Ref No. : EX /EE/PC/B/T/323/2022

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2022
(3rd Year, 2nd Semester)
ELECTRICAL UTILIZATION AND ILLUMINATION ENGINEERING

Time: Three Hours Full Marks: 100

Use a separate Answer-Script for each part
PART – I (50 marks)

Answer question no. 1 and any two from the rest.

Two (02) marks reserved for neat and well organized answers and answer scripts.

1 Correct and/or justify the following statements (any four) **4×4**

(a) If the current and voltage contain the same harmonics, the power factor may not reduce.

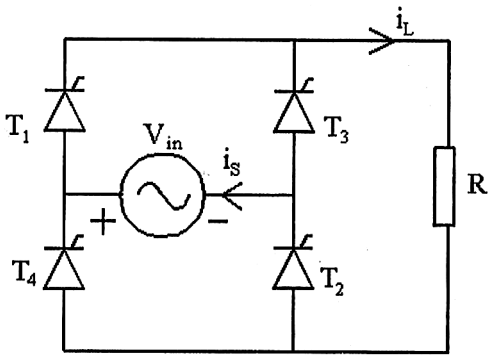
(b) Aluminum alloys are not suitable for Ajax-Wyatt furnace.

(c) For dielectric heating both the voltage and frequency have their limiting values.

(d) Reactors are used only for stabilizing the arc.

(e) Lead acid batteries should have temperature compensation technique.

2 (a) An electric heater (R) is supplied by a bridge rectifier as shown in the figure. Draw the waveform of the load current (I_L) and the source current (I_S) if T_1, T_2 are triggered at 0° and T_3, T_4 are triggered at 180° of the input sine wave. Also determine the average power, power factor, displacement factor and %THD of the source current. **6**



$V_{in} = 220 \sin(314.t)$ $R = 50\Omega$

(b) How does the tuned LC filter improve the power factor? **5**

(c) How a tuned LC filter installed by a consumer could be saved from being overloaded by neighbor's non-linear load consumption? **3**

(d) Relate CDF and THD. **2**

[Turn over

3 **(a)** A 12V, 1800 Ah battery bank takes a charging current of 10A from a 220V single phase source. The input current harmonic components (h being its order) are given in the following table as a percentage of fundamental current components. The Displacement Factor is 0.95. **10**

Calculate the %THD of the line current and the power factor of the load.

h	3	5	7	9	11	13	15	17	19
$(i_h/i_1)\%$	30	6.3	1.6	1.5	1.8	1.1	0.8	0.7	0.7

(b) What form of heating is the most efficient one? – write your view with justification. **6**

4 **(a)** Highlight the different charging modes used for Li-ion battery charging. **4**

(b) Write the merits and demerits of Lead-Acid batteries **6**

(c) How do you choose the correct battery for a particular application? **6**

5 **(a)** What are the factors on which the selection of the frequency for induction heating depends? **4**

(b) What are the advantages of induction heating? **4**

(c) Write short note on: **8**

Direct arc furnace and its electrode regulation system

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B.E. ELECTRICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2022

ELECTRICAL UTILIZATION & ILLUMINATION ENGINEERING

Time: Three Hours Full Marks : 100

Part-II (50 Marks)

Question number 1 is compulsory and answer any two questions from the rest (20 + 15X2)=50

Answer any 5 from Question number 1

Justify the following with necessary corrections, if any (4X5 =20)

1. a) A 200W incandescent lamp has higher efficacy than a 40W incandescent lamp.
   b) S/P ratio of a light source is an indicator to show effectiveness of the source.
   c) There is no difference between detector, sensor and meter for any photometric measuring instrument.
   d) Luminous flux of a source can't be estimated from the SPD of the source.
   e) Coefficient of Utilization (COU) and Light Output Ratio (LOR) of a luminaire are same for an Indoor lighting luminaire.
   f) The meaning of Network, Physical Layer, Program and Protocol are same in lighting control system.
   g) Diffusers are always required for lux meter.
   h) Visual Photometry and Physical Photometry are same.

2. a) How luminous flux can be measured by using Integrating Sphere? 8
   c) What is the role of auxiliary lamp in Integrating Sphere. 2
   b) Prove that in case of flat perfect diffuser Luminous Flux $\Phi = \Pi I_n$ where I_n = Intensity at normal position? 5

3. a) Mention the name of the Indian Standard so far consulted for Indoor Lighting Design. 2
   b) Design a Lighting Scheme with two different options with different types of lighting system (mentioned) for the KCR Hall of Electrical Engineering Department, Jadavpur University with the dimensions 28 m X 12 m X 5 m . The target illuminance level is 500 Lux . The overall Light loss Factor of the room to be considered as 0.8. Compare the energy consumptions and lighting power densities for each design option. 10

   Option-I

   Lighting System type –Luminaire with 2 X 40 W Fluorescent lamp & Electro Magnetic Ballast
   Luminous flux per Lamp = 2450 Lumen
   Coefficient of Utilization Value = 0.6
   Cost per Luminaire (including Ballast) = Rs 1000/-
   Cost per Lamp = Rs. 50/-
   Power consumption per luminaire (including Ballast) = 120 W

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ELECTRICAL UTILIZATION & ILLUMINATION ENGINEERING

Time: Three Hours Full Marks : 100

Part-II (50 Marks)

Question number 1 is compulsory and answer any two questions from the rest (20 + 15X2)=50

Option-2
Lighting System type –Luminaire with 2 X 36 W Fluorescent lamp & Electronic Ballast
Luminous flux per Lamp = 3250 Lumen
Coefficient of Utilization Value = 0.7
Power consumption per luminaire (including Ballast) = 80 W
Consider working schedule for the room is 10 hours per day & 300 days per year

Option-3
Lighting System type –Luminaire with 2 X 22 W LED tubes
Luminous flux per Lamp = 3000 Lumen
Coefficient of Utilization Value = 0.8
Power consumption per luminaire (including Driver loss) = 50 W
Consider working schedule for the room is 10 hours per day & 300 days per year

c) What do you mean by Human Centric Lighting? 3

4. a) The intensity distribution of a mirror optic luminaire is given below. Find out the total luminous flux (in Lumen) by using Zonal Lumen Method. 9

Midzone Angle(Degree)	Intensity(candela)
5	1400
15	1376
25	1275
35	1050
45	845
55	705
65	500
75	325
85	136
95	72
105	36
115	10
125	08
135	55
145	36
155	72
165	108
175	125

b) Write a note on Coordinate systems used in Photometry. 6

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Time: Three Hours Full Marks : 100

Part-II (50 Marks)

Question number 1 is compulsory and answer any two questions from the rest (20 + 15X2)=50

i. a) Write a note on average Intensity for the five plane photometry system and its relevance for LED photometry. 5

b) Develop the expressions of direct luminous flux transfer between a point source and point receiver.5

c) A lamp has five lines in the visible spectrum at 420.1, 452.4, 510.78, 553, 590.1 nm with radiant power densities of 1.0, 0.9,08,.02,.01 mW/cm^2 , respectively. Assuming 40 % of the input power density to the lamp is in these visible lines, compute the lumens per square centimeter emitted by the lamp and the lamp's luminous efficacy in lumens per watt. 5

Spectral luminous efficiency values few wavelengths for photopic vision are mentioned as

Wavelength (nm)	Spectral luminous efficiency values
410	0.0012
420	0.0040
430	0.0116
440	0.023
450	0.038
460	0.060
470	0.091
480	0.139
490	0.208
500	0.323
510	0.503
520	0.710
530	0.862
540	0.954
550	0.995
555	1.000
560	0.995
570	0.952
580	0.870
590	0.757
600	0.631
610	0.503