TECHNICAL UNIVERSITY OF MOMBASA

Engineering

Electrical Department

UNIVERSITY EXAMINATION FOR:

Bachelor's Degree in Electrical Engineering

TEE 4416 ILLUMINATION ENGINEERING PP1 AUG 2024

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME: 2 HOURS

DATE: AUGUST 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) Define the following terms as used in illumination engineering (i) Accommodation (ii) Adaption (iii) Luminous intensity. **(3mks)**

(ii) With aid of a sketch describe the lamberts Cosine law as used in illumination **(3mks)**

(iii) A 15 cm diameter globe of dense opal glass encloses a lamp emitting 1800 lumens and has uniform intensity of $5 \times 10^3 lm/m^2$ when viewed in any direction (i) Calculate the luminous intensity of the globe in any direction (ii) What percentage of the flux emitted by the lamp is absorbed by the globe? **(4mks)**

(b) (i) Describe the following types of lighting schemes and state ONE application of each (i)Direct (ii) General diffusing **(4mks)**

(ii) State any TWO standards a lighting scheme should meet for it to be termed as well designed **(2mks)**

(iii) A drawing hall in an engineering institute is to be provided with a lighting installation. The mounting height is 5m and the hall measures $30\,m \times 20\,m \times 8\,m$.The mounting height is $5\,m$ and the required illumination level is$144\,lm/m^2$. Using metal filament lamps, estimate the number of single filament lamps required and draw the spacing layout given maintenance factor =0.75, utilization factor=0.6, Space/height ratio =1. Given the following choice of lamps. 300W lamps with luminous efficiency of $13\,lm/W$,500W lamps with luminous efficiency of $16\,lm/W$. **(4mks)**

Question TWO

(a)(i) State the function of the following as used in seeing process (i) the modifier (ii) The sclera and choroid (iii) The retina **(3mks)**

(ii) With aid of a sketch describe the light range in the electromagnetic spectrum **(3mks)**

(iii) A football pitch $140\,m \times 55\,m$ is to be illuminated for night play by similar banks of equal 1200w lamps supported on 10 towers which are distributed around the ground to provide approximately uniform illumination of the pitch. Assuming 45% of the total light emitted reaches the playing ground and that illumination needed is$1100\,lm/m^2$, calculate the number of lamps on each tower. The overall efficiency of the lamps is taken as $55\,lm/W$ **(4mks)**

(b) (i) Describe the following factors to be considered during illumination design (i)Adequacy (ii)Suitability (iii) Diffusion **(3mks)**

(ii) Describe disability glare and state any TWO steps which can be used to compensate it **(3mks)**

(iii) A drawing office containing a number of boards and having total effective area of $90\,m^2$ is lit by a number of 35W incandescent lamps giving$15\,lm/W$. An illumination of 120lux is required on the drawing board. Assuming 75% of the total light emitted reaches the boards, calculate the number of lamps. **(4mks)**

Question THREE

(a)(i) State the first FOUR steps of the lumen method of illumination design **(2mks)**

(ii) Describe the application of the following in lumen method of installation design (i) Space/Height ratio (ii) Reflection factor **(4mks)**

(iii) A factory area is stated as $40\,m \times 20\,m \times 8\,m$,the point sources are suspended 1.5m below the ceiling level. The working plane is 1m high. Calculate the minimum number of luminaires which must be installed to conform to the recommended height/space ratio**,** draw the layout structure **(4mks)**

(b) (i) With aid of a sketch describe the operation low pressure sodium vapour lamp **(3mks)**

(ii) With aid of a sketch describe the construction of High pressure mercury vapour lamp **(3mks)**

(iii) A lamp of 1500lumens is suspended 1m below a plane mirror which reflects 75% of light falling on it. The lamp is hung 5m above the ground. Calculate the illumination 4m away from the lamp**.(4mks)**

Question FOUR

(a)(i) Describe TWO methods used to minimize stroboscopic effect in fluorescent lamps **(3mks)**

(ii) With aid of a sketch describe the construction of startles fluorescent lamp **(3mks)**

(iii) With aid a sketch derive an expression for illumination of an extended source of light **(4mks)**

(b)(i) State THREE factors which determine the utilization factor of an installation **(3mks)**

(ii) State THREE factors an engineer should consider to get uniform illumination on the working plane **(3mks)**

(iii) An office measuring $18\,m \times 10\,m \times 3\,m$ is to be illuminated to an average value of 480lux. $800\,mm \times 800\,mm$Recessed luminaires each containing 5lamps are used. Each lamp has an output of 1500lumens. Given utilization factor as 0.5 and maintenance 0.75, $SHR = 1.5:1$ (i) calculate the number of luminaries required (ii) Sketch the layout of the schedule. Indicating the spacing between the lamps **(4mks)**

Question FIVE

(a)(i) Describe the following materials used in the manufacture of lamps (i) Glasses (ii) Ceramics (iii) Metals **(4mks)**

(ii) Describe THREE types of Getters used in lamp manufacture**.(2mks)**

(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 **(4mks)**

(b)(i) Describe the need of Gases and vapors during lamp manufacture **(2mks)**

(ii) State TWO advantages of metal-glass sealing and describe problem likely to be experienced during the sealing process**(4mks)**

(iii)A 60W candle power 250V metal filament lamp has a measured candle 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**.(4mks)**