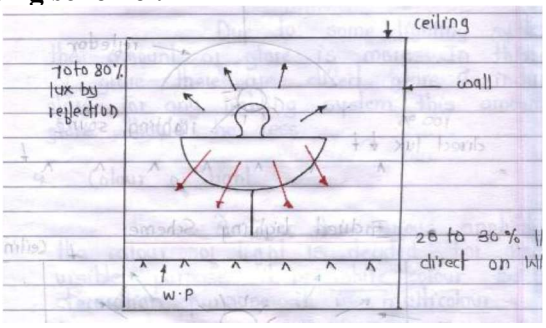
In this method the 100% light is reflected on ceiling and walls by the reflector and this reflected light will be available on working plane. It is less efficient and uneconomical scheme but glare and shadows are very less. i.e. why surrounding may be pleasant and widely used in hotels, guest room etc.

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.

b) Explain lumens or light flux method for calculation of light.

Ans: **Explanation of lumens or light flux method for calculation of light:** **(6 Mark)**

- In this method as per Indian illumination standard the actual lumens required on the working plane are calculated by following formulas:

Total Lumens received on W.P = No. of lamps x Wattage of each lamp x luminous efficiency x U.F. x M.F

OR

If the D (depreciation factor) is less than :1

$$Total\ \ lumens\ required\ on\ W.P = \frac{AIW}{CD}$$

If the D (depreciation factor) is more than :1

$$Total\ \ lumens\ required\ on\ W.P = \frac{AIW \times D}{C}$$

Where, A = area of working plane, I = Light intensity , W = waste light factor
C= Utilization factor , D = Depreciation factor

- This method is applicable where the sources of light produce an approximately uniform illumination on the working plane or where an average value is required.
- The accuracy of this method is also high and it is also less time consuming so this method is commonly used in practice.
- Beside this the single source method (only one light source is used for whole working plane. For e.g. flood light) , multisource method (More than one light source or mix light source from e.g. all types of lamps & discharge tubes) are commonly used.
- Light flux method is more accurate than watt/m^2 method and less accurate than point to point method.

OR

Lumens or Light flux method: **(6 Marks)**

This method is applied where an average illumination is required also when inform illumination is required. Total lumens output is calculated from the efficiency of each lamp and the number of lamp is used in the circuit. To calculate lumens received on the working plane, The total lumens already calculated multiplied by the co-efficient of utilization, when the lamps & the surroundings are not perfectly clean then while calculating the lumens received on the working plane, the depreciation factor or maintenance factor is taken into consideration,

- Beside this the single source method (only one light source is used for whole working plane. For e.g. flood light) , multisource method (More than one light source or mix light source from e.g. all types of lamps & discharge tubes) are commonly used.
- Light flux method is more accurate than watt/m^2 method and less accurate than point to point method.

Thus lumens received on working plane =(Number of lamps × wattage of each lamp × efficiency of each lamp× coefficient of utilization) / (depreciation factor)

OR

= number of lamps × wattage of each lamp × efficiency of each lamp × utilization factor × maintenance factor

$$Calculate\ \ Total\ \ Lumens = \frac{A \times I \times W}{C. \times M.F}$$

Q.5	**Attempt any TWO of the following :**	**16 Marks**
a)	**Define the following terms : (i) Luminous flux (ii) Utilization factor (iii) Mean Spherical Candle Power (MSCP) (iv) Lamp efficiency**	

Ans:

i) Luminous flux (F):- **(Each Definition: 2 Mark, Total 8 Mark)**

The total energy radiated by a source of light in all directions in unit is called Luminous flux. And its **unit is Lumen**

OR

Luminous flux is commonly called light output and is measured in lumens (lm).

ii) Utilization factor:-

It is defined as the ratio of total lumens reaching the working plane to the total lumens given out by the lamp. Its value is always less than one.

iii) MSCP (Mean Spherical Candle power):

It is the average of all candle powers in all direction in all planes. **OR**

$$MSCP = \frac{Total\ \ Lu\min ous\ \ lux\ \ in\ \ lumens}{4\ \Pi}$$

iv) Lamp η (lamp efficiency):-

It is defined as the ratio of the total luminous flux emitting from the source to Its electrical power input in watts.

b) A floor lighting is to be provided on the front of building of 40 m x 25 m for brightness of 18 lumens/m^2. The coefficient of reflection of building surface is 0.21. The lamp of 500 W having lumen output 8400 each are used. If beam factor is 0.65, waste light factor is 1.1, maintenance factor 0.85, then calculate number of lamp for flood lighting.

Ans:

"Note:- If students have attempted assuming appropriate values for constants, give appropriate stepwise marks"

Given Data: **(1 Mark)**

Area of working Plane = 40 x 25 m = 1000 m^2 E or I = 18 lumens/square meter

Reflection Factor = 0.21, Wattage of the lamp = 500, Lumen output of the lamps = 8400

W.F = 1.1, M.F = 0.85 Beam Factor = 0.65

$$Efficiency\ \ of\ \ the\ lamp = \frac{Lumen\ output\ of\ \ the\ lamp}{Wattage\ of\ \ the\ lamp}$$ ---------- **(1/2 Marks)**

$$Efficiency\ \ of\ \ the\ lamp = \frac{8400}{500}$$

$$Efficiency\ \ of\ \ the\ lamp = 16.8\ lumens\ \ per\ watt$$ ---------- **(1 Marks)**

$$Gross\ \ Lumens = \frac{A \times E \times W}{R.F \times B.F \times M.F}$$ ---------- **(1 /2Marks)**

$$Gross\ \ Lumens = \frac{40 \times 25 \times 18 \times 1.1}{0.21 \times 0.65 \times 0.85}$$ ---------- **(1 Marks)**

$$Gross\ \ Lumens = \frac{19800}{0.116}$$

$$Gross\ \ Lumens = 170689.65$$ ---------- **(1 Marks)**

It is assumed that 500 watt incandescent lamps are used for the workshop:

$$Number\ of\ \ Lamps\ \ \ required = \frac{Gross\ \ Lumens}{Wattage\ of\ \ each\ lamp \times efficiency\ of\ \ each\ lamp}$$ **(1 Marks)** ____

$$Number\ of\ Lamps\ \ required = \frac{170689.65}{500 \times 16.8}$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 20.32\ Nos\ lamps$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 21\ Nos\ lamps$$

OR Student may write this way

Total Lux I = $\frac{18}{0.21} = 85.71$ ---------- **(1 Marks)**

$$Total\ \ Lumens = \frac{A \times I \times W}{C. \times M.F}$$ ---------- **(1 Marks)**

$$Total\ \ Lumens = \frac{40 \times 25 \times 85.71 \times 1.1}{1 \times 0.85}$$

$$Total\ \ Lumens = 110918.82$$ ---------- **(1 Marks)**

$$Illumination\ of\ Lamp = \frac{Total\ Lumens \times beam\ \ factor}{Lamp\ \ \ Wattage}$$ ---------- **(1 Marks)**

$$Illumination\ of\ Lamp = \frac{8400 \times 0.65}{500}$$

$$Illumination\ of\ Lamp = 10.92$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ \ required = \frac{Total\ \ \ Lumens}{Wattage\ of\ each\ lamp \times Illumination\ of\ lamp}$$ **(1 Marks)** _____

$$Number\ of\ Lamps\ \ required = \frac{110918.82}{500 \times 10.92}$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 20.31\ Nos\ lamps$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 21\ Nos\ lamps$$

c) i) (i) State the criteria for preferring tungsten filament lamp on operation table in hospital.

Ans: **Following the criteria for preferring tungsten filament lamp on operation table in hospital:**

(4 Marks)

- On the operation table in a hospital bunched filament tungsten lamp is preferred because it has CRI = 100 i.e. colour Rendering Index is 100, so the doctor can see every part clearly at the time of operation of a patients.
- Due to bunched filament effect chances of failure are very less.
- Light intensity of the bunched filament lamp is high.
- The focus is also maintained by using proper shape of reflector.

c) ii) (ii) State the recommended illumination level required for any four areas of hospital lighting.

Ans: **(Any Four areas required- 1 Mark each, Total 4 Marks)**

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

Q.6 Attempt any FOUR of the following : 16 Marks

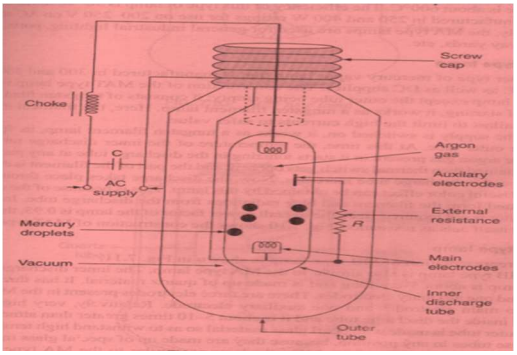
a) Explain construction and operation of lamp used for railway platform lighting.

Ans: **lamp used for railway platform lighting: (Figure: 2 Mark & Explanation: 2 Mark)**

1. Metal halide lamp
2. LED
3. Sodium vapour lamp
4. Mercury vapour lamp
5. CFL
6. Fluorescent tube

(Explanation of construction and operation of following ANY ONE LAMP EXPECTED: 4 Mark)

1) Mercury vapour lamp: (Figure: 2 Mark, Construction: 2 Mark)



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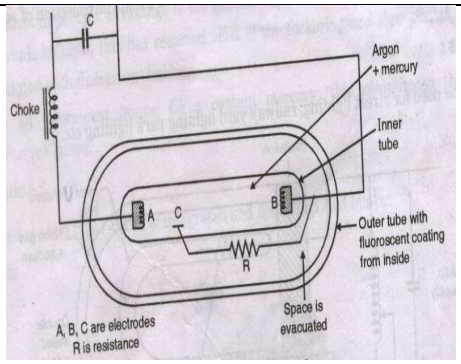


Construction;

- The construction of mercury vapour lamp is as shown in figure. The mercury vapour lamps are classified into three categories: i) MA type mercury vapour lamp (low pressure) ii) MB Type MVL (HPMVL) iii) Mercury iodide
- **MA Type MVL**: The constructions same as above the inert gases are filled at low pressure (2 to 3 times of atmospheric pressure). The size of this lamp is large. The illumination efficiency is 30 to 40 lumens/W.
- **MB type MVL**: The construction is similar but inert gases are filled at high pressure (5 to 2 times of atmospheric pressure). The illumination efficiency is 40 to 50 lumens/watt.
- **Mercury iodide vapour lamp**: It is similar to MB type MVL. Only difference is that the iodide powder is added with mercury powder. Due to this iodide is near about 78-90 lumens per watt.
- The construction of MVL is as given in the figure.
- The power factor improvement capacitor is used to improve the P.F. from 0.5 to 0.95. The chock is inserted in series with the electrode No.1 (filament No.1)
- The starting resistance which is connected across to filament No.1 & it is connected to the neutral also.
- The vaccum is created in between the outer tube & inner tube to maintain the 6000C temperature surrounding the inner tube.
- The mercury powder is added with inert gases (Argon + nitrogen+ neon etc) in the tube or discharge tube.

OR Student May write this way

Construction:-

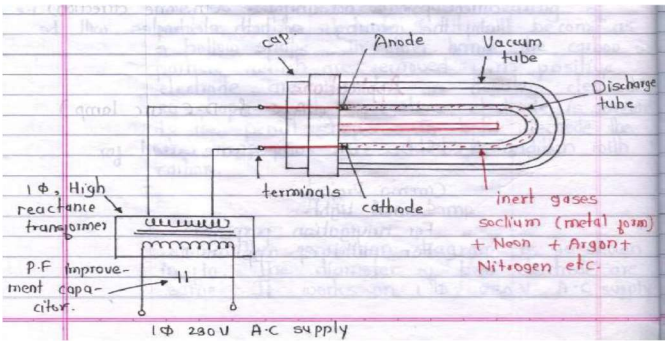
- It consists of an inner bulb generally of silicon, to withstand high temperatures.
- The bulb contains a small quantity of mercury and argon.
- It is protected by outer glass; this may be cylindrical or elliptical.
- The space between the two bulbs is filled with nitrogen at a pressure of half atmosphere.
- The discharge tube has three electrodes, namely two main electrodes A and B and one starting electrode.
- The starting electrodes are connected through a resistance of about 10-30 k ohm to the main electrode, located at the far end.

- The electrodes are of tungsten wire helices filled with electron emissive materials, usually barium and strontium carbonates mixed with thorium.

Working:-

- Whenever 1-ph, 230V, AC Supply is provided to the discharge tube of MVL initially to current will flow from Phase to the chock 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 6000C 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.

2. Sodium vapour lamp:



or equivalent figure

Construction:-

Above figure shows constructional details of sodium vapour lamp. It consists of 'U' shaped tube and at the ends of the tube two electrodes are sealed. This tube is filled with sodium and small quantity of neon gas. Since there is great effect of the change of surrounding temperature on the light output given by the lamp, hence the inner tube is enclosed in an outer double walled glass tube. Before sealing the lamp vaccum is created between the two glass tube (inner & outer).

Working:-

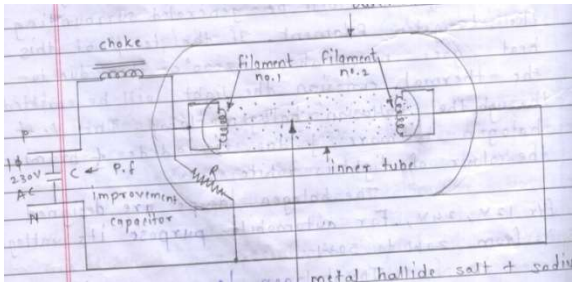
Before the lamp starts working, the sodium is usually in the solid form deposited on the sides of the inner tube wall. When the voltage is applied to the lamp it warms up and starts

vaporizing slowly and radiates out yellow colour light and after about 20 minutes, the lamp starts giving it's full output.

3) Metal Halide lamp:

Constructional it is similar to mercury lamp. Is discharge tube (inter tube) contain a drop of mercury which is named as 'metal' and halides such as thallium, indium or sodium, So the lamp is named as metal halide lamp.

Its operation is some similar to the mercury lamp. An arc is established between one main electrode & auxiliary electrode through argon gas and then regular discharge takes place between two main electrodes through mercury vapour. The light is produced from an excited mercury vapour and the products of dissociation of halide.

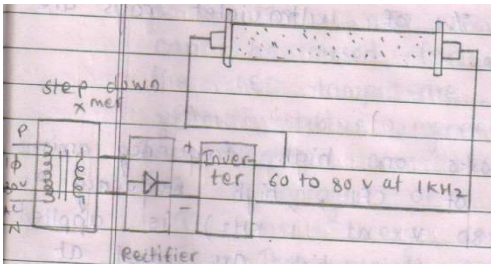


or equivalent figure

The halide cycle in metal halide lamp.

- Metal (mercury) atoms move from electric arc towards the tube wall where the halides are present.
- Near the wall, the temperature & vapors pressure allows the metals & halides to form a stable molecule which is known as metal halide molecules.
- When metal halides approaches the arc, molecules break apart.
- The halide move towards the wall and metals are excited and give out energy in the form of light.
- When enough metal atoms or loss during the operation the lamp fails.
- The outer glass may or may not be phosphor coated from inside.
- Electronic or auto transformer type ballast is used initiate the arc and to control the current,
- The capacitor is used to improve the power factor.
- The power ratings of lamp are from 175 watts to 1000 watts.
- The life is 2000 working hours.
- Some metal halides are used in indoor applications and the compact metal halide lamps are used for display and flood light etc.

4) CFL Lamp :



or equivalent figure

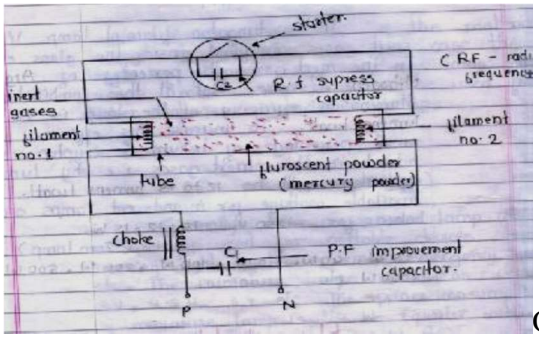
Explanation of CFL:

- The compact fluorescent lamps are as shown in figure; these lamps are available in various shapes.
- The CFL is always called as a energy saving lamps.
- The illumination efficiency of CFL is between the 50-60 lumens per watt.
- The life of the CFL is more than 3000 working hours and cost also less as compare to fluorescent tubes.
- The CFL are available in various colors.

Working of CFL:

- It works on high frequency emission for any type of CFL.
- High frequency AC Supply (60-80V at 1 KHz) is applied to the inert gases which are filled at low pressure.
- Then due to high frequency there will be ionization of mercury powder helium and other inert gases.
- And light is emitted through this fluorescent lamp.
- This high frequency is maintained constant throughout.

5) Fluorescent Lamp:



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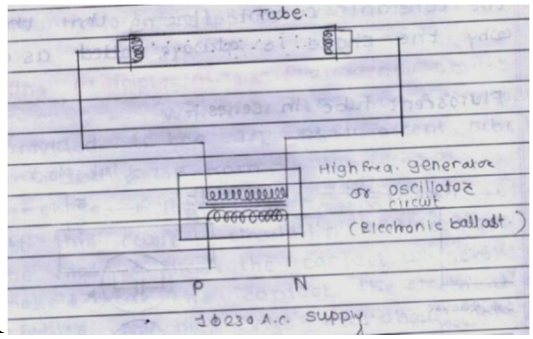


Construction:-

Fluorescent tube consists of tube, choke, starter & power factor improvement capacitor.

Working operation:-

When switch is ON current flows through the choke-filament no1- starter-

filament no. 2- to neutral, At that time choke induces high voltage which is applied to two filaments and ionized gas, Due to this there will be high voltage ionization so that light will be emitted through the tube. Choke is acting as ballast starter is used for make and break the circuit. To operate the fluorescent lamp, need a ballast (choke) to limit the current & provide the necessary starting voltage and starter for starting the tube.

6) LED Lamp explanation of construction & working:-

The working principle of LED is similar to diode (P-N junction) whenever DC current flows through the light emitting diode, if the current path is from anode to cathode there will be voltage drop across the diode. Ti is 1.5V to 2.1V then light will be emitted through this diode.

- The LED lamps are energy saving lamps,
- The power consumption of the single LED is very less. It is in mw. So by using series & parallel combination of LED.
- The LED lamp is manufactured the available wattage for the LED lamps are 1W,2W 3W, 5W etc.
- The LED lamps is available is various colours and diameter. The life of LED lamp is very high minimum 10000 working hours.

b) State any four specific requirement of flood lighting.

Ans: **(Any four point Expected:1 Marks each)**

Following are the specific requirements of flood lighting:-

1. Ideal for landscape and architecture lighting.
2. Widely used in home for the showroom purpose, office decoration, garden lighting, VIP building lighting parking lighting etc.
3. For flood lighting the luminous efficiency is high and the span for the life is long with less maintenance
4. Best thermal management.
5. Available in various sizes and shapes
6. Compact design can be possible.
7. Light intensity can be controlled.
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.

9. By using the LED lamps the multicolour shades can be possible.
10. The initial cost and running for the flood lighting can be minimized by proper selection of flood lighting.
11. Working nights of flood light can be increased.

OR

Following are the specific requirements of flood lighting:-

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. **Fewer 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. **Fewer 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, multicolor light intensity control is also possible in electrical illumination.

c)	State the purpose of lighting control. Which device is used for this purpose ?

Ans:

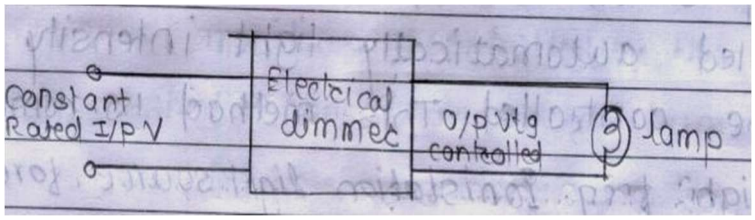
Lighting Control can be used to achieve following points or purposes:

(Any Four point expected: 1 mark each point, Total 4 Marks)

1. To minimize Shadows.
2. To minimize glares.
3. To get uniform distribution of light throughout the working plane.
4. for proper Colour of light.
5. To turn ON or OFF the lamps
6. For dimming, the dimming control permits the adjustment of lighting intensity.
7. For changing the lighting levels according to need or desired of the owner.
8. For energy saving.
9. To increase the life of lighting source.
10. To increase the safety of lighting system.
11. In some types of industrial automation there is need of effective lighting control.
12. To provide proper lux level on working plane the lighting control is required.
15. To control the brightness of T.V monitor there is need of lighting control.

OR

Purpose of lighting control:- **(4 Mark)**



In the electrical dimmer electrical components for e.g. rheostat, transformer etc are commonly used. In the electrical dimmer the input voltage is always constant and output voltage across lamp is changed to control the brightness of light intensity. In the electrical dimmer there are four types.

OR

1. To turn ON or OFF the lamps
2. For dimming, the dimming control permits the adjustment of lighting over a range.
3. For changing the lighting levels according to need or desired of the owner.
4. For energy saving.
5. To increase the life of lighting source.

	6. To increase the safety of lighting system. 7. In some types of industrial or automation there is need of lighting control. 8. To provide proper lux level on working plane the lighting control is required. 9. To fulfillment light intensity as per Indian or international standard 10. To control the brightness of T.V monitor there is need of lighting control. **Following Devices are used for this purpose:** 1) Resistance dimmer 2) Auto transformer dimmer 3) Two winding transformer dimmer 4) Electronic dimmer 5) Salt water type dimmer 6)occupancy sensor 7)day light sensor 8)infrared sensor
d)	**State any four desirable characteristics of lighting required in aquariums.**
Ans:	**The following characteristics should be desirable for Aquariums :-** **(Any Four Characteristics are Expected: 1 Marks Each)** 1. The aquarium lightly depends open the size of the aquariums tank (Length, width and depth. 2. The aquarium lighting depends upon the all sounding condition e.g. colour and size of the given hall in which the aquarium is placed. 3. The aquarium lighting depend open the maintenance schedule of the tank water and other aquarium accessories. 4. The aquarium lighting depends open the surrounding temperature and required temperature of water in the tank.

	5. In sum type of aquarium the ultraviolet lamp are provided for the bacteria filling purpose 6. The aquarium lighting also depends open the various aquarium lighting also depends open the various aquarium accessories used in the tank. 7. The aquarium lighting should be electrically and mechanically safe to the all type rises and operator also. 8. The aquarium lighting should be economical. 9. The life of the aquarium lighting should be long.
e)	**State the general requirement for agriculture and horticulture lighting. State the lamp used for these application.**
Ans:	**General requirement for agriculture and horticulture lighting (Green House): (2 Marks)** 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. 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 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. **Following Lamps used agriculture and horticulture (Green House):- (2 Marks)** 1. High pressure sodium vapour lamp 2. High pressure Mercury vapour lamp 3. Fluorescent tubes 4. Metal Halide Lamps 5. Flood light 6. Incandescent lamp 7. CFL 8. FTL 9. Ultraviolet lamp 10. Infra-red lamp

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