

**BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING SUPPLEMENTARY  
EXAMINATION, 2023  
(3<sup>rd</sup> Year, 2<sup>nd</sup> Semester)  
ELECTRICAL UTILIZATION AND ILLUMINATION ENGINEERING**

Time: Three Hours

Full Marks: 100

Use a separate Answer-Script for each part

**PART – I (50 marks)**

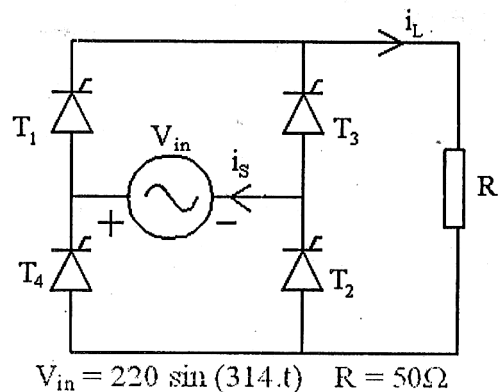
**Answer question no. 1 and any two from the rest.**

**Ques No. 2 carries maximum marks.**

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

- (a) Transformers and Electrical Motors are greatly affected by line harmonics.
- (b) Tama Furnace is suitable for Aluminum alloys.
- (c) For induction heating both the voltage and frequency have their limiting values.
- (d) Reactors are used only for stabilizing the arc.
- (e) Li-ion 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  $30^\circ$  and  $T_3, T_4$  are triggered at  $120^\circ$  of the input sine wave. Also determine the average power, power factor, displacement factor and %THD of the source current.



**10**

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

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

[ Turn over

- 3 (a) A 12V, 1800 Ah battery bank takes a charging current of 20A 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 0.97. 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
$(i_h/i_1)\%$	20	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 Lead-acid battery charging. 6
- (b) Write the merits of Li-ion batteries 4
- (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

**B.E. ELECTRICAL ENGINEERING THIRD YEAR SECOND SEMESTER SUPPLEMENTARY  
EXAMINATION-2023**

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No. of questions	<p align="center"><b>Part II</b> <b>Answer any three questions.</b> <b>Two marks reserved for neatness and well organized answer.</b></p>	Marks																											
1. a)	State and explain Wien's Displacement Law related to Blackbody radiation.	6																											
b)	Explain photopic, scotopic and mesopic vision with their corresponding visual response curve.	4																											
c)	Calculate the luminous efficacy of the 200W tungsten filament lamp from the following data:- <table border="1" data-bbox="272 1086 1321 1243" style="margin: 10px auto;"> <thead> <tr> <th><math>\lambda</math> (nm)</th> <th>&lt;400</th> <th>400-450</th> <th>450-500</th> <th>500-550</th> <th>550-600</th> <th>600-650</th> <th>650-700</th> <th>&gt;700</th> </tr> </thead> <tbody> <tr> <td><math>\bar{V}_\lambda</math></td> <td>0</td> <td>0.008</td> <td>0.110</td> <td>0.780</td> <td>0.910</td> <td>0.320</td> <td>0.020</td> <td>0</td> </tr> <tr> <td><math>M_\lambda</math>(W)</td> <td>1.8</td> <td>1.0</td> <td>1.3</td> <td>1.6</td> <td>2.2</td> <td>2.3</td> <td>3.1</td> <td>172.6</td> </tr> </tbody> </table>	$\lambda$ (nm)	<400	400-450	450-500	500-550	550-600	600-650	650-700	>700	$\bar{V}_\lambda$	0	0.008	0.110	0.780	0.910	0.320	0.020	0	$M_\lambda$ (W)	1.8	1.0	1.3	1.6	2.2	2.3	3.1	172.6	6
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2. a)	A luminaire is suspended above the center of a circular table of 5 m diameter. The luminaire mounting height is 1.8m. The intensity distribution is given by, $I_y = 150 \cos y$ [cd]. Find out the illuminance at center and periphery of the table.	8																											
b)	Mention the two characteristics of the sensor of any luxmeter.	4																											
c)	Briefly explain about "5 plane photometry".	4																											
3.a)	What do you mean by 'visual photometry'? Mention its differences from 'detector based photometry'.	6																											
b)	Draw the schematic diagram of an integrating sphere and write down the procedure of measurement of luminous flux of Test lamp using it.	8																											
c)	What is the use of auxiliary lamp in integrating sphere?	2																											
4.a)	Explain the starting operation of a glow start fluorescent lamp with magnetic ballast. Mention the functions of starter and ballast.	8																											

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b)	Calculate DLOR, ULOR and LOR for a luminaire from its I-table given below. The lumen output of lamp is 3250 lumen.	8																						
<table border="1"> <tbody> <tr> <td>Angle (deg)</td> <td>5</td> <td>15</td> <td>25</td> <td>35</td> <td>45</td> <td>55</td> <td>65</td> <td>75</td> <td>85</td> <td>95</td> </tr> <tr> <td>I (cd)</td> <td>1390</td> <td>1363</td> <td>1285</td> <td>1150</td> <td>940</td> <td>620</td> <td>367</td> <td>225</td> <td>135</td> <td>109</td> </tr> </tbody> </table>			Angle (deg)	5	15	25	35	45	55	65	75	85	95	I (cd)	1390	1363	1285	1150	940	620	367	225	135	109
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5. a)	Write down the benefits of lighting control. Draw and explain the block diagram of basic lighting control scheme.	8																						
b)	A class-room of 8m × 6 m × 3 m is to be illuminated with maintained average illuminance level of 500 lux over the working plane. Calculate the number of luminaire required to achieve the illumination level and also sketch the luminaire layout. Assume the utilisation factor of 0.65 and maintenance factor of 0.70. Luminaire: 2X36 Watt FTL, 6500 K, HF and lumen per lamp=3250.	8																						