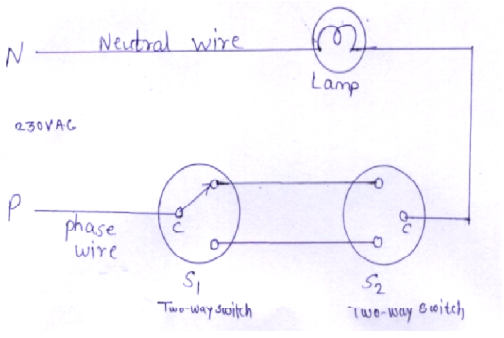
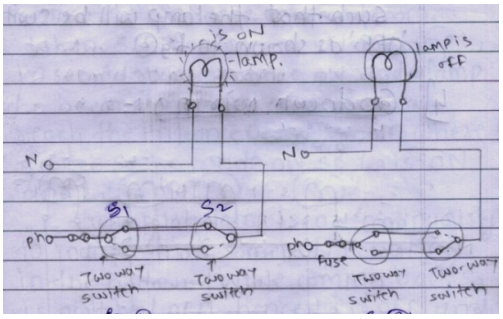
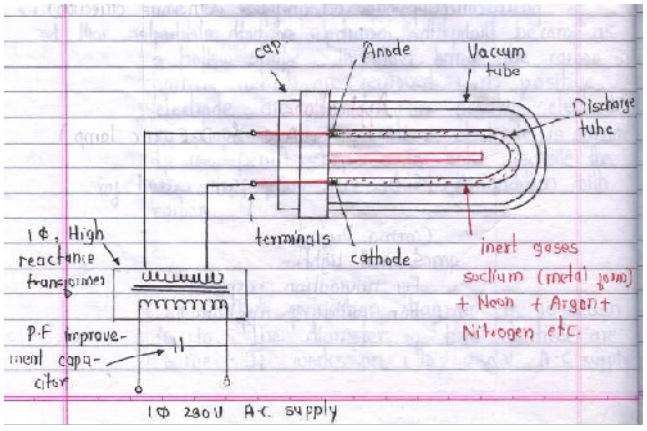
Important suggestions to examiners:

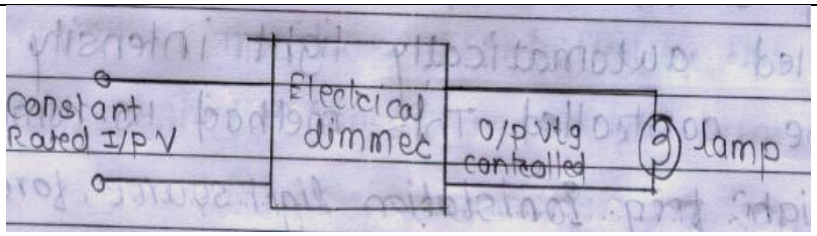
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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)	**Enlist any four features of good illumination scheme.**
Ans:	**Following features of good illumination scheme:** **(Any four point expected-1 Mark each)** ➢ **Comfortable:** The energy illumination scheme should be comfortable to everybody. ➢ **Pleasant surrounding**: By the electrical lighting or the electrical illumination scheme the surrounding area of that location should be pleasant. ➢ **Long life:** The life of the designed illumination should be large ➢ **Economy:** The cost of the designed illumination scheme be low. ➢ **Less Maintenance:** For only type of illumination scheme the maintenance and repairing should be less. ➢ **Appearance:** The appearance of illumination scheme should be good. ➢ **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. ➢ **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.

	➢ **To avoid hard shadows:** The whole illumination scheme is designed for minimum shadows. At the time of flood light the hard shadows are avoided. ➢ **Sufficient lux level:** The lux level is decided by the type of applications, type of location & their countries standard ➢ **Cleanliness:** The illumination scheme should be free from any type of ash, smoke or any other air pollution it should be clean. ➢ **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)	**State any two advantages and two disadvantages of CFL lamps.**
Ans:	**Advantages of CFL lamps :-** **(Any Two expected : 1 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) Maintenance cost is less 7) Can be available in various colours. **Disadvantages of CFL lamps;** **(Any Two expected : 1 Mark each)** 1) The initial cost of CFL is high. 2) Starting time is about 3 to 5 min. 3) The CFL produces electronic interference to the electronic equipments.
c)	**Draw and explain the circuit for single lamp controlled by two switches.**
Ans:	**One Lamp controlled by Two switch :-** **(Figure: 2 Marks & Explanation:2 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'.
d)	**State the meaning of polar curve and give two applications of it.**
Ans:	**Meaning of Polar Curves:-** **(Meaning : 2 Marks & Application : 2 Marks)** Polar curves are graphical representation of light intensity with respect to angular position in horizontal or vertical plane passing through the light source. **Applications of polar curve:** 1. It indicates coverage of lights which helps lighting scheme. 2. To know the intensity of light emitted by the source in different direction.
Q.1B)	**Attempt any ONE of the following : 06 Marks**
i)	**With the help of labelled diagram, explain construction and working of sodium vapour lamp.**
Ans:	**Diagram of sodium vapour lamp:** **(Construction-2 Marks, Working-2 Marks & Figure-2 Mark)**  **or equivalent figure** **Construction:-** Above figure shows constructional details of sodium vapour lamp. It consists of

	'U' shaped tube and at the ends of the tube two electrodes are sealed. This tube is filled with sodium and small quantity of neon gas. Since there is great effect of the change of surrounding temperature on the light output given by the lamp, hence the inner tube is enclosed in an outer double walled glass tube. Before sealing the lamp vaccum is created between the two glass tube (inner & outer). **Working:-** Before the lamp starts working, the sodium is usually in the solid form deposited on the sides of the inner tube wall. When the voltage is applied to the lamp it warms up and starts vaporizing slowly and radiates out yellow colour light and after about 20 minutes, the lamp starts giving it's full output.
ii)	**Define the following terms related to laws of illumination : (1) M.H.C.P. (2) M.S.C.P. (3) M.H.S.C.P.**
Ans:	**(Each Definition : 2 Mark each)** **1) M.H.C.P (Mean horizontal candle power):-** It is defined as average of candle powers in all direction in the horizontal plane containing the source of light. 2) **MSCP (Mean Spherical Candle power):** It is the average of all candle powers in all direction in all planes. **OR** $MSCP = \frac{Total\ Lu\min ous\ lux\ in\ lumens}{4\ \Pi}$ **(3) M.H.S.C.P.:** It is defined as the mean of the candle power of source in all directions above and below the horizontal planea.
Q.2	**Attempt any TWO : 16 Marks**
a)	**State the purpose of lighting control. List different types of dimmer. Explain any two dimmers in detail with suitable diagrams.**
Ans:	**Purpose of Dimmer:-** **(2 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

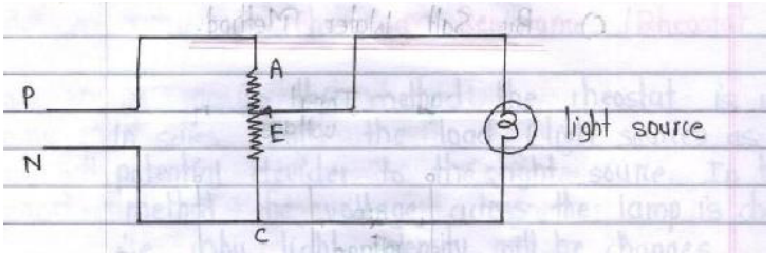
1. To turn ON or OFF the lamps
2. For dimming, the dimming control permits the adjustment of lighting over a range.
3. For changing the lighting levels according to need or desired of the owner.
4. For energy saving.
5. To increase the life of lighting source.
6. To increase the safety of lighting system.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

Types Of Dimmer : **(Any Four Types expected : 1/2Mark each)**

1) Dimmer by using changing résistance (Rheostatic)
2) By using auto transformer
3) By salt water method
4) By two winding transformer tap changing method
5) Thyristor or SCR operated dimmer
6) Triac operated Dimmer
7) PWM (Pulse width modulation) Controlled technique

1) Dimmer by using changing resistance –

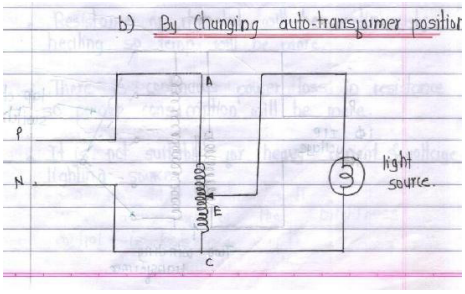
(Any Two Types Expected: Explaination-1 Mark & Figure - 1 Mark)



or equivalent figure

In this method as resistance changes output voltage across the light sources changes of that light intensity will be changes.

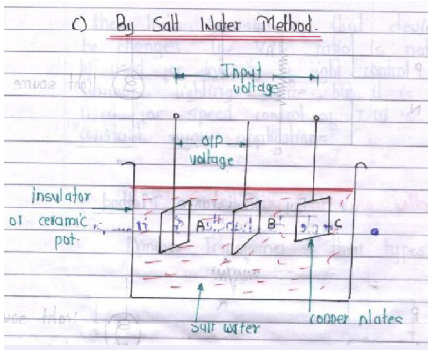
2) By using auto transformer –



or equivalent figure

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

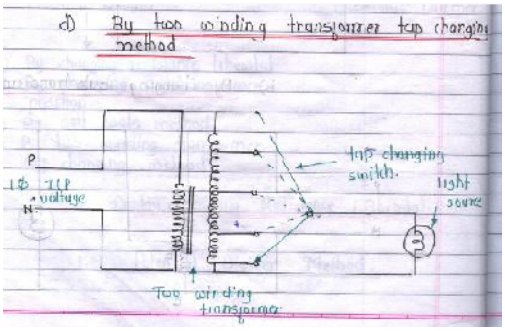
3) By salt Water method –



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.

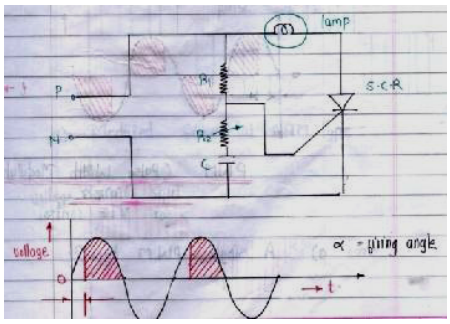
4) By two winding transformer tap changing method –



or equivalent figure

- Output voltage across the source depends upon tap position of the two winding. Transformer so that light intensity of light sources will be changes.

5) Thyristor or SCR operated dimmer:–

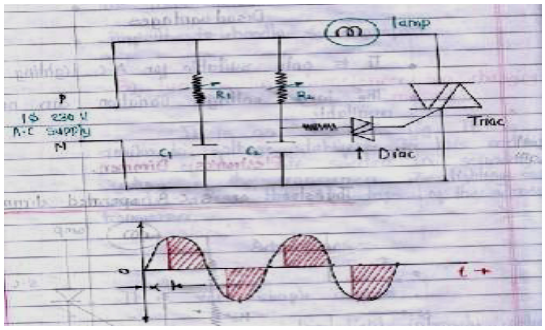


or equivalent figure

The SCR is generally used as switching component in electrical system. In the SCR when the anode terminal is +ve cathode is –ve and if the trigger pulse is applied to the gate of the SCR, then at that moment SCR will start conducting.

In the present circuit the capacitor is charged through variable resistance R2 so that Charging time constant (R2C) will be decided and after that whenever capacitor is fully charged it will discharge through the gate terminal, and SCR will be fired [ON]. The firing period is decided by the value of R2C i.e. why conduction & firing angle will be changed. This firing angle may be vary 0 to 180º i.e. why the fired output voltage can be (variable) available across the lamp. So that light intensity will be changes, By the SCR only +ve half cycle are controlled.

6) Triac operated Dimmer:–



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

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

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

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

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

7) PWM(Pulse width modulation) Controlled technique:

It is part of electronic dimmer. The output voltage across the lamp is controlled by using various PWM signals. This PWM signal can be achieved by PWM chips, microprocessors or microcontrollers. In PWM technics, there are three types a) Single pulse PWM b) Multiple pulse PWM c) Modified sinusoidal PWM

In this three technics, the output voltage across the lamp is controlled to control the light intensity.

b) An indoor badminton court is accommodated in a hall of 20 m length; 10 m width; and 15 m height. The walls and ceiling of hall are painted black and do not reflect any light. Design a scheme for providing an average illumination of 80 lux at ground surface, using 200 W tungsten filament lamps with suitable fitting. Give reason for your choice. Take coefficient of utilization = 0.5, efficiency of lamps = 15 lumens/watt.

Ans:

Given Data:

E = 80 Lux — Area of working plane = 20 m x 10 m = 200 m^2

U.F = 0.5 & — Wattage of each lamp = 200 watt

Efficiency of lamp = 15 lumens/watt

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

= 80 x 200 = 16000 Lumens----------**(1 Marks)**

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

$= \frac{16000}{0.5}$

$= 32000\ Lumens$ ---------- **(1 Marks)**

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

$= \frac{32000}{15}$

$= 2133.333\ \ Watts$ ---------- **(2 Marks)**

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

$= \frac{2133.333}{200}$

$= 10.66 \cong 11\ \ Nos$ ---------- **(2 Marks)**

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

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)**

$N = \frac{80 \times 200}{200 \times\ 15 \times 0.5}$

$N = 10.66 \cong 11\ Nos\ lamps\ of\ 100 watt.$ ---------- **(2 Mark)**

OR

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

$$= \frac{200 \times 80 \times 1}{0.5 \times 1}$$

$$= 32000 \; Lumens$$ ----------**(1 Marks)**

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

$$= \frac{32000}{15}$$

$$= 2133.333 \quad Watts$$ ----------**(1 Marks)**

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

$$= \frac{2133.333}{200}$$

$$= 10.66 \cong 11 \; Nos\ of\ lamp$$ ----------**-(2 Marks)**

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

Ans: **Given Data:**

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

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

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

Distance of Projector from building = 25 mtr

$$Number\ of\ \ projectors = \frac{illu\,\text{min}\,ation\ level \times Area \times waste\ light\ \ factor \times D.F}{Wattage\ each\ lamp \times\ \ lamp\ efficiency \times U.F}$$ **(1 Marks)**

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

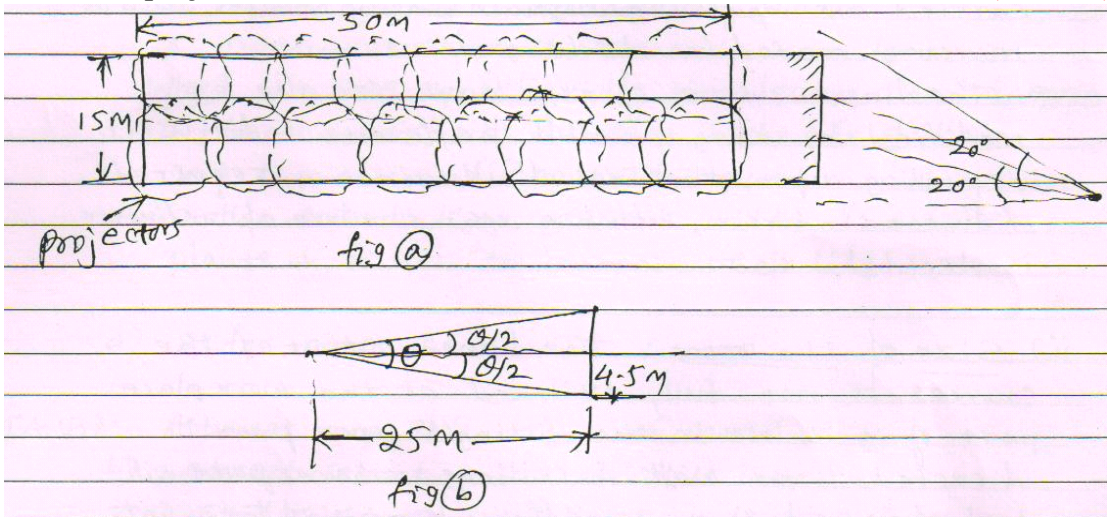
$$Number\ of\ \ projectors = 15.88 \approx 16$$

(3 Marks)

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

angle of spread (Q) as follows

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



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

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

Q.3	**Attempt any FOUR :** **16 Marks**
a)	**a) State the specific requirements for : (i) Factory lighting (ii) Sports lighting**
Ans:	**(i) Factory lighting**

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

(Any four point expected– 1/2 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.

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

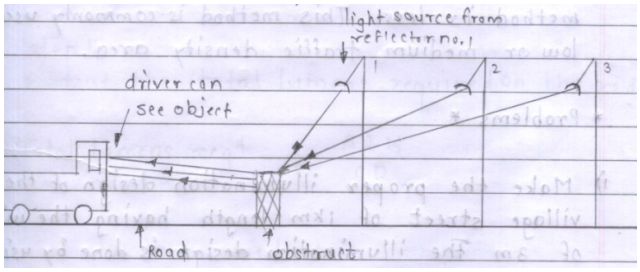
10) Life of the projector & bunched filament lamp should be high.

b) State and explain the design of street light installation principles.

Ans: **Types of the design of street light installation principles:** **(1 Marks)**

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

1) Explain specular-reflection principle of street lighting with figure. **(1.5 Marks)**



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: **(1.5 Marks)**

- In this type, the light is directed downwards from the lamps with the intension of producing a uniform illumination on the road surface.
- This is possible by use of suitably design reflectors.
- The filament of the lamp is invisible expect from almost beneath it.
- 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) **A 250 V lamp has a total flux of 1500 lumens and takes a current of 0.4 A. Calculate (i) Lumen per watt (ii) M.S.C.P. per watt**

Ans:

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

$$Total\ MSCP\ of\ the\ lamp = \frac{1500}{4\pi}$$

$$Total\ MSCP\ of\ the\ lamp = 119.3662$$

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

$$Power\ of\ the\ lamp\ = V \times I = 250 \times 0.4 = 100\ watt$$

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

$$i)\ Lumens\ per\ Watt\ = \frac{1500}{100} = 15$$

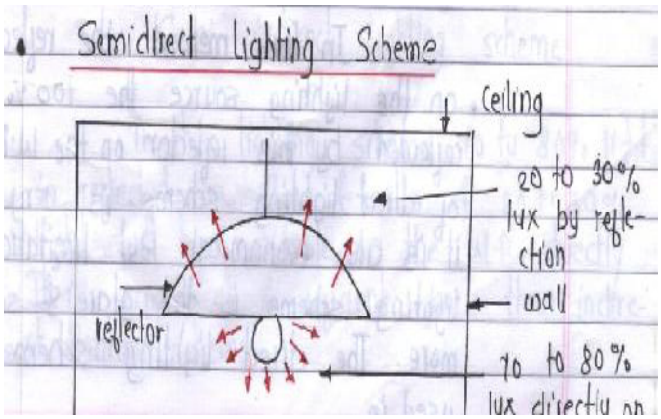
---------- **(1 Mark)**

$$ii)\ MSCP\ per\ Watt\ = \frac{119.366}{100} = 1.19366$$

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

d) **Describe semi-direct and semi-indirect scheme for illumination.**

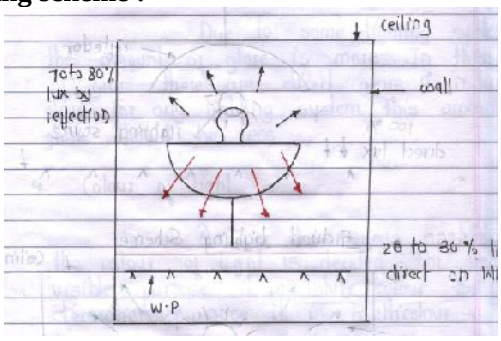
Ans: **i) Semi direct lighting scheme** :- **(2 Mark)**



or equivalent figure

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.

ii) Semi indirect lighting scheme :- **(2 Mark)**

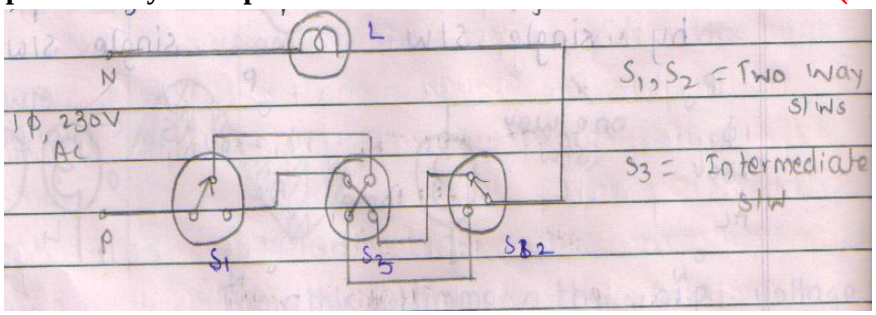


or equivalent figure

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.

e) Explain single lamp control by three point method and four point method.

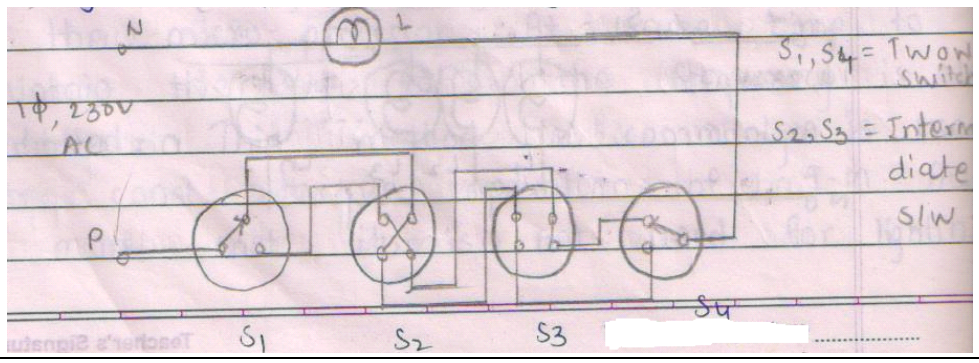
Ans: **Single lamp control by three point method:** **(1 Mark)**



Explanation: **(1 Mark)**

- 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.
-

Single lamp control by Four point method: **(1 Mark)**



Explanation: **(1 Mark)**

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

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

a) State general illumination level in lux as per Indian standards for following places at a sports complex.
(1) Badminton court (2) Carrom Hall (3) Table Tennis Hall (4) Basket Ball Court

Ans: **(Each Point : 1 Mark)**

S.No	Places of sports complex	illumination level in lux
1	Badminton court	750 Lux
2	Carrom Hall	500 Lux
3	Table Tennis Hall	500 Lux
4	Basket Ball Court	500 Lux

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

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

(Any four point expected 1- Mark each)

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

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

6. Decide the type and wattage of lamp which is to be used for that particular application
7. Assume the proper illumination efficiency of those specific lamps which are to be

used on that working plane

8. Find out total no. of lamps and tubes for that particular working plane and after that find out total no. of lamps & tubes or any other lamps for interior application of commercial installation. By assuming proper space to height ratio make the proper illumination scheme. This procedure is repeated for every working plane in every room.
9. Find out total no. of lamps or tubes for that particular working plane

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

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

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

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

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

c) State which type of lamps are used for decorative lighting and why.

Ans: **Type of lamps are used for decorative lighting: (Any Two lamps expected: 1Mark 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 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:**

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.

d) A small assembly shop 16 m long; 10 m wide and 3 m up to trusses is to be illuminated to a level of 200 lux. The utilization and maintenance factors are 0.74 and 0.8 respectively. Calculate number of lamps required to illuminate whole area if the lumen output of the lamp selected is 3000 lumens.

Ans: **Given Data:** --

Area of working Plane = 16 x 10 m = 160 m^2 E or I = 200 lumens/square meter

Utilisation Factor = 0.74 M.F = 0.8 Lumens output of each lamp = 3000 lumens

$$N = \frac{illumination\ level \times Area}{lumens\ output\ of\ each\ lamp \times U.F \times M.F}$$ ---------- **(2 Mark)**

$$N = \frac{200 \times 160}{3000 \times 0.74 \times 0.8}$$

$$N = 18.018 \cong 18\ Nos\ lamps\ of\ 100watt.$$ ---------- **(2 Mark)**

Q. 4 B) Attempt any ONE : 06 Marks

a) Distinguish between incandescent lamp and flourescent lamp on the basis of following :(1) Lumen output (2) Luminous efficiency (3) Initial cost (4) Brightness(5) Voltage Regulation (6) Energy saving

Ans:

(Each Point : 1 Mark)

S.No	Points	Incandescent lamp	Fluorescent lamp
1	**Lumen output**	Less	More
2	**Luminous efficiency**	Less	More
3	**Initial cost**	Less	More
4	**Brightness**	More	Less
5	**Voltage Regulation**	Yes	No
6	**Energy saving**	No	Yes

b)	**Which type of lamps should be selected for following applications?** **(1) Aquariums (2) Stage lighting (3) Flood lighting (4) Advertisement (5) Factory lighting (6) Street lighting**
Ans:	**(1) Aquariums : (Lamp name any one expected)** **(Each point : 1 Mark)** 1) Small size and low power halogen lamps. 2) Ultraviolet lamps and tubes. 3) Compact fluorescent lamps **(2) Stage lighting :** 1) High intensity discharge lamp. 2) Multi-colour LED Lamp. **(3) Flood lighting :** 1) High intensity discharge lamp. Like 2) High pressure mecurrey vapour lamp. 3) High pressure Sodium vapour lamp. 4) Metal Halide Lamp **(4) Advertisement :** 1) Metal Halide Lamp 2) Neon sign tubes **(5) Factory lighting :** 1) High pressure mecurrey vapour lamp. 2) High pressure Sodium vapour lamp. **(6) Street lighting :** 1) High pressure mecurrey vapour lamp. 2) High pressure Sodium vapour lamp. 3) Fluorescent tube 4) LED Lamp
Q.5	**Attempt any TWO** **16 Marks**
a)	**State illumination level in lux as per I.S. for residential purposes in following places :** **(i) Living Room (ii) Bedroom (iii) Kitchen (iv) Stairs (v) Dining Room (vi) Dressing table (vii) Bathroom mirror (viii) Study table**
Ans:	**(Each Point : 1 Mark)**

S.No	Places of residential Purpose	illumination level in lux
i	Living Room	300 Lux
ii	Bedroom	200 Lux
iii	Kitchen	200 Lux
iv	Stairs	100 Lux
v	Dining Room	150 Lux
vi	Dressing table	200 Lux
vii	Bathroom mirror	700 Lux
viii	Study table	300 Lux

b)	**State and explain the general factors to be considered while designing the lighting scheme for outdoor application.**
Ans:	**Factors to be considered while designing the illumination for outdoor application:-** **(Any Eight 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 larger. 4. **Economy: -** The cost of the designed illumination scheme should be low. 5. **Less maintenance: -** For any type of illumination scheme the maintenance & repairing should be less. 6. **Appearance: -** The appearance of illumination scheme should be good. 7. **Less glare: -** The glare is fatigue to the human eyes. The illumination scheme is designed is such a way that there should be less glare to everyone i.e. Only electrical & mechanical accidents will be less. 8. **Less 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 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 and explain general requirement for illumination of Health care centres and hospitals.**
Ans:	**General requirement for illumination of Health care centres and hospitals:**

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 and Health Care Centre :-

(Any Four Point expected: 1 Mark each Total:4 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.
- $Calculate\ \ Total\ \ Lumens = \dfrac{A \times I \times W}{C. \times M.F}$
- 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.

OR

General requirement for illumination of Health care centers and hospitals:

(Any eight Point expected: 1 Mark each Total:8 Mark)

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.
Q.6	**Attempt any FOUR : 16 Marks**
a)	**Define the following terms related to flood lighting :(i) Coefficient of utilisation (ii) Depreciation factor (iii) Space to height ratio (iv) Reflection factor**
Ans:	**(i) Coefficient of utilization:** **(Each Definition : 1 Mark)** It is defined as the ratio of total number of lumens reaching the working plane to total number of lumens emitting from the source. **ii) Depreciation factor:** It is the ratio of illumination when everything is clean to the illumination under normal operating condition. **iii) Space-Height ratio:**

$$Space\ \ height\ ratio = \frac{Space\ \ between\ \ lamps}{Height\ \ of\ \ lamps\ \ above\ \ working\ \ plane}$$

iv) Reflection factor:

It is the ratio of luminous flux leaving the surface to the luminous flux incident on it.

b) State the fundamental lighting criteria which is to be considered while designing railway platform lighting installations from following two points of view —
(i) Types of lamp (ii) Types of luminaire

Ans: **Following fundamental lighting criteria which is to be considered while designing railway platform lighting installations:** **(Any Four point expected : 1 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.

c) Explain the effect of variation of supply voltage on the performance of CFL as regards current, lumen output, efficiency and life.

Ans: **The effect of variation of supply voltage on the performance of CFL :**

(Each point : 1 Mark)

S.No	As regards	Variation of supply voltage	
		Decreases (Low)	**Increases (High)**
1	Current	Increases	decreases
2	Lumen output	Reduces	increases
3	Efficiency	Reduces	Reduces
4	Life	More	Less

d)	**State the lighting schemes to be preferred for agricultural and horticultural applications and why.**
Ans:	**(4 Marks)** ➢ Direct Lighting Scheme is preferred for agricultural and horticultural applications. ➢ Because for the growth of plants, flowers etc the rays of light from the source (Lamps) should reach them directly. ➢ The warm and light effect is provided as a natural sun light whenever it required. ➢ The wind pressure is also provided by maintaining the exhaust fan/ regular fan. ➢ Room temperature and humidity is also controlled.
e)	**State the criteria for preferring tungsten filament lamp on operation table in hospital.**
Ans:	**Following the criteria for preferring tungsten filament lamp on operation table in hospital:** **(4 Marks)** ➢ On the operation table in a hospital bunched filament tungsten lamp is preferred because it has CRI = 100 i.e. colour Rendering Index is 100, so the doctor can see every part clearly at the time of operation of a patients. ➢ Due to bunched filament effect chances of failure are very less. ➢ Light intensity of the bunched filament lamp is high. ➢ The focus is also maintained by using proper shape of reflector.

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