



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY
SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING
DIPLOMA IN ENGINEERING (ELECTRICAL) - STAGE 3
EED511 ELECTRICAL DESIGN AND POWER UTILISATION

FINAL EXAMINATION

Semester 1, 2019

Total Marks: 100

Total No. of Pages: 4

Duration: 3 hours and 10 minutes

DATE/TIME/ROOM: Refer to Timetable

INSTRUCTIONS TO CANDIDATES

1. You are allowed 10 minutes extra reading time during which you are NOT to write.
2. Begin each SECTION on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and ATTACH these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use of programmable calculator(s) is prohibited.
8. ANSWER ALL QUESTIONS
9. Show all working where necessary.
10. ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE EXAM ROOM

SECTION A:**TARIFF****(25 MARKS)**

1. List down any three objectives of Tariff. **(3 marks)**
2. State any three characteristics of a Tariff and elaborate on it. **(3 marks)**
3. Choose any two types of Tariff structure explain and state one advantage and one disadvantage of using such type of tariffs. **(6 marks)**
4. In a Domestic installation where Residential Tariff is used and a household income is less than \$30,000.00 and registered for Government subsidy, a kWh meter established 1011kWh. The previous monthly reading was 0916 kWh. *(Refer to Table 1)*
 - a. Calculate the cost of energy for the current billing month of 31 days **(4 marks)**
 - b. If the current monthly reading was 0813 kWh, then what will be charge for that month. **(3 marks)**

Tariff Categories	Approved Tariff Rates (cents/unit) (VEP) Effective 1st August 2017
Domestic Category Domestic Tariff – Government subsidy. This Tariff only applies if customer has Combined household income Less than or equal to (\leq) \$30,000.00 per annum and registered for Government subsidy. Customers who qualify and are registered will be subsidized for the first 100 units of consumption.	33.10 cents (15.90 cents/unit will be subsidized by the Government and customer pays 17.20 cents/unit)

Table 1

5. A table containing energy usage information for a small business company is given below:

Tariff Description	Reading Type	Meter Number	Reading		Usage	Billed Days
			Present	Previous		
Com Step 1	Normal Reading	50158977:1	00006735	00005685	1050	32
Reactive Units	Normal Reading	50158977:2	00003739	00003040	699	32

Table 2

To assist you with the bill calculation, the following information is also given below

Commercial Tariff	Tariff Price – VAT Exclusive
Units up to 14,999kWh – cents per kWh per month	39.90cents
Units over 14,999kWh – cents per kWh per month	41.80 cents
Excess Reactive Energy – cents per kVarh per month	41.80 cents

Table 3

Allowed Reactive Energy = $0.62 \times$ Total kWh (for the relevant billing period). Any reactive power which is used over this calculated 'Allowed Reactive Energy' figure is the 'Excess Reactive Energy' and is chargeable at a rate of \$0.4180 /kVarh. For the information provided above, calculate the bill for the small business company showing a step by step calculation and also taking VAT into account. **(6 marks)**

SECTION B:**LIGHTING****(25 marks)**

1. Street lighting/ Public Lighting is one of the major electric loads in municipal areas. Number of street lights used in a Municipal area varies from 1000 to 50000 in numbers depending on the kilometers of road illuminated within the municipal limits. List down two [2] controls that are adapted by Municipal council to reduce energy consumption in street lighting system. **(2 marks)**

2. In a class room, where good lighting is required, a 700 lux light source is recommended. A lighting system is chosen where 3 x 60W suspended white fluorescent lamp fittings are to be used. Each 60W lamp emits 3800lm. The fitting provides direct lighting. The room dimensions are: Length – 15m, Width – 8m, Height – 4m.
The working area is 650mm above the floor. Suspended height of the lamps is 0.5m.
The Utilisation factor is 0.54 and the maintenance factor is 80%.
Using Zonal Cavity Method for Indoor Lighting, calculate the following:
 - a. Height of direct lighting **(1 marks)**
 - b. Room Index **(1 marks)**
 - c. Number of light fittings **(2 marks)**
 - d. The illumination level when the lights have been recently installed and all brand new. (maintenance factor M= 1) **(2 marks)**

3. Using a simple calculation elaborate on the **Inverse Square Law**. **(2 marks)**

4. One of the energy saving opportunities in the lighting systems is “**Task Lighting**”. In your own words discuss what do you understand by term. **(2 marks)**

5. Energy efficiency in lighting systems is very important. Discuss three primary considerations which support the statement. **(3 marks)**

6. Explain the following basic parameters and terms in lighting system
 - a. Circuit Watts
 - b. Luminaire
 - c. Luminous Efficacy **(3 marks)**

7. The recommended maintenance illuminance for the general working area of a bakery is 200lux. If the floor length is 30m and width is 10m. Find the useful flux incident on the working plane. **(2 marks)**

8. Fill in the missing information in table below: **(5 marks)**

NAME	SYMBOL	UNIT	ABBREVIATION
Luminous flux			lm
Luminous Intensity			
Luminance	L		
Illuminance			

Table 4

SECTION C:**AIR CONDITIONER/REFRIGERATION****(25 MARKS)**

1. Design and explain the Refrigeration cycle. **(5 marks)**
2. Distinguish between any two types of Refrigeration System **(5 marks)**
3. List any two types of compressors and state its application **(4 marks)**
4. List down the 4 major components of an Air Conditioner and explain its function. **(4 marks)**
5. List and elaborate on any two opportunities of energy saving in HVAC and Refrigeration systems **(3 marks)**
6. Discuss four [4] safety precautions while using refrigerators. **(4 marks)**

SECTION D:**HEAT ENERGY AND ENERGY MANAGEMENT****(25 marks)**

1. Design and explain the schematic diagram of a “Combined Heat and Power Plant” (CHP). **(5 marks)**
2. Design and explain the principles of Induction Heating. **(5 marks)**
3. Resistance heating is based on the principle that, when a current is passed through an electrical resistor, electrical energy is converted to thermal energy. The thermal energy then is transferred to the part by convection, radiation and/or conduction. List down 4 advantages electric resistance heating. **(4 marks)**
4. A metal plate 1.5cm thick and 250cm² in area, having a relative permittivity of 2 and power factor of 0.1 is to be heated using dielectric heating. The power required is 500W and a frequency of 20MHz is used. Determine
 - a. The voltage required
 - b. The current flow through the material. **(5 marks)**
5. List down four [4] energy efficiency measures in Buildings for **Lighting System**.
6. Explain the term “Building Management System (BMS). **(3 marks)**
7. Elaborate on three [3] industrial application of Indirect resistance heating. **(3 marks)**

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