TECHNICAL UNIVERSITY OF MOMBASA

Engineering

Electrical Department

UNIVERSITY EXAMINATION FOR:

Bachelor's Degree in Electrical Engineering

TEE4416 ILLUMINATION ENGINEERING (PP2) NOV 2024

END OF SEMESTER EXAMINATION

SERIES: NOVEMBER 2024

TIME: 2 HOURS

DATE: NOVEMBER 2024

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory 20 marks)

(a)(i) Describe the function of the following parts as used in the seeing process (i) a source (ii) the modifier (iii) the eye

(ii) Describe the nature of light

(iii) Given two lamps A and B of 1500lm and 2000lm respectively are placed $90\,m$ apart. The height of A above the ground level is $15\,m$ and that of B is$25\,m$. If a photometer is placed at the center of the line joining the two posts, calculate its reading. **(10mks)**

(b) (i) Define the following terms as used in illumination engineering (i)illumination (ii) Luminous intensity (iii) Luminous flux

(ii) Describe the inverse square law as used in illumination

(iii) An office has an effective area of 100Msq, is lit by 60W incandescent lamps giving 22lm/W. An illumination of 110lux is required on the working desk. Assuming 75% of the total light emitted by the lamp is available for illuminating the working desk, estimate the number of lamps required. **(10mks)**

Question TWO

(a)(i) State the difference between light and heat waves

(ii)Describe the process of production of artificial light

(iii)A globe of 35cm diameter of dense opal glass encloses a lamp emitting 2500lumens with brightness of $6 \times 10^4 lm/m^2$ when viewed in any direction. Calculate the luminous intensity of the globe in any direction and the percentage of the light emitted by the lamp is absorbed by the globe**.** **(10mks)**

(b)(i) State type of lamps its TWO characteristics suitable for the following application

(i)Emergency lights, signal lights

(ii)Highways, open spaces

(iii)Halls, industrial or commercial premises.

(ii)With aid of a sketch describe the construction and operation of high pressure mercury vapor lamp

(iii)A hospital ward $60m \times 35m \times 6mhigh$ is to be illuminated with fluorescent lamps of average illumination $100 lm/m^2$on working plane 1 meter above the floor. A lamp rated 200W has luminous efficiency of 18lm/w, 300W has efficiency of 20lm/w and 500W has efficiency of 25lm/w. The depreciation factor is 0.9 and utilization factor is 0.7 Estimate suitable number, size and mounting height of lamps to be used. Sketch a suitable spacing layout **(10mks)**

Question THREE

(a)(i) Describe the cause of Glare and state TWO steps the designer can take to limit glare

(ii) With aid of a sketch describe the light flow structure

(iii)Derive an expression for the luminance of an extended source **(10mks)**

(b)(i) State the importance of the following factors when the Lumen method of illumination design is used (i) Mounting height and spacing of fittings (ii) The best type of fittings (iii) Glare index of discomfort

(ii) Describe Efficacy versus colour rendering of tri-phosphor fluorescent lamps

(iii)A production factory has the following specification, $60m \times 40m \times 9mHigh$.Point sources should be suspended $0.5m$ below the ceiling level and the working plane is $2m$ high. Calculate the minimum number of luminares which must be installed to conform to the recommend SHR of 1.5:1 **(10mks)**

Question FOUR

(a)(i) State the first FOUR steps of Lumen method of illumination design

(ii) Describe the following general lighting objectives (i) Safety and health aspects (ii) Performance characteristics (iii) Appearance and comfortability

(iii)The average luminous output of 100W lamp, 2m in length and 4cm in diameter is 4500 lumens. If the auxiliary gear associated with the lamps consume a load equivalent to 15 percent of the lamp, calculate the cost of running a twin unit for 3500 hours at a cost of ksh14 per hour. **(10mks)**

(b)(i) Define a light fitting and state TWO of its functions

(ii) Describe TWO general fitting classification

(iii)A stadium $200\,m \times 80\,m$ is to be illuminated for night events by similar light banks supported on 18towers distributed around the ground to provide uniform illumination. Assuming 35% of the total emitted light reaches the ground and that an illumination of $1600\,lm/m^2$ is needed calculate the number of lamps on each tower. Take the overall efficiency of the lamps as 40lm/w. **(10mks)**

Question FIVE

(a)(i) Describe the following materials used in the manufacture of lamps (i) Glasses (ii) Ceramics (iii) Metals

(ii) Describe THREE types of Getters used in lamp manufacture.

(iii)It's decided instead of using 15, 200W mercury vapors lamps, 15, 100W fluorescent tubes are used with average luminous efficiency of 60lm/w and a loss of 15% due the choke. The vapor lamps have an efficiency of 25lm/w. Coefficient of utilization is the same in both cases. Determine total savings in electrical load and percentage increase in illumination **(10mks)**

(b)(i) Describe the need of Gases and vapors during lamp manufacture

(ii) State TWO advantages of metal-glass sealing and describe problem likely to be experienced during the sealing process

(iii)A 60W candle power 250V metal filament lamp has a measured canle power of 71.5 candela at 260V and 50 candela at 240V. (a) Find the constant for the lamp expression $C = aV^b$ where C=candle power and V=voltage. (b) Calculate the change in candle power per volt at 250V. Determine the percentage variation of candle power due to a variation of 4% from the normal value.