

**BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FOURTH YEAR
FIRST SEMESTER SUPPLEMENTARY EXAM 2024**

ELECTRICAL UTILISATION & ILLUMINATION ENGINEERING

Time: Three Hours

Full Marks: 100 (50 for this part)

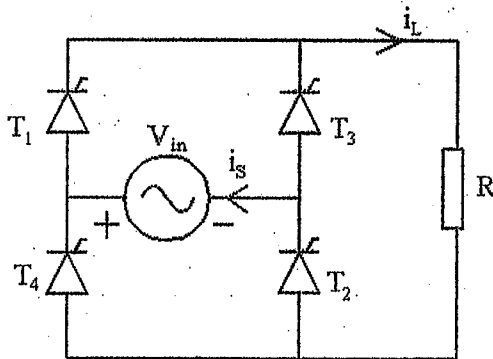
Use a separate Answer-Script for each part

PART – I (50 marks)

Answer question no. 1 and any two from the rest

1. Correct and/or justify the following statements. 4x5
- (a) Power factor may not reduce if voltage and current both have harmonics.
 - (b) Indirect Arc Furnace power supply should be star connected.
 - (c) Arc furnace requires an inductor to reduce harmonics.
 - (d) Tuned LC filter can provide reactive power.
 - (e) Gassing reduces the life of a Lead Acid battery.

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. Here, $V_{in} = 311 * \sin(314*t)$ and $R = 20\Omega$. 7

- (b) With proper schematics and waveforms discuss how a nonlinear load can be modified for unity power factor operation. 8
3. (a) Explain the terms applicable to lead-acid batteries: (i) C-rate, (ii) DoD, (iii) Shedding 6
- (b) What are the charging modes/methods applicable to Lead Acid batteries? 6
 - (c) What is float charging? 3

4. (a) Explain the principle of induction heating. 5
- (b) Discuss the open loop control methods applicable to indirect resistance heating. 7
- (c) What are the advantages of dielectric heating? 3
5. Write short notes on :
 - (a) Active Power Conditioner 7
 - (b) Different types of UPS architecture. 8

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Ref. No. Ex/EE/5/T/412/2024(S)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)

FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY

EXAMINATION, 2024

(1st/2nd Semester/Repeat/Supplementary/Spl. Supplementary/Old/Annual/Bi-Annual)

**SUBJECT ELECTRICAL UTILISATION &
ILLUMINATION ENGINEERING**

(Name in full)

PAPER

Full Marks 100

Time : ~~Two hours~~/~~Three hours~~/~~Four hours~~/~~Six hours~~

(50 marks for each part)

Use a separate Answer-Script for each part

No. of questions	PART II (50 Marks)	Marks
1.	<p align="center"><u>Question No 1 (5 X 4) is compulsory & Answer any 2 (2 X 15) from the rest</u> <u>Answer any 5 of Question No 1</u></p> <p>a) Write a note on Blackbody Radiation laws.</p> <p>b) What is Spectral Power Distribution (SPD)? Draw typical SPDs for GLS Lamp & SOX lamp</p> <p>c) Why luminous flux is called most fundamental parameters of illumination engineering ?</p> <p>d) Explain the operating principle of fluorescent lamp.</p> <p>e) What do you mean by five plane photometry ?</p> <p>f) Write a note on relating lumen to watt.</p> <p>g) What is the difference between luminous efficacy and efficiency of a light source ?</p> <p>h) What do you mean by Cosine error for a detector ?</p> <p>i) What do you mean by retrofit Compact Fluorescent Lamp & why it is called energy saver?</p> <p>j) Write a note on Light loss factor (Maintenance Factor) of a lighting design.</p> <p>k) There is a difference between Light Output Ratio (LOR) and Coefficient of Utilization (COU) of indoor luminaire. - justify</p>	5 X 4 =20

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BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)
FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY..... EXAMINATION, 2024

(1st/2nd Semester/Repeat/Supplementary/Spl. Supplementary/Old/Annual/Bi-Annual)

**SUBJECT ELECTRICAL UTILISATION &
 ILLUMINATION ENGINEERING**

(Name in full)

PAPER

Full Marks 100

**Time : Two hours/Three hours/Four hours/Six
 hours**

(50 marks for each part)

Use a separate Answer-Script for each part

No. of questions	PART II (50 Marks)	Marks
2. a)	Derive Inverse Square Cosine Law of Illuminance for a point source?	4
b)	A lamp has four lines in the visible spectrum at 404.7 , 435.8, 546.1, 578.0.1 nm with radiant power densities of 1.0, 0.9, 0.2, 0.01 mW/cm ² , respectively. The corresponding V(lamda) values are as follows 0.0008 , 0.018 , 0.979, 0.886. 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.	11
3. a)	Discuss the basic functions of a luminaire?	5
b)	Explain the characteristics of indoor luminaires.	5
c)	Prove that in case of flat perfect diffuser Luminous Flux $\Phi = \pi I_n$ where I_n = Intensity along normal direction	
4. a)	What are the basic design steps for Indoor Lighting?	3
b)	Design a general Lighting Scheme with two different options with different types of lighting system (mentioned below) for the KCR Hall of Electrical Engineering Dept, Jadavapur University. The tentative dimension of Seminar room is 20 m X 10 m X 4 m . The target maintained average illuminance level is 300 Lux as recommended by IS 3646, Part-I & II , 1992. The overall Light Loss Factor to be considered as 0.8. Calculate LPD for both.	12

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FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY 2024**

(1st/2nd Semester/Repeat/Supplementary/Spl. Supplementary/Old/Annual/Bi-Annual)

**SUBJECT ELECTRICAL UTILISATION &
ILLUMINATION ENGINEERING**
(Name in full)

PAPER

Full Marks 100

(50 marks for each part)

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No. of questions	PART II (50 Marks)	Marks
	<p>Option-1 Lighting System type –Luminaire with 2 X 36 W , T8 Fluorescent lamp & Electro Magnetic Ballast. Luminous flux per Lamp = 2800 Lumen Coefficient of Utilization Value = 0.75 Cost per Luminaire (including Ballast) = Rs 2000/- Cost per Lamp = Rs. 50/- Power consumption per luminaire (including Ballast) = 80 W</p> <p>Option-2 Lighting System type –Luminaire with 2 X 20 W LED tube based lighting system Luminous flux per Lamp = 3250 Lumen Coefficient of Utilization Value = 0.85 Cost per Luminaire (including Driver) = Rs 6000/- Power consumption per luminaire (including Driver lost) = 42 W</p>	