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)	**Define each of the following terms of illumination : lux, lumen, luminous flux, illumination**
Ans:	**1) Lux :-** **(Each Definition : 1 Mark)** It is unit of illumination and it is defined as luminous flux falling per unit area **OR** It is defined as the luminous flux falling per square meter on the surface which is perpendicular to the rays of light from the source of one candle power and one meter away from it. **OR** **Lux =** 1 Lumens/ m^2 **OR** It is defined as the illumination of the inside of a sphere of radius 1 m and a source of 1 C.P is fitted at the centre of sphere. **2) Lumen :-** One lumen is defined as the luminous flux emitted in a unit solid angle by a source of one candle power. i.e Lumens = Candle power x solid angle ,It is unit of luminous flux. OR Lumens is unit of luminous flux **3) Luminous flux :-** The luminous flux is the total energy radiated by the light source in all direction. **4) Illumination :-** 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^2 OR 1 Lumens/m^2 = 1 Lux

b) State any four differences between tungsten filament bulb and fluorescent tube light.

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

S.No	Tungsten Filament Lamp	Fluorescent Tube light
1	The incandescent lamp works on heating effect. Whenever temperature surrounding the filament increases more than 1800^0C then light will be emitted.	It is works on high frequency & High voltage ionisation
2	It is cost is low	The cost of fluorescent tube is high
3	The maintenance for this lamp is less.	The maintenance for this tube is more.
4	The P.f. of this lamp is unity.	The P.f. of this tube is electrical choke is 0.5 to 0.6 and with electronic choke is 0.995
5	After the switch on the light will be emitted immediately through the filament.	After the switch on the light will be emitted after some time delay through the tubes/discharge lamps
6	Due to supply voltage variation the light intensity may changes it means flicker	In the fluorescent tube the choke is acting as ballast so that light intensity will not changes.
7	There is a No need of P.F. improvement capacitors	There is a need of P.F. improvement capacitors.
8	Life of lamp is Less. (about 1000 working hrs)	The Life of this lamp is More. About 2000 working hrs)
9	By this lamp we cannot get multicolour light.	By using the various chemical powders in inert gases the various colours can be achieved in the lamp.
10	No stroboscopic effect.	There is stroboscopic effect
11	There is humming is less or no humming in this lamp.	There is humming in this tube due to the electrical choke
12	The illumination/lumens efficiency is very less. (5 to 18 lumens/watt)	The illumination/lumens efficiency is more.(40 to 60 lumen/watt)

OR

S.No.	Points of comparison	Tungsten filament bulb	Fluorescent Tube light
1	Quality of light	Good	Best
2	Capital cost	less	more
3	Running cost	more	less
4	Lamp efficiency	Less (12 to 15 lm/w)	More (20 to 50 lm/w)
5	Colour index	Very good	good
6	Life	less	more

c) Explain difference between dimming control & on/off control in lighting control.

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

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 whiles 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 any six factors on which efficiency of lighting depends.

Ans: **Following six factors on which efficiency of lighting depend:**

(First Any Two Point: 1 Mark & Other any Four Point : 1/2Mark Each)

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)

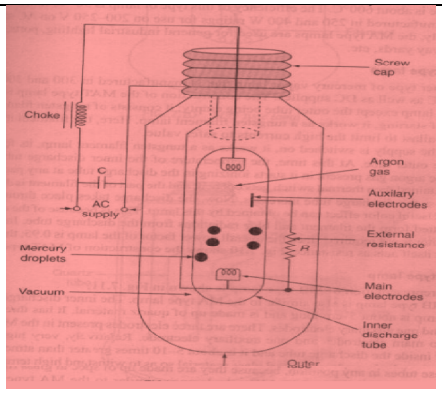
6) Maintenance: Regular cleaning of lamps & light fittings is necessary to maintain their efficiency. The maintenance is necessary against dust, water leakage, dangerous gases which may cause corrosion of light fittings. Hence light fittings should be simple & easy from maintenance point of view.

7) Following factors are considered while designing interior illumination: utilization factor, deprecation 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. **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, 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 of the following : 06 Marks**
a)	**Explain with neat sketch construction and working of High Pressure Mercury Vapour Lamp.**
Ans:	➢ **Figure Mercury Vapour discharge lamp :-** **(Figure: 2 Mark, Construction: 2 Mark & Working : 2 Mark)**



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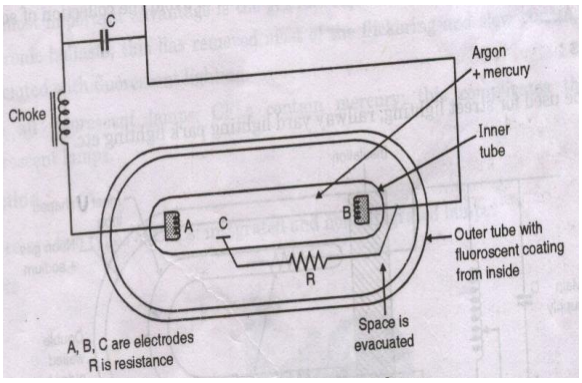


Construction;

- 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 600^0C temperature surrounding the inner tube.
- The mercury powder is added with inert gases (Argon + nitrogen+ neon etc) in the tube or discharge tube.

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 600^0C 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 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.

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^2R loss which is converted into heat. If the temperature of this heat goes near about 600^0C 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 6000C 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

Working:-

- When supply is switched on an initial discharge lamp is established in the Argon gas between main electrode A and aux. electrode C
- The heat is produced due to the discharge through gas which causes warming up of inner lamp
- Thus mercury gets vaporized and increasing its pressure and thus the light output.
- It takes about 5-7 min. for the mercury arc to buildup &gives full light output.
- After 3-4 min. mercury vapors is greenish blue light.
- If the supply interrupted, the lamp must cool down and the vapour pressure be reduced before it will start. It takes approximately 3-4 min.
- The efficiency of this type of lamp is 30-40 lumens/W.

  Mercury lamps are available in 125W; 250W & 400W rating for use 250V AC Supply.

b) Define each of the following terms of illumination: Maintenance factor, Absorption factor, Utilization factor.

Ans: **(Each Definition: 2 Mark, Total: 6 Marks)**

1) Maintenance factor:-

It is defined as the ratio of illumination under normal working conditions to the illumination when everything is clean. **OR**

$$Maintenace factor = \frac{Illumination\ under\ normal\ \ working\ condition}{Illumination\ under\ every\ thing\ is\ clean}$$

2) Absorption factor:-

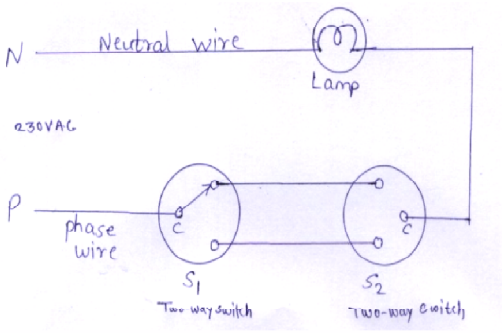
$$Absorption\ Factor = \frac{Net\ lumen\ avaliable\ after\ absorption}{Total\ lumens\ emitted\ by\ the\ source\ of\ light}$$

This factor is due to the smoke fumes. It varies from 0.5 to 1

3) Utilization factor:-

It is defined as the ratio of total lumens reaching the working plane to the total lumens given out by the lamp.

Q.2	**Attempt any TWO :**	**16 Marks**
a)	**Draw and explain how one lamp can be controlled by two switches.**	
Ans:	**One Lamp controlled by Two switch :-** **(Figure: 4 Marks & Explanation:4 Marks)**	



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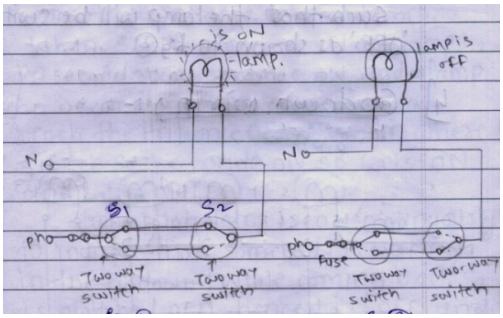


or equivalent figure

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.

Assume that the lamp is in between ground floor and first floor with switch S_1 is on ground floor and S_2 is on first floor. When the position of the switches S_1 & S_2 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 S_2 such that the lamp will be switched 'OFF'.

b)	**A uniform illumination of 50 lux is to be obtained on the floor of a room measuring 10 in x 10 m by arranging electric light suitably. Calculate the number of lamps and watt rating of each lamp if the efficiency of lamp is 15 lumens/watt. Assume and write suitable values required in this calculation.**	
Ans:	**NOTE: 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**	

Given Data:

E = 50 Lux — Area of working plane = 10 m x 10 m = 100 m^2

Assumed: U.F = 1 & D.F = 1 — Wattage of Lamps Assumed = 100 watt or 60 Watt

Efficiency = 15 lumens/watt — assumed: Waste light factor = 1

i) Total Lumens utilized = E x A or ---------- **(1/2 Marks)**

= 50 x 100 = 5000 Lumens----------**(1Marks)**

ii) Total Lumens given out by the lamp = $\frac{Total\ lumens\ utilised}{U.F \times D.F}$ --------- **(1/2 marks)**

$$= \frac{5000}{1 \times 1}$$

$$= 5000 \; Lumens$$ ---------- **(1Marks)**

iii) Total Wattage $= \frac{Total\ lumens\ given\ out\ by\ the\ lamps}{lu\,\text{min}\,ous\ efficiency}$ ----------**(1/2 Marks)**

$$= \frac{5000}{15}$$

$$= 333.333 \;\; Watts$$ ---------- **(2Marks)**

The wattage of lamps is assumed – 100 watt

iv) Number of Lamps $= \frac{Total\ Wattage}{Wattage\ of\ \ each\ lamp}$ ----------**(1/2 Marks)**

$$= \frac{333.333}{100}$$

$$= 3.33 \cong 4 \;\; Nos$$ ----------**(2Marks)**

$\therefore Numbers\ of\ \ lmaps = 4\ Nos$

OR Student may Write

$$N = \frac{illu\,\text{min}\,ation\ level \times Area}{Wattage\ each\ lamp \times \ lamp\ efficiency \times U.F \times D.F}$$ ---------- **(1/2 Mark)**

$$N = \frac{50 \times 100}{100 \times \ 15 \times 1 \times 1}$$

$N = 3.33 \cong 4\ Nos\ lamps\ of\ 100watt.$ ---------- **(2 Mark)**

OR

Total lumens required on working plane = $\frac{AIW}{C \times D}$ ----------**(1/2 Mark)**

$$= \frac{100 \times 50 \times 1}{1 \times 1}$$

$$= 5000 \; Lumens$$ ----------**(1 Marks)**

iii) Total Wattage $= \frac{Total\ lumens\ given\ out\ by\ the\ lamps}{lu\,\text{min}\,ous\ efficiency}$ ----------**(1/2 Marks)**

$$= \frac{5000}{15}$$

$$= 333.333 \;\; Watts$$ ----------**(1Marks)**

iv) Number of Lamps $= \dfrac{Total\ Wattage}{Wattage\ of\ each\ lamp}$ ----------**(1/2 Marks)**

$= \dfrac{333.333}{100}$

$= 3.33\ Nos\ of\ lamp$ ----------**(2Marks)**

$\therefore Numbers\ of\ lamps = 4\ Nos\ of\ 100\ watt$

OR Student Assume Wattage of Lamp = 60

iv) Number of Lamps $= \dfrac{Total\ Wattage}{Wattage\ of\ each\ lamp}$ ----------**(1/2 Marks)**

$= \dfrac{333.333}{60}$

$= 5.55\ Nos\ of\ lamp$ ----------**(2Marks)**

$= 6\ Nos\ of\ lamp$

c) A room of 20 m x 10 m in is illuminated by 20 numbers of 200 W lamps. The MSCP of each lamp is 240. If utilization factor is 0.65 and depreciation factor 1.25 then find average illumination produced on the floor

Ans: **Given data:** **(1 Mark)**

i) Area of room=A=20 mt× 10 m= 200 m^2. ii) MSCP of each lamp = 240

iii) Depreciation factor=D.F= 1.25 iv) Co-efficient of utilization= U.F=0.65

v) Number of lamps = 20 vi) wattage of each lamp = 200 watts

Find: Average illumination=E=?

Solution:

Total lumens given out by all lamps= $(MSCP \times 4\pi) \times 20$ ---------- **(1/2 Mark)**

$= (240 \times 4\pi) \times 20$

= 60288 Lumens. ---------- **(1 Mark)**

Total lumens received on the floor = Total lumens given out by all lamps x $\dfrac{U.F}{D.F}$ -- **(1/2 Mark)**

Total lumens received on the floor = $60288 \times \frac{0.65}{1.25}$

= 31349.76 Lumens. ---------- **(2 Mark)**

Average illumination on the floor = $E_{AV} = \frac{Total\ lumens\ recieved\ on\ the\ floor}{Area}$ ----- **(1 Mark)**

$= \frac{31349.76}{200}$

E_{AV}= 156.748 Lumens per square Meter-- Answer---------- (2 Mark)

OR **E_{AV}= 156.748 Lux**

Q.3	**Attempt any FOUR :**	**16 Marks**
a)	**State any four characteristics of factory lighting.**	

Ans:

The following characteristics should be considered for factory lighting:-

(Any four point expected– 1 Marks each)

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.

b) State illumination in Lux for each of the following : operation theatre, stair, living room, study room

Ans: **(Each Illumination- 1 Mark each)**

S.No	Areas	Recommended illumination in Lux
1	Operation theatres -	500 to 700 lux
2	Stair	60 to 80 lux areas
3	Living Room	200 to 300 lux
4	Study Room -	250 to 350 lux etc

c) A 230 V lamp has a total flux of 2500 lumens and takes a current of 0.7 amp. Calculate lumens per watt and MSCP per watt.

Ans:

$$Total\ MSCP\ of\ the\ lamp = \frac{Total\ lumens\ required\ on\ working\ plane}{4\pi}$$ ---- **(1/2 Marks)**

$$Total\ MSCP\ of\ the\ lamp = \frac{2500}{4\pi}$$

$$Total\ MSCP\ of\ the\ lamp = 199.044$$

---------- **(1/2 Mark)**

$$Power\ of\ the\ lamp = V \times I = 230 \times 0.7 = 161\ watt$$

---------- **(1 Mark)**

$$MSCP\ per\ Watt = \frac{199.044}{161} = 1.23$$

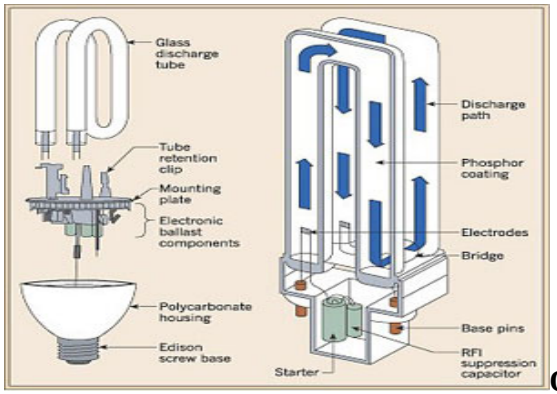
---------- **(1 Mark)**

$$Lumens\ per\ Watt = \frac{2500}{161} = 15.527$$

---------- **(1 Mark)**

d) Explain with diagram construction and working of CFL lamp.

Ans: **Construction diagram of CFL Lamp:** **(Figure : 2 Mark & Explanation : 2 Mark)**



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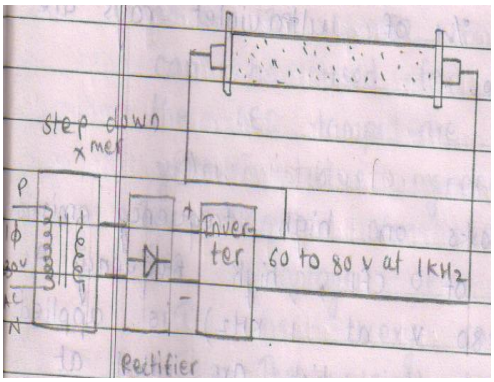

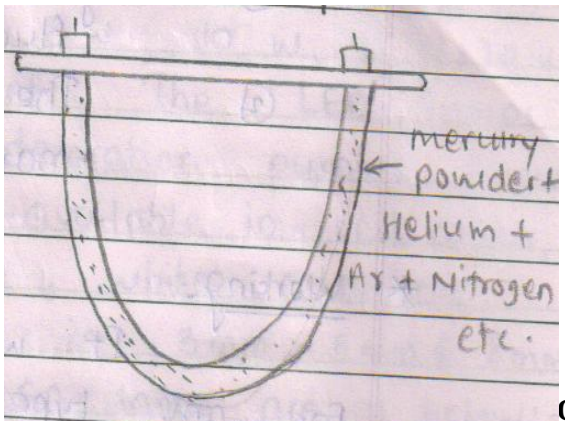

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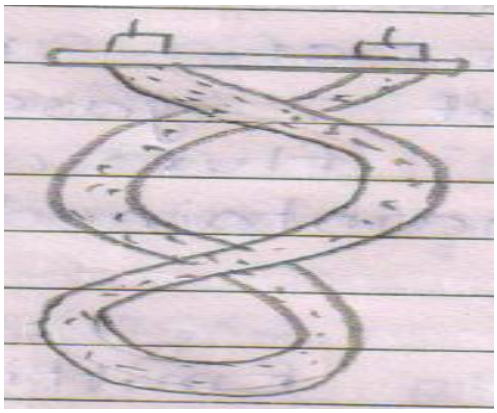


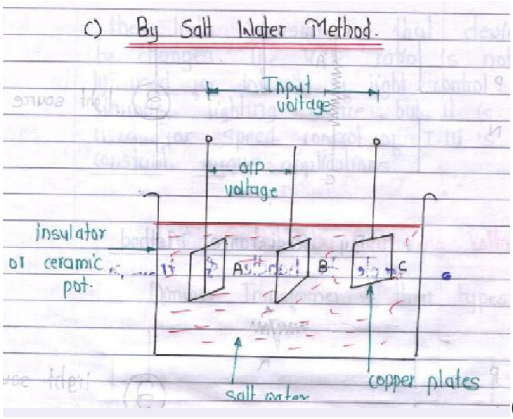
Explanation of CFL:

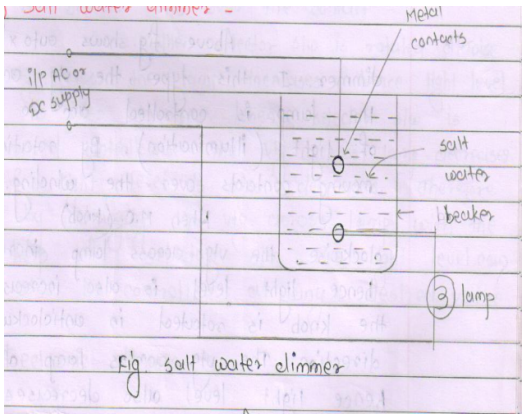
- The compact fluorescent lamps are as shown in figure; these lamps are available in various shapes.
- The CFL is always called as a energy saving lamps.
- The illumination efficiency of CFL is between the 50-60 lumens per watt.
- The life of the CFL is more than 3000 working hours and cost also less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

e)	**Explain working of salt water dimmer with the help of diagram.**
Ans:	**By salt Water method –** **(Figure : 2 Mark & Explanation : 2 Mark)**





OR

or equivalent figure

- As position of rod in immersed position changes output voltage across light sources will be changes .So that light intensity also will be changes.
- The above figure shows salt water dimmer. In this dimmer the three copper plates are immersed in salt water which is kept in insulating pot.
- By increasing depth of immersed copper plate the current flowing through the lighting device can be increased.
- In other hand by changing the distance between plate No.1 and Plate No.2 the output volt across the lamp can be controlled for proper brightness.

OR

- Above figure shows salt water dimmer in this there are Two metal contacts in a glass beaker, one contact is at the bottom and is fixed and other contact is movable up & down direction,
- the closer the Two metal contacts higher is the level illumination & vice versa

Q.4 A)	**Attempt any THREE :** **12 Marks**
a)	**Explain difference between uniform lighting and localized lighting (any four)**
Ans:	**Difference between uniform lighting and localized lighting:** **(Any Four Point Expected: 1 Mark each)**

S.No	Uniform lighting	Localized lighting
1	It is a general lighting	It is a local lighting
2	It is used in domestic, commercial and industrial illumination	It is used along with general lighting
3	It is uniformly distributed on working plane or entire surface which is to be illuminated	It is focused on a particular area

	4	It requires number of lamps or light source	It requires single lamp or light source of required wattage in a particular housing,
	5	Light intensity at any point on working plane is constant	Light intensity at any point on working plane may vary.
	6	Reflectors cannot be used.	Reflectors can be used.

b) State any four specific requirements 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, multicolour light intensity control is also possible in electrical illumination.
c)	**State any four applications of decorative lighting.**
Ans:	**Following are the applications of decorative lighting:** **(Any four Application Expected:1 Marks each)** 1. For decoration of ancient and VIP Buildings. 2. For decoration of gardens. 3. To increase the beauty of interior and exterior applications. 4. To increase the festival mood. 5. For domestics function. 6. For various stages. 7. For advertisement of commercial building. To improve energy saving, economy, reliability of lighting system **OR**

➢ **Following applications of Decorative purpose:** **(4 Mark)**

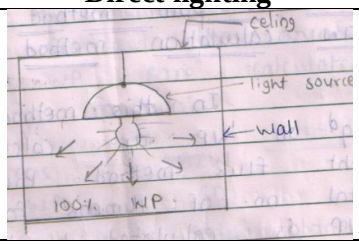
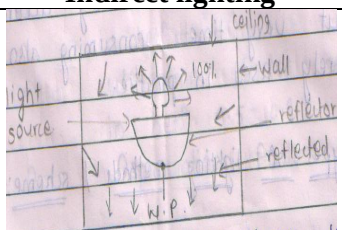
Generally Stage is required to perform various social & cultural activities. For e.g. Dance, Drama, gathering etc. The decorative lighting is commonly used for to fulfill all these activities and is very important part of this program

For the decorative lighting multicolours LED lamps, Compact fluorescent lamp (CFL), small capacity projector lamps, metal halide lamp, Neon Lamp & other types of advanced lighting system can be provided.

d) Explain any four differences between direct lighting and indirect lighting.

Ans: **Difference between direct lighting and indirect lighting:**

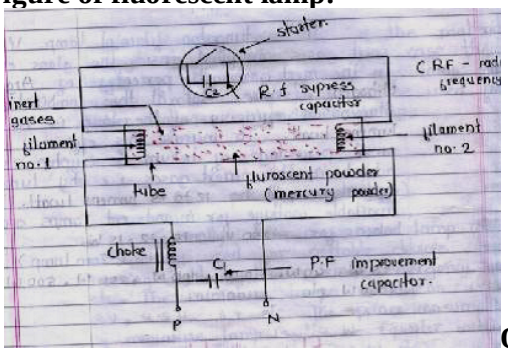
(Any four point Expected:1 Marks each)

S.No	Direct lighting	Indirect lighting
1		
2	It is not commonly used type of lighting scheme.	In this the light does not reach the Working plane directly from the lamp
3	In this type more than 90% of total light is directed towards working plane.	The light is directed towards ceiling & walls from where it is indirectly reaches the W.P.
4	It is more efficient	It is also called diffused reflection
5	It cause glare & hard shadows	It provides shadow less illumination
6	It gives tunneling effect i.e ceiling of room remains OFF	No Glare
7	It is used for industry, domestic and general outdoor lighting	It is used for drawing offices, composing rooms, hotels and workshop
8	Power consumption for direct lighting scheme is less	Power consumption for indirect lighting scheme is More
9	Efficiency for direct lighting scheme is high	Efficiency for indirect lighting scheme is less
10	The percentage of glare is more	The percentage of glare is Less.
11	The percentage of shadows are more	The percentage of shadows are less
12	E.g. Flood lighting, Play ground lighting, lighting in drawing hall etc	E.g. Restaurants and Hotels, Conference room, Guest room etc.

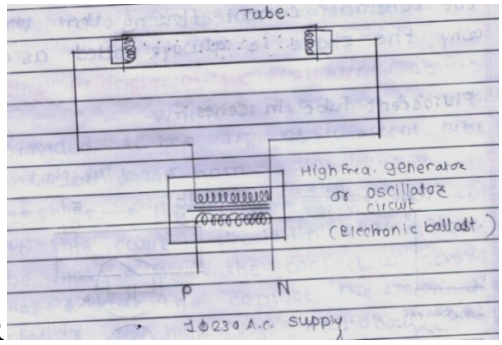
Q. 4 B) Attempt any ONE : **06 Marks**

a)	**Explain with neat diagram, construction and working of fluorescent tube light.**
Ans:	**(Figure: 3 Mark, Construction-1 Mark & Working- 2 Mark)**

Figure of fluorescent lamp:-



OR



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.

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

$$Total\ Lumens\ required\ on\ W.P = \frac{A\ I\ W}{CD}$$

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 over te 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.
Q.5	**Attempt any TWO** **16 Marks**
a)	**Estimate the number and wattage of lamps which is required to illuminate a workshop space 70 m x 20 m by means of lamps mounted 5.5 m above the working plane. The average illumination required is 90 lux, coefficient of utilization is 0.45, luminous efficiency 18 lumens per watt. Assume a space height ratio of unity and maintenance factor 0.85.**
Ans:	**NOTE: 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.** Given Data: **(1 Mark)** Area = A = 70m x 20m = 1400 m^2 Illumination = E or I= 90 lux Efficiency of lamp = 18 lm/watt U.F. = 0.45, M.F. = 0.85 Mounting Height = 5.5 mtr **Determine:** 1) Number of lamps if luminous efficiency of 14 lumens/watt 2) Wattage of lamp =? **Solution:** $Gross\ \ Lumens = \frac{A \times E}{U.F \times D.F}$ ---------- **(1 Marks)** $Gross\ \ Lumens = \frac{1400 \times 90}{0.45 \times 0.85}$ $Gross\ \ Lumens = 329411.76$ ---------- **(1 Marks)** $Total\ required\ wattage = \frac{Gross\ Lumens}{Lamp\ efficency}$ ---------- **(1 Marks)** $Total\ required\ wattage = \frac{329411.76}{18}$ ---------- **(1 Marks)** $Total\ required\ wattage = 18300.65\ watt\ or\ \ 183 KW$ **It is assumed that 100 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)** ----

$$Number\ of\ Lamps\ \ required = \frac{329411.76}{100 \times 18}$$ ---------- **(1 Marks)**

$$Number\ of\ Lamps\ required = 183\ Nos\ lamps$$ ---------- **(1 Marks)**

OR Student may Write this way

It is assumed that 200 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)**

$$Number\ of\ Lamps\ \ required = \frac{329411.76}{200 \times 18}$$ ---------- **(1 Marks)**

$$Number\ of\ \ Lamps\ required = 91.5 \cong 92\ Nos\ lamps$$ ---------- **(1 Marks)**

1. For total gross lumens calculation there is another formula for which mark should be given $Gross\ \ Lumens = \frac{A \times I \times W}{U.F \times D.F}\ \ assume\ W = 1$

Given Data :- Note As per Assumption Final Answer may change so give marks for correct steps and don't stickup with Final Answer

Hall Dimension : 70 m x 20m = 1400 m^2 **(1 Mark)**

U.F = 0.45, M.F.= 0.85 Assumption :- Let, waste light factor= 1,

Wattage of each lamp= 100 watt

$$\therefore D.F = \frac{1}{M.F} = \frac{1}{0.85} = 1.176$$ **(1 Mark)**

- Total Lumens required on working plane =

$$\frac{Area\ of\ \ Working\ \ plane \times \text{Lux level required on working plane} \times \text{Waste light factor} \times \text{D.F}}{\text{UF}}$$

(1 Mark)

$$= \frac{(70 \times 20) \times 90 \times 1 \times 1.176}{0.45}$$

$$= \frac{148235}{0.45}$$

= 329411.76 Lumens----------

(1 Mark)

Assumed wattage of lamp = 100 watt

$$\text{Total No. of Lamps} = \frac{\textit{Total lumens required on working plane}}{\text{Wattage of each lamp} \times \text{output (lumen efficiency)}}$$

$$= \frac{329411.76}{100 \times 18} \qquad = 183 \text{ Lamps}$$

Total No. of Lamps = 183 Nos. Say----------Answer---------- **(1 Mark)**

OR

Assumed wattage of lamp = 200 watt

$$\text{Total No. of Lamps} = \frac{\textit{Total lumens required on working plane}}{\text{Wattage of each lamp} \times \text{output (lumen efficiency)}}$$

$$= \frac{329411.76}{200 \times 18} \qquad = 91.5 \text{ Lamps}$$

Total No. of Lamps = 92 Nos. Say----------Answer---------- **(1 Mark)**

OR Student May write this way

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

$$Gross\ \ Lumens = \frac{1400 \times 90}{0.45 \times 0.85}$$

$$Gross\ \ Lumens = 329411.76$$ ---------- **(1 Marks)**

$$Total\ required\ wattage = \frac{Gross\ Lumens}{Lamp\ efficency}$$ ---------- **(1 Marks)**

$$Total\ required\ wattage = \frac{329411.76}{18}$$

$$Total\ required\ wattage = 18300.65\ watt\ or\ \ 183 KW$$ ---------- **(1 Marks)**

$$\text{Assuming} = \frac{S}{H} = 1\,(given)\ \ S = H = 5.5m\,(given)$$

$$Length\ wise\ number\ of\ lamps = \frac{70\ m}{5.5} = 12.72 \cong 13\ Nos$$ ---------- **(1 Marks)**

$$Width\ wise\ number\ of\ lamps = \frac{20\ m}{5.5} = 3.3663 \cong 4\ Nos$$

$$Total\ number\ of\ lamps = 13 \times 4 = 52\ Nos$$

$$Wattage\ of\ each\ lamp = \frac{Total\ Wattage}{Total\ number\ of\ lamps}$$ ---------- **(1 Marks)**

$$Wattage\ of\ each\ lamp = \frac{18300.65359}{52}$$

$$Wattage\ of\ each\ lamp = 351.9356$$

$$Wattage\ of\ each\ lamp = 350\ Watts$$ ---------- **(1 Marks)**

$$Number\ of\ lamps = 52\ Nos$$ ---------- **(1 Marks)**

b) A floor lighting is to be provided on the front of a building of 40 m x 25 m for brightness of 18 lumens/square meter. The coefficient of reflection of building surface is 0.21. The lamps 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 lamps for flood lighting.

Ans: **Given Data:** **(1 Mark)**

NOTE: 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.

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)	**Explain how lighting scheme should be designed for each of the following operation theatre in hospital, general ward in hospital.**
Ans:	**In Operation Theater:-** **(Any Four Point expected: 1 Mark each Total: 4 Mark)** ➢ In operation theater of hospital the direct lighting scheme is normally used. ➢ On operation table bunched filament lamps or focus lamps can be used. ➢ On operation table sometimes metal halide lamps of lower wattages with multiple sources are also used. ➢ Normally high illumination efficiency white colour emitted light source are preferred. ➢ In operation theaters some ultraviolet lamps or tubes are also used as a anti-bacteria source. ➢ Lux level on the working plane is high. (400 to 600 lux) **In General ward of the hospital:-** **(Any Four Point expected: 1 Mark each Total:4Mark)** ➢ General lighting scheme is preferred. ➢ Reflectors are not used. ➢ Fluorescent tubes, CFL or incandescent lamps are used as a lighting source. ➢ Lux level on the working plane is less. (100 to 150 lux) ➢ Area of working Plane. ➢ $Calculate\ \ Total\ \ Lumens = \frac{A \times I \times W}{C. \times M.F}$ ➢ Assume wattage and efficiency of the lamp ➢ Find out number of lamps = $Number\ of\ \ Lamps\ \ \ required = \frac{Total\ \ \ Lumens}{Wattage\ of\ \ each\ lamp \times Illu\min ation\ of\ \ lamp}$ ➢ Mark the number of Lamps on given plane layout. ➢ Calculate total power.
Q.6	**Attempt any FOUR :** **16 Marks**
a)	**A hall of 80 m x 40 m with a ceiling height of 5.2 m is to be provided with a general illumination of 150 lumens/sq.m. Assuming coefficient of utilization of 0.6 and depreciation factor of 1.35, determine the number of fluorescent tubes required, the distance between them, mounting height, total wattage. The luminous efficiency of fluorescent tube is 35 lumens per watt for 40 watt tube light.**
Ans:	**Given Data:** Area = A = 80m x 40m = 3200 m^2 Illumination = E or I= 150 lumens/m^2 Efficiency of the fluorescent tube = 35 lm/watt of 40 watt tube U.F. = 0.6, D.F. = 1.35 = Mounting Height = 5.2 mtr **Determine:** 1) Number of Fluorescent tube

2) Space = ? 3) Height = ? Total Wattage = ?

Solution:

$$Gross\ \ Lumens = \frac{A \times E \times D.F}{U.F}$$

$$Gross\ \ Lumens = \frac{3200 \times 150 \times 1.35}{0.6}$$ ---------- **(1/2 Marks)**

$$Gross\ \ Lumens = \frac{648000}{0.6}$$

$$Gross\ \ Lumens = 1080000$$ ---------- **(1/2 Marks)**

It is assumed that 40 watt Fluorescent Tubes are to be used for the working plane:

$$Number\ of\ \ Lamps\ \ \ required = \frac{Gross\ \ Lumens}{Wattage\ of\ \ each\ lamp \times efficiency\ of\ \ each\ lamp}$$

$$Number\ of\ \ Lamps\ \ \ required = \frac{1080000}{40 \times 35}$$ ---------- **(1/2 Marks)**

$$Number\ of\ \ Lamps\ required = 771.42\ Nos\ lamps$$ ---------- **(1/2 Marks)**

$$Number\ of\ \ Lamps\ required = 772\ Nos\ of\ \ Tubes$$

It is assumed that the tube set of Double Tube (Twin tube) are to be used for the working plane :

$$Total\ \ Number\ Twin\ Tubes\ Set\ \ = \frac{Total\ \ No.of\ \ Tubes}{2} = \frac{772}{2}$$

$$Total\ \ Number\ Twin\ Tubes\ Set\ \ = \frac{Total\ \ No.of\ \ Tubes}{2} = 386\ Nos$$

------- ---------- **(1 Mark)**

OR Student may Write this way

1. **For total gross lumens calculation there is another formula for which mark should be given** $Gross\ \ Lumens = \frac{A \times I \times W \times D.F}{U.F}$ $assume\ W = 1$

Given Data :- Note As per Assumption Final Answer may change so give marks for

correct steps and don't stickup with Final Answer

Hall Dimension : 70 m x 20m = 3200 m^2

U.F = 0.6, D.F.= 1.35 Assumption :- Let, waste light factor= 1,

Wattage of each Tube= 40 watt

Lumens required on working plane =

$$\frac{Area\ of\ Working\ plane \times Lumens \text{ required on working plane} \times \text{Waste light factor} \times \text{D.F}}{\text{UF}}$$

(1/2 Mark)

$$= \frac{(80 \times 40) \times 150 \times 1 \times 1.35}{0.6}$$

$$= \frac{648000}{0.6}$$

= 1080000 Lumens----------

(1/2 Mark)

Assumed wattage of Fluorescent Tube = 40 watt:

$$\text{Total No. of Lamps} = \frac{Total\ lumens \text{ required on working plane}}{\text{Wattage of each lamp} \times \text{output (lumen efficiency)}}$$ **(1/2 Mark)**

$$= \frac{1080000}{40 \times 35} \qquad = 771.42 \text{ Tubes}$$

Total No. of Tubes = 772 Nos. Say----------Answer---------- **(1/2 Mark)**

It is assumed that the tube set of Double Tube (Twin tube) are to be used for the working plane :

$$Total\ Number\ Twin\ Tubes\ Set = \frac{Total\ No.of\ Tubes}{2} = \frac{772}{2}$$

$$Total\ Number\ Twin\ Tubes\ Set = \frac{Total\ No.of\ Tubes}{2} = 386\ Nos$$

---------- ----- **(1 Mark)**

Distance Their disposition: **(1 Mark)**

- Number of lamps lengthwise (No of rows) = $\frac{Length\ (L)}{Space\ (S)} = \frac{80}{3} = 26.66 \cong 27$
- Number of lamps widthwise (No of columns) = $\frac{Width\ (W)}{Space\ (S)} = \frac{40}{3} = 13.33 \cong 14$

---------- L= 80 Meters ----------

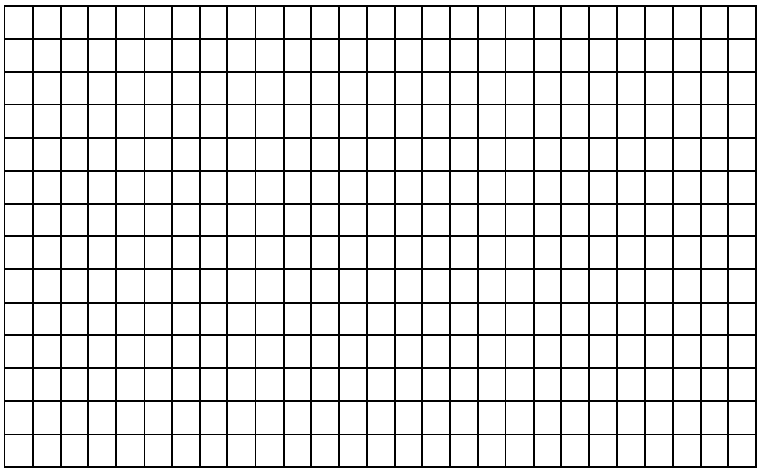


Fig: Dispositions of lamps (at each cross or Junction of there is one Twin set)

- Total number of Tubes column wise = 27 Nos
- Total number of Tubes Row wise = 14 Nos
- So Total Number of Twin Tube set = 378 Nos
- Total Power Consumption for the Hall = 378 x 2 x 40 = 30240 watt or 30.24 KW
- Space between the Tube set = 3 meter
- Mounting Height of the tube set is decided by space to height ratio.
- Space to height ratio = $\frac{3\ meter}{5.2\ meter} = 0.57$
- Mounting Height is considered 5.2 meter

b) **A 0.5 meter diameter diffusing sphere of opal glass (25% absorption) encloses a lamp with luminous flux of 4800 lumens. Calculate average luminance of the sphere.**

Ans: **Given Data:** **(1 Mark)**

Diameter of the sphere d = 0.5 mtr,

Percentage absorption of the flux by the sphere = 25 % = 0.25

Also % of the flux emitted by the sphere = 100-25 % = 75 % (1-0.25 = 0.75)

Luminous flux of a lamp = 4800 lumens, Calculate Average luminance of the sphere=?

Solution:

Radius (r) = d/2 = 0.5/2= 0.25

Flux emitted by lamp or source = 4800 lumens

	Flux emitted by a sphere = 0.75 x 4800 = 3600 lumens ---------- **(1 Mark)** $Average\ \ luminance\ of\ \ the\ Sphere\ = \frac{Flux\ emitted\ by\ the\ Sphere}{area\ of\ \ the\ Sphere\ (4\pi\ r^2)} = \frac{3600}{4\times\pi\times(0.25)^2}$ $Average\ \ luminance\ of\ \ the\ Sphere\ = \frac{3600}{0.7853}$ ---------- **(1 Mark)** $Average\ \ luminance\ of\ \ the\ Sphere\ = 4584.2353\ \ Lumens/m^2\ or\ lux$ ---------- **(1 Mark)**
c)	**State any four requirements of illumination of sports lighting.**
Ans:	**Sports Ground lighting design can be done by considering following points:** **(Any four point Expected-1 Mark each)** 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.
d)	**State any four effects that can be obtained by lighting on stages.**
Ans:	**(Any four Effect are Expected-1 Mark each)** Generally Stage is required to perform various social & cultural activities. For e.g.

	Dance, Drama, gathering etc. The stage lighting is commonly used for to fulfill all these activities and is very important part of this program. **The following effects can be obtained by lighting on the stage:** 1. The activity or programme on the stage should be performed without any disturbance. 2. The lux level on the stage and light intensity is maintained and controlled as per requirement of activity. 3. The multi colour effect for particular activity of drama is also possible. 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.
e)	**State any four desirable characteristics of lighting required in aquarium**
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 electricity 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.

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