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** |
|---|---|
| **i)** | **Define the terms:- Illumination; Light intensity; Lumen and Lux.** |
| Ans: | **( Each Definition: 1 Mark)** |

**i) 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

**ii) Luminous intensity:**

The Luminous flux emitted by the light source per unit solid angle called as the luminous intensity. **OR** $I = \frac{\phi}{w}$ (*Where* $\phi = luminous\ flux, w = Solid\ Angle$)

**iii) Lumen:**

It is defined as the luminous flux emitted by a source of one candle power per unit solid angle in all directions **OR**

It is unit of luminous flux. One lumen is defined as luminous flux emitted per unit solid angle from a point source of candle power.

**iv) Lux** :-

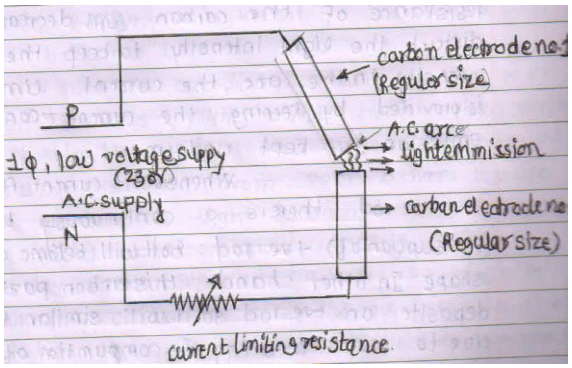
It is unit of illumination and it is defined as luminous flux falling per unit area

| ii) | **Explain with neat sketch the working, of carbon-arc lamp with its applications.** |
|---|---|

Ans:

**Sketch of carbon-arc lamp: ( Figure:1 Mark, Working:2 Mark & Application:1 Mark)**

**1) A.C. Arc Lamp: ( Any one Types expected)**

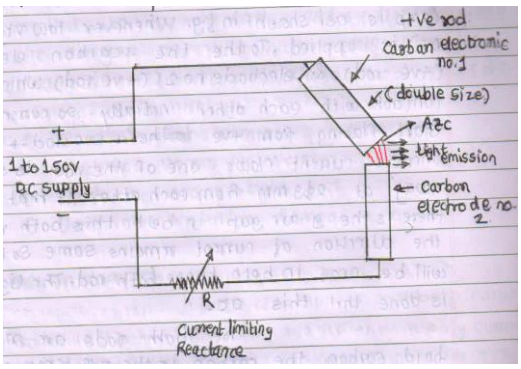



or equivalent figure

**Working of A.C. Carbon-arc lamp:-**

- In a.c arc lamp size of both carbon electrodes is same because, due to a.c supply current will flow from electrode no.1 to electrode no.2 for positive half cycle and negative half cycle its direction is vice-versa. i.e why the wearing of both electrode will same.
- In A.C arc lamp lowing is equal to or less than 230V is applied to the both carbon electrode. After stretching the one of the carbon electrodes at 2 to 3mm distance from each other. The arc will be induce & light is emitted through this arc.
- Out of total light emission 45% light will be emitted by carbon electrode no.1 & 45% light will be emitted by carbon no.2 & 10% and light will be emitted by the air gap.
- The illumination efficiency of a.c arc lamp is 8 lumens/watt

**2) D.C.Arc Lamp:**




or equivalent figure

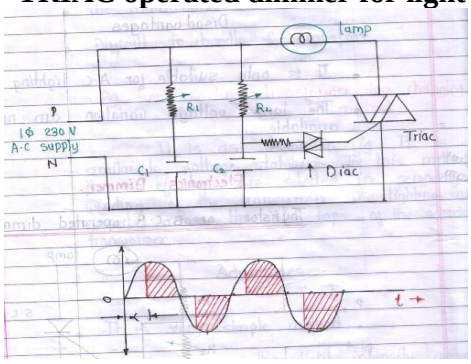
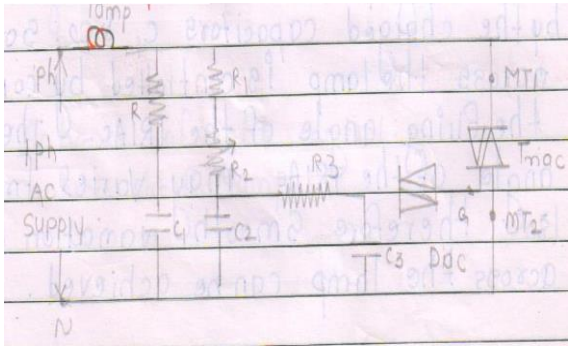
**Working of D.C. Carbon-arc lamp:-**

- The connection diagram for d.c arc lamp is as shown in figure.

- Whenever low voltage (110 to 150V) D.C. is applied, to the carbon electrode no.1 (positive rod) & electrode no.2 (negative rod) which are in contact with each other initially, so current will start flowing from positive to negative direction vice versa.
- Whenever current flows one of the rod is stretched away at 2 to 3mm from each other. At that time there is the air gap in between this both rods & the direction of current remains same, so that there will be arc in between these both rod. The light emission is done through this arc.
- The both rods are made by hard carbon. The carbon is the negative temperature co-efficient of material, so that whenever temperature increases the resistance of the carbon will decreases it will disturb the light intensity to keep the uniform light intensity in the arc, the current limiting resistance is provided by keeping the current constant light emission is kept uniform
- Whenever current flows from positive to negative rod there is a continuously wearing of (consumption of) positive rod, so it will become as a hallow shape.
- In other hand this carbon particles will deposite on negative rod, so it will similar to pencil shape due to more wearing & consumption of positive rod, its size is taken as a double of negative rod.
- At the time of light emmition the temperature of the positive electrode is near about $3500^0$C i.e. why 85% light will be emitted through this positive rod.
- The lamp of negative rod is the near about $2500^0$C, so 10% light is emitted to the negative rod and 5% light is emitted by the air gap.
- The illumination efficnecy of the D.C arc lamp is 9 lumens/watt
- Out of total light emission 45% light will be emitted by carbon electrode no.1 & 45% light will be emitted by carbon no.2 & 10% and light will be emitted by the air gap.
- The illumination efficiency of a.c arc lamp is 8 lumens/watt

**Applications of A.C & D.C carbon-arc lamp:**

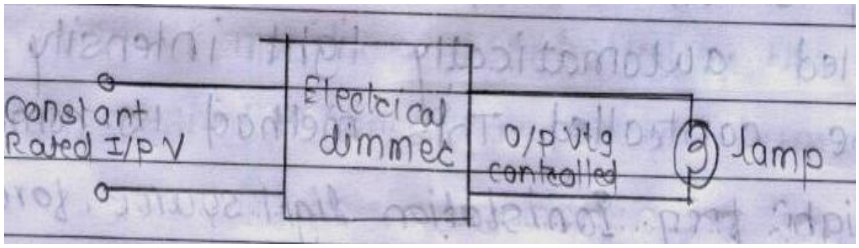
1. Used in flash camera
2. Used in cinema projector
3. Used as search light
4. Used as projection Lamp

| | |
|---|---|
| **iii)** | **Explain with circuit diagram; the working of Triac Operated Dimmer?** |
| Ans: | **TRIAC operated dimmer for light control – ( Figure: 2 Mark & Explanation: 2 Mark)**<br>  <br><br>**OR**<br>  <br><br>**or equivalent figure**<br>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.<br>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.<br>But for the –ve half cycles the capacitor C1 is charged & discharged through the R1 & firing angle is decided by this R1C1 values.<br>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.<br>This method is commonly used for light intensity control and other application also e.g. fan regulator. |
| **iv)** | **State the purposes of lighting control.** |
| Ans: | **Purpose of Lighting Control: ( Any Eight point expected: 1/2 each point)**<br>1. Shadows: - Shadows should be minimum.<br>2. Glare: - Glare should be minimum.<br>3. Uniformity: - uniform distribution of light throughout the working plane.<br>4. Colour of light: - Choose fitting which produces colour like a day light e.g. Fluorescent tube<br>5. To turn ON or OFF the the lamps<br>6. For dimming, the dimming control permits the adjustment of lighting over a range. |

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 or automation there is anent of lighting control.
12. To provide proper lux level on working plane the lighting control is required.
13. To provide proper lux level on working plane the lighting control is required.
14. As per Indian or international standard
15. To control the brightness of T.V monitor there is need of lighting control.

**OR**

**Purpose of 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.

| Q.1B) | Attempt any ONE of the following : 06 Marks |
|---|---|
| a) | **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)**

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)**

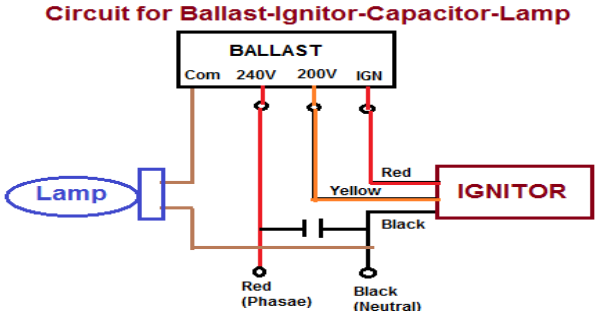
1. **Comfortable:** The energy illumination scheme should be comfortable to everybody.
2. **Pleasant surrounding**: By the electrical lighting or the electrical illumination scheme the surrounding area of that location should be pleasant.
3. **Long life:** The life of the designed illumination should 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.

**b) Explain with neat sketch; the construction; working principle and applications of metal halide lamp.**

Ans: **Metal Halide lamp:**

**( Diagram:2 Mark, Construction & Working:2 Mark & Application: 2 Mark)**




**Construction is similar to mercury lamp**.

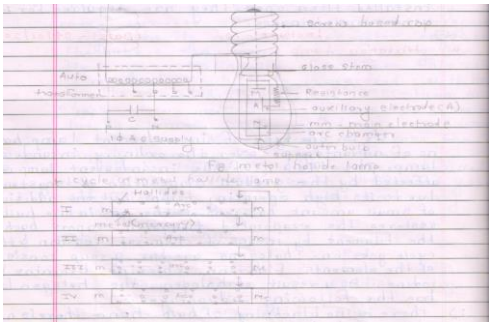
1. MH lamps consist of an arc tube (inner) enclosed by an outer tube.
2. Vacuum is created between the inner & outer glass tube to prevent heat loss.
3. The inner arc tube contains the electrodes and various metal halides, along with mercury and inert gases that make up the mix.
4. MH lamp has three electrodes – two for maintaining the arc and a third internal starting electrode
5. **OR** Pulse-start MH lamps do not have a starting electrode. An igniter in the pulse start system delivers a high voltage pulse (typically 3 to 5 kilovolts) directly across the lamp's operating electrodes to start the lamp
6. IT require a ballast to give high voltage at staring to produce the arc
7. The capacitor is used to improve the power factor.

**Working principle of Metal Halide Lamp:**

- When the lamp is turned on, a high voltage at staring is applied across two electrodes, to initiate an arc which discharges and vaporizes argon gas (starting gas), mercury vapor and chemical components called "metal halides"
- The energized metal atoms emit light.

**OR Student may Wright**

**Construction:**



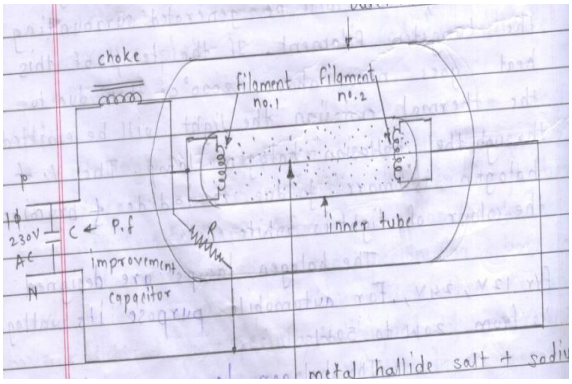
**or equivalent figure**

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**

**Diagram:**




**or equivalent figure**

The halide cycle in metal halide lamp.

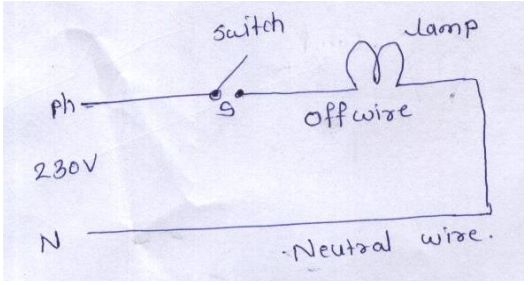
8. Metal (mercury) atoms move from electric arc towards the tube wall where the halides are present.

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

**Application of metal halide lamp: (Any two advantages are expected)**

1. for the tennis board.
2. for the cricket stadium
3. for the ancient building & museums
4. for the water falls

| | | |
|---|---|---|
| **Q.2** | **Attempt any TWO :** | **16 Marks** |
| **a)** | **a) Explain with neat sketch the following lighting control circuits :-**<br>**(i) Single lamp controlled by single switch**<br>**(ii) Single lamp controlled by two point method**<br>**(iii) Single lamp controlled by three point method.**<br>**(iv) Auto transformer dimmer** | |
| **Ans:** | **(i) Single lamp controlled by single switch:** **(Figure:1 Marks Explanation:1 Marks)** | |



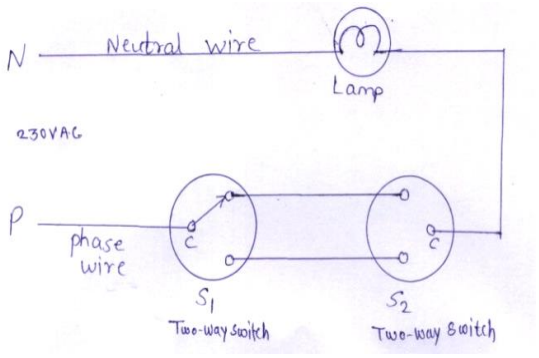

**or equivalent figure**

For a lamp one live wire (phase) and one neutral is necessary to control the supply to the lamp switch is introduced in the live wire & neutral is directly connected to the lamps as shown

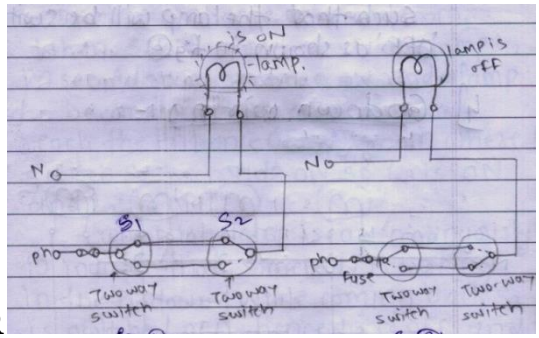
in figure.

When switch is 'ON' a full voltage gets applied across the lamp & lamps become 'ON' and when the switch is 'OFF' the circuit gets opened and lamps becomes OFF'. this is controlling of one lamp by one switch.

**ii) Single lamp controlled by two point method:-** **(Figure:1 Marks Explanation: 1 Marks)**




**OR**

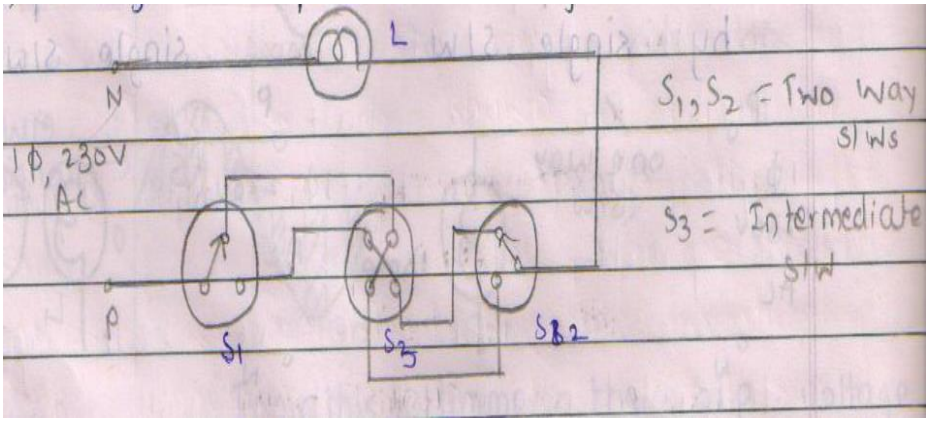



**or equivalent figure**

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'.

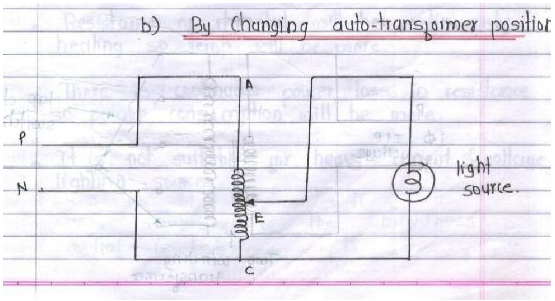
**iii) Single lamp control by three point method:** **(Figure:1 Marks Explanation:1 Marks)**



**Explanation:**

- It consists of two way switches & intermediate switch (the lamp is controlled by three different positions) the circuit diagram is as shown in figure above.

**iv) Auto transformer Dimmer –** **(Figure:1 Marks Explanation:1 Marks)**




**or equivalent figure**

- As position of dimmer or auto transformer changes output voltages across light source will changes .So that light intensity also changes.

**b) An illumination on the working plane of 75 lux is required in a room 72 m x 15 m in size. The lamps 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 lamps and disposition of lamps.**

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 = 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)**

- 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) (i) State main objectives of street lighting. Explain general principles employed in the design of street lighting.**

Ans:

**Objectives of street lighting:**

**( Any four point expected: 1/2 Marks each)**

1. The street lighting should be such that the object can be seen driver of any vehicle.
2. The street lighting should be attractive.
3. It should increase the community value.
4. As per the Indian standard, the illumination level required for high traffic density should be 20:30 lux for medium traffic density it should be 8-15 lux & for low traffic density it should be minimum 4 lux.
5. It should be such that a river of any vehicle sees the object up to 30 mtr.

6. Percentage of glare should be less so there are less chances of accidents, for that angle of reflector should be well maintain.
7. It should be electrical & mechanical safe.
8. The replacement of lighting accessories should be simple
9. The maintenance & repairing should be simple future expansion should be carries out without any difficulty.
10. It should be economical.
11. For high traffic density, generally metal halide lamp, halogen lamps should be used. For medium traffic density sodium vapour lamp , mercury vapour lamp should be used & for low traffic density CFL, LED and fluorescent tube should be used.

**OR**

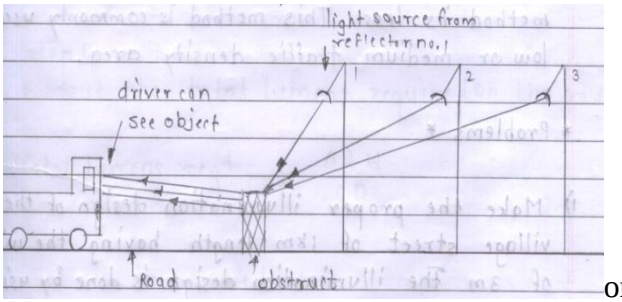
**Main Objectives of street Lighting:**

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

**General Principals employed in the design of street lighting:** **( 2 Mark)**

1. Specular-reflection principle of street lighting
2. Diffusion principle

**1) Specular-reflection principle:-**



or equivalent figure

- In this method obstruction will be clearly visible to the driver by using reflectors with small angle of incidence.
- In this method reflectors are used in such a way that driver can see any object clearly from more than 40 m distance on road. So that accident will be less.
- Power consumption required for this method is less.
- This method is commonly used for low or medium traffic density area.

| | |
|---|---|
| | **2) Diffusion Principle:**<br>➢ In this type, the light is directed downwards from the lamps with the intension of producing a uniform illumination on the road surface.<br>➢ This is possible by use of suitably design reflectors.<br>➢ The filament of the lamp is invisible expect from almost beneath it.<br>➢ This illuminates glare, the road surface has a diffusing mature due to which it diffuses some proportion of light towards the observer. This makes the road surface bright for the observer. |
| **c) (ii)** | **Explain the illumination level for street lighting mounting height of lamps in street lighting and types of lamps used for street lighting?** |
| Ans: | **illumination level for street lighting mounting height of lamps in street lighting depends upon the :**<br>1. Width of road and total length of the road<br>2. Total coverage illumination area of the road.<br>3. Frequency and location of the street<br>4. The civil construction quality of the street.<br>5. The average speed of vehicles on the road.<br>6. Street for the rural application, semi urban and urban application are different.<br>7. The average lux level for rural street is 10 to 40 Lux, semi-urban 30 to 80 Lux and urban applications 60 to 100 Lux<br>➢ **Types of lamps used for street lighting**: **(2 Mark)**<br>1) High pressure mercury vapour lamp.<br>2) High pressure Sodium vapour lamp.<br>3) Fluorescent tube<br>4) LED Lamp<br>5) Metal Halide Lamp |
| **Q.3** | **Attempt any FOUR :** **16 Marks** |
| **a)** | **A lamp of 500 watts having mscp of 1000 is suspended 2.7 meters above the working plane. Calculate :- (i) Illumination directly below the lamp at the working plane. (ii) Lamp efficiency.** |
| Ans: | $Total\ MSCP\ of\ the\ lamp = \frac{Total\ lumens\ required\ on\ working\ plane}{4\pi}$ - --- **(1/2 Marks)** |

$$1000 = \frac{Total\ lumens\ required\ on\ working\ plane}{4\pi}$$

$$Total\ lumens\ required\ on\ working\ plane = 1000 \times 4\pi$$

$$Total\ lumens\ required\ on\ working\ plane = 12560 \text{ lumens}$$ ---------- **(1/2 Marks)**

**(i) Illumination directly below the lamp at the working plane:** **( 1.5 Marks)**

$$Illumination\ exactly\ below\ the\ lamp\ (E) = \frac{I}{d^2}$$

$$Illumination\ exactly\ below\ the\ lamp\ (E) = \frac{1000}{(2.7)^2}$$

$$Illumination\ exactly\ below\ the\ lamp\ (E) = 137.17\ lux$$

**(ii) Lamp efficiency:** **( 1.5 Marks)**

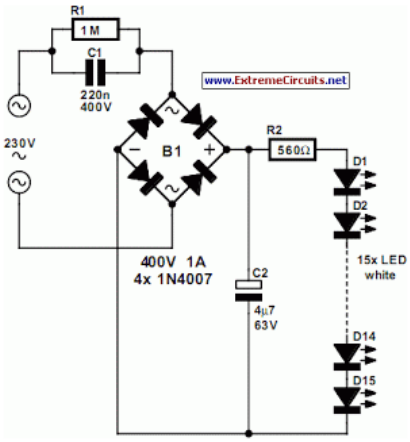
$$Lamp\ efficiency = \frac{Total\ lumens}{Wattage\ of\ the\ lamp}$$

$$Lamp\ efficiency = \frac{12560}{500}$$

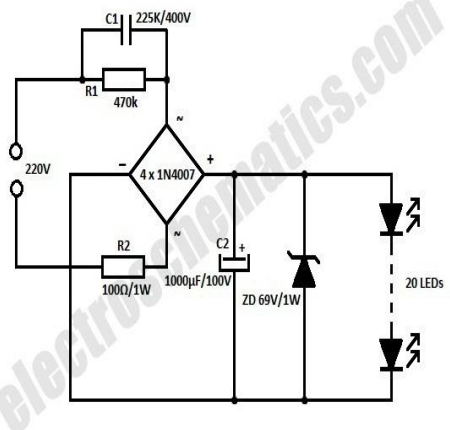
$$Lamp\ efficiency = 25.12\ lumens/watt$$

**b) Draw the typical circuit diagram of LED lamp. State any four applications of LED lamp.**

Ans: **Typical circuit diagram of LED lamp:** **(Diagram: 2 Mark & Application: 2 Marks)**




OR




**OR**

or equivalent figure

**Applications of LEDs:** **(Any two Applications 2 Mark)**

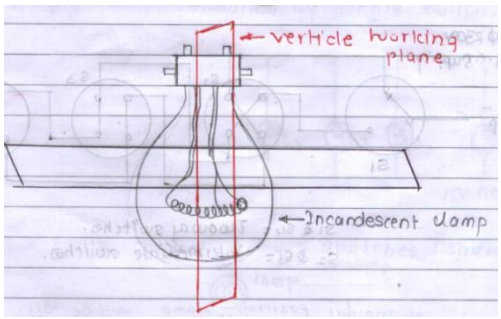
1. Street Lighting
2. Domestic Lighting,
3. Campus lighting
4. Parking Lighting,

**c) What is a polar curve? How it is useful for designing the lamps.**

**Ans:**

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

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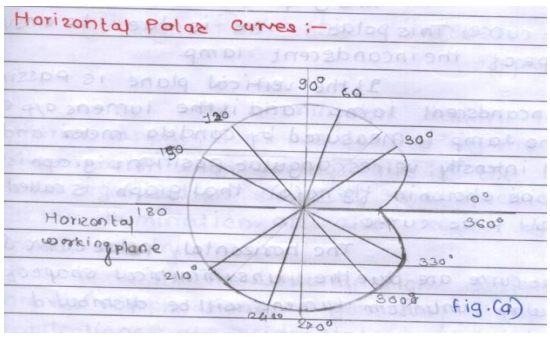
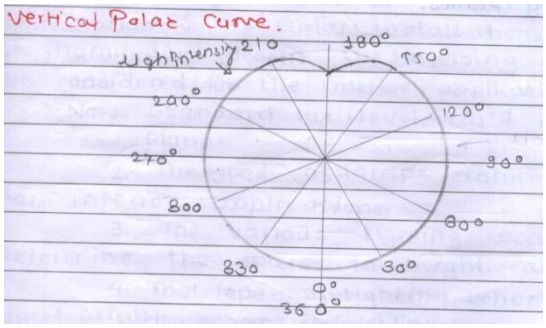



**Importance of polar curves in illumination Engg:-.**

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

**d) Select illumination level required as per IS1 for the following working plane in residential building -**
**(i) Kitchen (ii) Living room (iii) Dinning room (iv) Study room**

Ans: **Recommended illumination level required for any four area of residential premises.**

**( Any Four Point expected : 1 Mark)**

| S.No | Places of residential Purpose | illumination level in lux |
|---|---|---|
| i) | Kitchen | 150 to 200 Lux |
| ii) | Living Room | 300 Lux |
| iii) | Dining Room | 150 Lux |
| iv) | Study Room | 300 Lux |

**e) State the general requirements for factory lighting.**

Ans: **The following general requirement of factory lighting:-**

**(Any Eight point expected– 1/2 Marks each)**

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 colour 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.

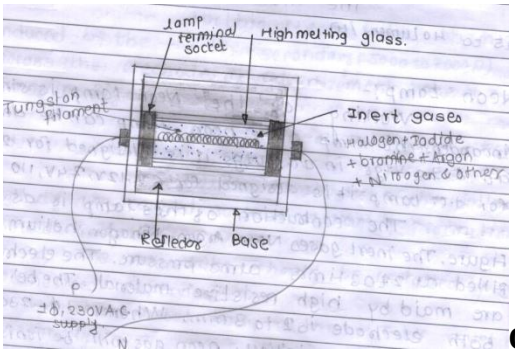
**OR**

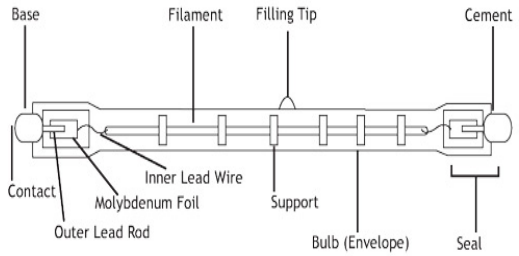
1) The type of industry or factory.
2) The total premises area of the whole factory in $m^2$.
3) The location of the factory.
4) The surrounding conditions. e.g. wind pressure, natural sun light, rainfall, etc.
5) The type of product which are manufactured in the factory.
6) The total indoor & outdoor 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.

| Q.4 A) | **Attempt any THREE :** | **12 Marks** |
|---|---|---|
| **i)** | **Explain with neat sketch the working, of Halogen lamp. State its applications.** | |

Ans:

**Sketch of Halogen Lamp:-** **( Sketch : 1 Mark)**




**OR**

**or equivalent figure**

**Working of Halogen Lamp:-** **( Working : 2 Mark)**

- This is one type of incandescent lamp having number of advantages over the ordinary incandescent lamp.
- The life & efficiency of an incandescent lamp is affected by the gradual & evaporation of tungsten and also its operating temperature but the addition of small amount of halogen vapour to the gas in bulb restores.
- The evaporated tungsten vapour back to the filament by means of chemical reaction and the cycle goes on.
- Halogens are a group consisting of the elements chlorine, fluorine & bromine & iodine. As a result halogen lamps have the following advantages.
- There is no blacking of bulb so there is no depression of light output.
- It has 50 % more efficiency than that of an ordinary incandescent lamp.
- It is smaller in size.
- It gives better coloured radiation.
- Halogen lamps are manufacture upto 5KW and are suitable for outdoor illuminations.

**Application of Halogen Lamp:** **( Application : 1 Mark)**

1) Hospitality (restaurants, lounges**,** hotels )

2) Museums**,** galleries and art displays

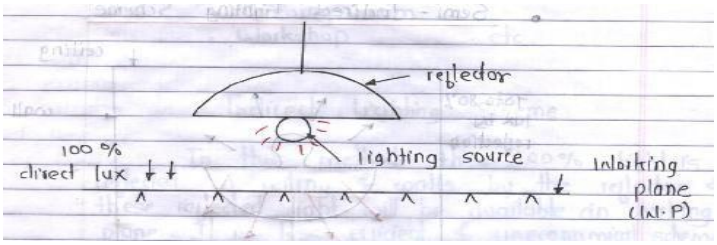
3) Retail displays (merchandising**,** accent lighting)

4) Residential, commercial, offices, grocery, food, decorative and decorative

| | |
|---|---|
| **ii)** | **What are the factors governing the illuminance of visual task in interior lighting scheme?** |
| Ans: | **Following are the factors governing the illuminance of visual task in interior lighting:**<br>**( Any Four point expected: 1 Mark each)**<br>1. To create a visual environment space to height ratio is important.<br>2. Space to height ratio is important from the point of illumination level required according to recommendation.<br>3. Space to height ratio is important according to requirement/application e.g. street lighting, open parking, security lighting, landscape accent lighting, Sign lighting and garden lighting etc.<br>4. Space to height ratio is important from the point of light pollution.<br>5. Space to height ratio is important from the point of vertical & horizontal illumination.<br>6. It is important from the point of view to obtained shadow less light.<br>7. It is important to obtained glare free lighting. (To avoid discomfort).<br>8. It is important to avoid overlapping of light.<br>9. It is important from the CRI (Colour rendering index) point of view.<br>10. It is important from the point of view co-related to CCT ( Colour Temperature)<br>11. It is important from the point of operating environment ( atmosphere)<br>12. It is important from the point of aesthetic point of view.<br>13. It is important from the point of energy efficiency & saving and maximum utilization factor.<br>14. It is important from the point of safety against road traveling.<br>15. It is important from the point of method of lighting (direct or indirect).<br>16. It is important for the point of type and physical size of luminaries. |
| **iii)** | **List the various indoor lighting schemes and describe any one of them with sketch.** |
| Ans: | **(ii) List the various indoor lighting:** **( Any Two Schemes expected: 1/2 Mark each )**<br>1. Direct Lighting Scheme<br>2. Indirect lighting scheme<br>3. Semi direct Lighting Scheme<br>4. Semi indirect lighting Scheme<br>5. General Lighting Scheme |

**Explanation :** **(Any one explanation Expected: Figure; 1 Mark & Explanation: 2 Mark)**

**i) Direct lighting :**

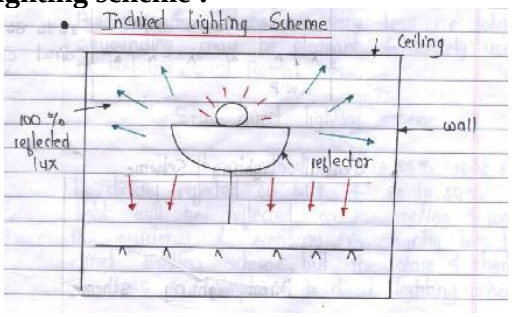



In this method, the reflector is used on the lighting source. The 100% light is reflected by this reflector on the working plane. So efficiency of direct lighting scheme is very high and it is economical also. But limitation of direct lighting scheme is that glare & shadows are more. The direct lighting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

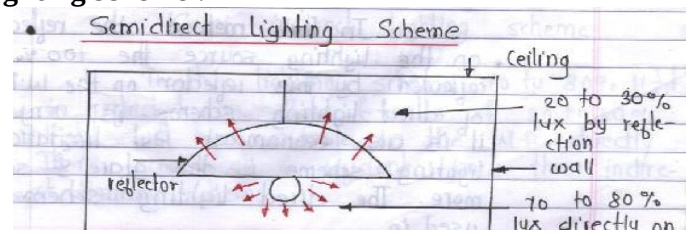
**ii) Indirect lighting scheme :-**




**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.

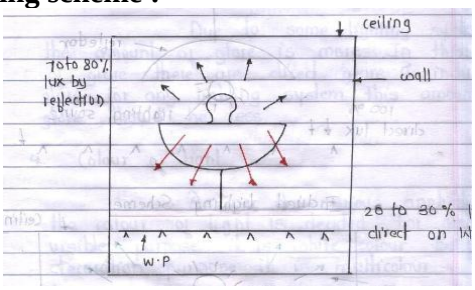
**iii) Semi direct lighting scheme** :-




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.

**iv) State different types of lamps used for decorative purpose and stage lightings and state the reasons why these lamps are used.**

Ans: **Type of lamps are used for decorative lighting and Stage Lighting:**

**(Any Two lamps expected: 1 Mark each)**

1. Flood Fight
2. Neon Lamp
3. Mercury vapour lamp
4. Spdium vapour lamp
5. Multi colour LED Lamp
6. Compact Fluorescent lmap
7. Halogen Lamp
8. Small capacity projector lamp
9. Metal Halide Lamp

**For the following reasons of decorative lighting & Stage Lighting are used:**

**(Any four reason Expected:1/2 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 reason of Decorative purpose and Stage lighting:**

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.

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

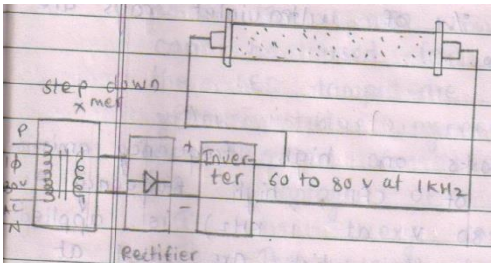
**i) Compare incandescent and fluorescent lamps on the basis of:-**
**(1) Luminous efficiency (2) Colour rendering (3) Effect of voltage fluctuation (4) Life of lamp (5) Cost (6) Quality of light**

Ans:

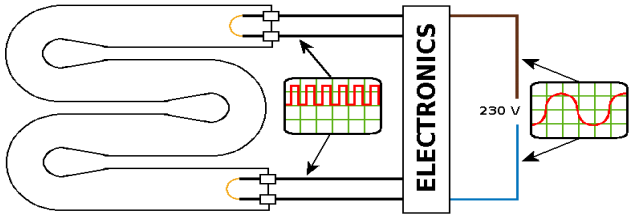
**( Each Point : 1 Mark)**

| S.No. | Points of comparison | Incandescent Lamp | Fluorescent Lamp |
|---|---|---|---|
| 1 | Luminous efficiency | Less ( 12 to 15 lm/w) | More ( 40 to 60 lm/w) |
| 2 | Colour rendering | Very good | Good |
| 3 | Effect of voltage fluctuation | Yes | No |
| 4 | Life of lamp | less | More |
| 5 | Cost | Capital cost is less and Running cost is more as life is less | Capital cost is more and Running cost is less as life is more |
| 6 | Quality of light | Good | Best |

| | |
|---|---|
| **ii)** | **Explain with neat sketch the working principle advantages; disadvantages and applications of CFL lamp.** |
| Ans: | **Sketch of CFL Lamp :** **( 1 Mark)** |




**OR**




or equivalent figure

**Operation:-** **( 2 Mark)**

- The electronic ballast circuit takes a 220 V input from external power source and sends high frequency supply is applied to that two terminals of CFL
- This ionizes the argon and mercury vapor particles.
- The ionized particles emit ultra violet radiations which strike with the fluorescent layer of material coated on the tube.
- In turn, fluorescent material spread a white light which lights up the room.

**OR**

**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.

**Advantages of CFL**:- **(Any Two expected : 1/2 Mark each)**

1) Available in any shape
2) Power consumption is less
3) Illumination efficiency is high
4) Life in working hours is large as compare to incandescent lamp.
5) Compact tube size as compare to fluorescent tube.
6) Can be available in various colours.
7) Smooth light and low maintenance.
8) Low running cost
9) Attractive look
10) High color rendering index (CRI)
11) No stroboscopic effects.

**Disadvantages of CFL lamps;** **(Any Two expected : 1/2 Mark each)**

1. Glare is more
2. Ultra violet rays more
3. Lux level reduces due to ageing.
4. High cost
5. Contain mercury

**Applications of CFL lamps :-** **(Any Two expected : 1/2 Mark each)**

1) Domestic Lighting.
2) Hospitals.
3) Shops
4) As a energy saving lamps in passage, corridors etc

| | | |
|---|---|---|
| **Q.5** | **Attempt any TWO** | **16 Marks** |
| **a)** | **State the specific requirements and type of lamps used for the following interior lighting :- (i) Office building (ii) Multistoreyed industrial buildings (iii) Single storeyed without skylight industrial building (iv) Highbay industrial** | |
| Ans: | **Following are the specific requirement for interior lighting:** **(Any Four point expected: 1 Mark, Total : 4 Mark)** | |

1. Standard lux level required on the working plane.

2. The types of lamps which are used for interior application
3. The various lighting accessories to determine the space to height ratio.
4. The type of lighting scheme for e.g. direct lighting scheme, indirect lighting scheme, semi direct lighting scheme, semi-direct lighting scheme & general lighting scheme.
5. The wattage and size of lamp which are used for interior application.
6. Some times at the time of illumination designs the point of energy saving and energy conservation is also to be considered.
7. The rays emitted by the lamp for e.g. ultraviolet rays, infrared rays are also to be taken into account at the time of lamp selection because these rays directly affects to the human body.
8. By the illumination design the environmental condition should be unchanged & pleasant. There should not be sound pollution or harmonic effect.
9. At the time of doing the illumination design the glare is set to the every operator which is working in that premises should be very less.
10. At the type of commercial applications for e.g. decoration, as a showpiece purpose the colour of light is decided. To get this colour of light the type of lamp (discharge lamps or LED lamps etc) is also taken into account.
11. The illumination design should be electrically & mechanically safe for the interior applications.
12. The repairing & maintenance for this illumination design should be low.
13. The life of the illumination design lighting devices & lighting accessories should be more.
14. The cost of illumination design should be low.

**Type of lamps used for the following interior lighting:** **( Each Name of Lamp : 1 Mark)**

| S.No | Name of interior Lighting | Lamp used |
|---|---|---|
| i) | Office building | Fluorescent tube, CFL, LED Lamps, etc |
| ii) | Multistoreyed industrial buildings | Fluorescent tube, CFL, LED Lamps, projector lamps, bunched filament lamps, Halogen Lamps, |

| | | |
|---|---|---|
| | | Metal halide lamp etc |
| iii) | Single storeyed without skylight industrial building | Fluorescent tube, CFL, LED Lamps, projector lamps, bunched filament lamps, Halogen Lamps, Metal halide lamp etc |
| iv) | Highbay industrial | Fluorescent tube, CFL, LED Lamps, projector lamps, bunched filament lamps, Halogen Lamps, Metal halide lamp etc |

**b)** **State the general and specific requirements of illumination scheme for aquarium and shipyards. State the lamps used for them.**

Ans: **The requirement of scheme for Aquariums:- (Any Four points Expected: 1/2 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.

**Following Lamps used aquarium:** **(Any Four Lamp expected: 1/2 Mark each)**

1) Small size and low power halogen lamps.
2) Ultraviolet lamps and tubes.
3) Compact fluorescent lamps
4) LED lamps
5) Multi colour small discharge lamps
6) Decorative lamps
7) Special purpose lamps
8) Bollards
9) foot lamp
10) Solar grass lamp
11) LED- Solar energy lawn lamps

**The requirement of scheme for shipyards:-** **(Any Four points Expected 1/2 Marks Each)**

1. The shipyard lighting always depends.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.<br>7. The life of the shipyard lighting should be always more.<br>8. The cost of the ship-yard lighting should be always economical.<br>9. 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.<br>10. At the time of ship-yard lighting for the outdoor applications we have consider total area of water, which is covered by the illumination.<br>11. The ship-yard lighting is always at the remote place slightly away from the sea-share, so at the time of ship-yard lighting the wiring & accessories can be replace easily.<br>12. 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.<br>13. 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.<br><br>**Following Lamps used shipyard:** **(Any Four Lamp expected: 1/2 Mark each)**<br>1. Metal halide lamp<br>2. LED lamps<br>3. Halogen Lamps<br>4. Bunched filament focus lamp<br>5. Foot lamp<br>6. Bollards<br>7. CFL |
| **c)** | **What is flood lighting? State its purpose? Why it is necessary to have projectors for flood lighting? State different types of projectors used for flood lighting?** |
| Ans: | **1. Flood lighting:** **(2 Mark)**<br>Flood lighting means flooding of large surface area with light from powerful sources using projector<br><br>**2. Various purpose of Flood Lighting:** **(2 Mark)**<br>1) **Aesthetic flood Lighting** : It is used for buildings at night, ancient building and |

monuments, churches & gardens etc

2) **Industrial & Commercial Flood lighting:** It is used for illuminating railway yards, stadiums, car parking area etc.

3) **Advertising flood lighting:** It is used for illuminating advertisements, boarding's etc

**OR**

1. It is used for buildings at night, ancient building and monuments, churches & gardens etc
2. It is used for illuminating railway yards, stadiums, car parking area etc.
3. It is used for illuminating advertisements, boarding's etc

**3. Reason for necessary to have projectors for flood lighting:-** **(2 Mark)**

- Due to the projector reflection factor is very good, maximum lumens will reached on flooding surface

**4.Types of projectors used for flood lighting:** **(2 Mark)**

a) Narrow beam Projector
b) Medium angle Projector
c) Wide angle Projector

| Q.6 | **Attempt any FOUR :** | **16 Marks** |
|---|---|---|
| **a)** | **Explain in brief requirements of lighting for following places in Hospitals -**<br>**(i) Patient's ward (ii) Operation theatres** | |

Ans:

**i) In Patient's ward of the hospital:-**

**(Any Four Point expected: 1/2 Mark each Total: 2 Mark)**

- 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 =

$$Number\ of\ Lamps\ \ required = \frac{Total\ \ Lumens}{Wattage\ of\ \ each\ lamp \times Illumination\ of\ \ lamp}$$

- Mark the number of Lamps on given plane layout.
- Calculate total power.

**OR**

**General requirement for illumination of Patient's ward of the hospital:**

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.

**2. In Operation Theater:-** **(Any Four Point expected: 1/2 Mark each Total: 2 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.<br>➢ In operation theaters some ultraviolet lamps or tubes are also used as a anti-bacteria source.<br>➢ Lux level on the working plane is high. ( 400 to 600 lux) |
| **b)** | **State the general requirement for agriculture and horticulture lighting. State the lamps used for these application.** |
| Ans: | **General requirement for agriculture and horticulture lighting (Green House): ( 2 Marks)**<br>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.<br>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.<br>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.<br>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.<br>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.<br>**Following Lamps used agriculture and horticulture (Green House):- ( 2 Marks)**<br>1. High pressure sodium vapour lamp<br>2. High pressure Mercury vapour lamp<br>3. Fluorescent tubes<br>4. Metal Halide Lamps<br>5. Flood light<br>6. Incandescent lamp |
| **c)** | **Explain in brief the general and specific requirements for railway platform lighting and state the lamps used?** |
| Ans: | **Following the general and specific requirements for railway platform lighting: ( 2 Mark)**<br>Good platform lighting on all stations is essential for the safety and comfort of passengers and railway staff. The recommended value of illumination is 100-150 lux. T-5 fluorescent lamps are used as source of light.<br>The luminaries should be arranged in such a way that the light strikes the platform 'H' straight down and without shadows provided reasonable uniform light across the width of the |

platform. For non-covered portion of the railway station, street light fitting of T-5 fluorescent lamps with width angle distribution reflectors are suitable modern LED street light fitting of 36/40 w are also used.

**OR Student may be write ( Any Four point expected : 1/2 Mark each )**

1. The general requirements & objectives for the railway lighting is similar to shipyard lighting or factory lighting.
2. The total area covered by the railway department.
3. Total number of platforms available on the station.
4. The total length of every platform.
5. The total indoor facilities of the railways station for e.g. waiting room, guest room, booking counter & booking office, signal & controlling room, TC chamber, go downs, canteen, book stall.
6. The platform lighting is generally done as outdoor lighting of factory premises or It is similar to street lighting.
7. For indoor lighting the standard lux level available is common but for the platform lighting the 60 to 80 lux should be available on the railway track & platform.
8. The signaling is very important part. At the time of illumination design we have to consider it.

**OR Student may be write ( Any Four point expected : 1/2 Mark each )**

1. Selection of correct source of light.
2. Adequate level of illumination on the W.P.
3. Correct brightness, relationship eliminating glare and reflection.
4. Appropriate colour of light having regards to: a) requirement of work or process
   b) Psychological effects and combination with natural light.
5. Proper shadow characteristics.
6. Provision of auxiliary and emergency lighting for safety.
7. Provisions for operation i.e. current, switching groups, proper switching control.
8. Maximum overall economy consistent with efficiency.
9. Aesthetic blending of light and décor.

**The lamps used in railway platform: ( 2 Mark)**

1. Fluorescent Lamp
2. Metal Halide Lamp
3. High pressure mercury vapour lamp
4. High pressure Sodium vapour lamp

**d) State the lamps used for -**
**(i) Advertisement / Hoardings**
**(ii) Sport lighting ? State general illumination level in Lux for these places.**

Ans:

**(i) lamps used for Advertisement / Hoardings:-** **( 2 Marks)**

- Illumination level for advertisement and Hoardings 300 to 600 Lux
-

| S.No | Lamp Name |
|---|---|
| 1 | Neon tubes:- |
| 2 | Metal Halide lamp |
| 3 | Halogen Lamp |
| 4 | LED Lamp |

**ii) Sport lighting:-** **( 2 Marks)**

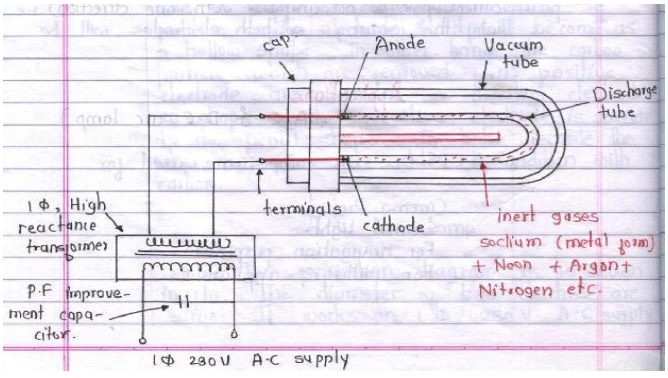
- For indoor sports lighting 300 to 600 Lux
-

| S.No | Lamp Name |
|---|---|
| 1 | Bunched Filament focus lamps |
| 2 | Metal Halide lamp |
| 3 | Halogen Lamp |
| 4 | LED Lamp |
| 5 | Projector Lamp |

**e) Explain with neat sketch the working principle of any one type of following lamp?**
**(i) Sodium vapour lamp (ii) Mercury vapour lamp**

Ans: **( Any one Lamp expected: Figure: 2 Mark, Working: 2 Mark )**

**(i) Sodium vapour lamp :-**

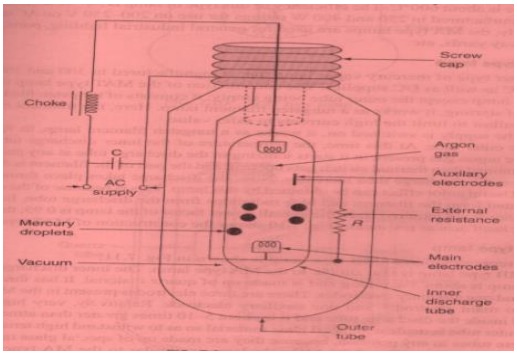



**or equivalent figure**

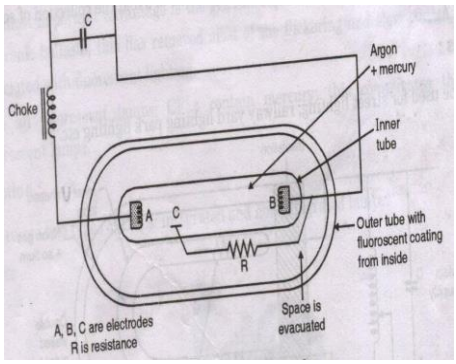
**Working:-**

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.

**ii) Diagram of mercury vapour lamp:**




OR




**or equivalent figur**e

**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.

**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.<br>➢ **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 6000C then there will be heating effect & inert gases ionization will be start.<br>➢ **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.<br>➢ **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.<br>➢ **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.<br>➢ **Power factor improvement Capacitor:** The function of power factor improvement capacitor is to improve the power factor 0.5 to 0.95 |

**----------END----------**