Ref No. : EX /EE/T/325/ /2017

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2017
(3rd Year, 2nd Semester)

ELECTRIC UTILIZATION AND ILLUMINATION ENGINEERING

Time: Three Hours Full Marks: 100

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

Answer any three. Question no. 3 carries the maximum marks

1. (a) How does the shunt connected "series tuned LC filter" improve the power factor? **5**

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

(c) A 12V, 1800 Ah battery bank takes a charging current of 10A DC from a charger of 220V(AC)/13.2V(DC). 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.

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

Calculate the %THD of the line current and the power factor of the load. **8**

2. (a) How environmental constraints affects the selection of a battery. **4**

(b) Absence of temperature compensation may result in Sulphasion or gassing of a lead-acid battery- explain. **5**

(c) A smart solar photovoltaic system has a 120 V, 30 kAh Battery bank. The Charge controller cum inverter connected to the battery sets a float voltage of 132V at the normal ambient temperature (27°C). Calculate the float voltages required for incorporating the temperature compensation in the charge controller when the battery will be used in Jaisalmer during the summer (52°C) and in Pahalgam during winter (-25°C). According to the manufacturer the compensation required is -3.6 mV/°C/cell. **7**

[Turn over

3. (a) What are the factors those affect the selection of frequency of an Induction heating? **6**

(b) Aluminum and its alloys are difficult metals to melt in the Ajax Wyatt furnace –Explain. **3**

(c) What will be the ratio of R_t/R_a to get the maximum efficiency of an electric arc furnace at a power factor of 0.9 ?
Where R_t= Total resistance of the arc transformer referred to the secondary side + the resistance of the leads and electrode, and
R_a=Resistance of the arc. **9**

4. (a) What type of heating do you think will be most energy efficient for cooking? **3**

(b) Explain the basic principle of dielectric heating. **4**

(c) A 10 kW single phase 220V resistance oven employs a rectangular strip of 1 mm thick for its heating element. If wire temperature is not exceeding 1170 °C and the temperature of the charge is to be 500 °C calculate the width and length of the wire. Take K=0.57, e=0.95, ρ=1.09μΩ-m. 9

5. Write short notes on (any two) **8x2**

a) Electrode position control in an EAF
b) Charge termination processes in storage batteries
c) Active power filter

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No. of questions	**Part II** **Question No 1 (4 X 5) is compulsory & Answer any 2 (2 X 15) from the rest** **Answer any 5 of Question No 1**	Marks
1. a)	Luminous flux is the fundamental parameter.-Justify or do the necessary corrections, if any.	
b)	Spectral luminous efficiency function V(λ) depends on light level.- Justify with necessary corrections , if any.	
c)	Luminous flux of a light source doesn't depend on human vision- Justify with necessary corrections, if any.	
d)	Mention the basic differences between neutral density filter (ND) & selective filters. Also mention two applications of both the filters.	
e)	Light Power Density (LPD) is the best parameter to evaluate any lighting design – Justify with necessary corrections, if any.	
f)	V(λ) correction is necessary for mirror distribution photometer- Justify ?	
g)	Write a note on average Intensity for the five plane photometry system and it's relevance for LED photometry.	
2. a)	Develop the expressions of flux transfer between a point source and area receiver?	3
b)	How do you differentiate between properties of blackbody from radiation laws of blackbody?	2
C)	Calculate the luminous efficacy of the 200W tungsten filament lamp from the following data:-	6

λ (nm)	<400	400–450	450–500	500–550	550–600	600–650	650–700	>700
$\overline{V}_\lambda$	0	0·008	0·110	0·780	0·910	0·320	0·020	0
M_λ(W/	1·8	1·0	1·3	1·6	2·2	2·3	3·1	172·6

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d)	The filament of an incandescent lamp is 0.01 cm in diameter and 100 cm long. It consumes 200 W. Assuming that the filament can be considered a black body radiator, at what temperature is it operating? How many Watt would it consume at a temperature of 4000K?	4
3.a)	What is the fundamental difference between a detector and sensor?	2
b)	Clearly explain the difference between network, physical layer, program and protocol as defined in IES TM 23 lighting control protocol.	6
c)	What is the role of ballast for discharge lamp operation? Explain it with the example of fluorescent lamp.	7
4.a)	Prove that in case of flat perfect diffuser Luminous Flux $\Phi = \Pi I_n$ where I_n = Intensity along normal direction.	5
b)	What do you mean by Light Loss Factor for lighting design?	2
c)	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 KCR hall is 28 m X 12 m X 4 m . The target maintained average illuminance level is 300 Lux . The overall Light Loss Factor to be considered as 0.7. Consider the room is to be used for 300 days per year with 10 hours per day. Compute the energy consumption for both the options and clearly mention which one is the best option from energy saving point of view. Also calculate LPD for both. **Option-1** Lighting System type –Luminaire with 2 X 36 W T12 Fluorescent lamp & Electro Magnetic Ballast Luminous flux per Lamp = 3100 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	8

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Option-2
Lighting System type –Luminaire with 2 X 20 W LED tube based lighting system
Luminous flux per Lamp = 3350 Lumen
Coefficient of Utilization Value = 0.85
Cost per Luminaire(including Driver) = Rs 6000/-
Power consumption per luminaire (including Ballast) = 42 W

5. a) The intensity distribution of a luminaire is given below. Find out the total luminous flux (in Lumen) by using Zonal Lumen Method. Find out LOR , ULOR & DLOR for the luminaire. Consider lamp lumen as 6000. [8]

Angle(Degree)	Intensity(candela)
5	1800
15	1542
25	1375
35	1122
45	995
55	843
65	690
75	300
85	138
95	76
105	37
115	13
125	06
135	85
145	96
155	182
165	250
175	389

b) What is the significance of three values of service illuminance level as mentioned in IS 3646, 1992, Part-II ? [2]

c) Show that the illuminance received at any position on the surface of the Integrating Sphere from another part of the surface is independent of their relative positions. [5]