

LABORATORY 4

TITLE: Circuit Control Operation

OBJECTIVE: To understand circuit control using time switch.

NOTES: While it is possible to control electric power by manual switch, it is sometimes necessary to use automatic on-off devices. Example of these include, pressure switch, thermostat, time switch and humidstat. They are used when equipment is to be switched on and off without operator assistance. Examples of such equipment include, automatic milking machines and automatic feeders for livestock.

PROCEDURE

A. Switch-on timer

1. Connect a bulb to the switch – on timer
2. Set the timer to 5 minutes
3. Observe the light come on
4. Draw the circuit diagram

B. Switch off timer

Repeat as in A.

C. Switch on and off

1. Combine the two times and watch the light go on and off
2. Sketch the circuit diagram

D. Answer the following questions

1. List 6 equipment where the use of automatic switches may be necessary
2. Explain the operation of a thermostat

**FEDERAL UNIVERSITY OF
AGRICULTURE, ABEOKUTA
FIRST SEMESTER EXAMINATION (2010/2011
SESSION)**

AGE 405 (3 UNITS): FARM ELECTRIFICATION
INSTRUCTION: ANSWER QUESTION ONE AND ANY OTHER TWO
TIME: 2¹/₂HOURS

Present appropriate diagrams, sketches and calculations where necessary

QUESTION ONE (30 Marks)

- a. What are the safety steps recommended to prevent electrical hazards on the farm?
- b. Explain briefly, the generation and flow of electricity using the atomic theory.
- c. Using your answers in (c) briefly describe how the principle can be used to explain the conductivity and resistance to electricity for conductive materials.
- d. Using fluid flow phenomenon, briefly define the electrical terms similar to the parameters in fluid system.
- e. Heavy machineries are known to start with high current, state and explain briefly the principle of operation of the device used to prevent these machines from affecting others during starting.
- f. Determine the cost of using the following appliances for the period indicated. Use PHCN domestic rate. (i) 2000W water heater for 3 hours
 - i. Sixty 60W bulbs in a poultry from 7pm till 7am for a month.

- ii. An hammer mill with 2000W electric motor in a feedmill. It is normally operated non-stop only during official government working hours for 22 days in a month.

QUESTION TWO (20 Marks)

- a. List at least six different types of work that can be done with 1KWhr of electricity.
- b. Wire guage No 10 on the American Wire Guage has a current carrying capacity of 30A and a resistance of 0.9998 Ohm per 330 m. Calculate the voltage drop and the power loss if the wire is used to transmit power from a poultry house to the feed store which is about 0.33km away.
- c. During the operations in a feedmill, the meter disk makes 8.5 rev in 30 seconds. The meter $K = 0.6$ Watt/rev. What is the energy consumption? Calculate the monthly cost of operating the feedmill if the production capacity is an average of 3 bags/minute for a requirement of 1360 bags per day. The PHCN Industrial tariff rate is ₦8.00 per KWhr.

QUESTION THREE (25 Marks)

In a farm settlement, there are 5 pepper grinders using 2kW electric motor; 20 households (each with 12, 60W light bulbs; 5, 13A sockets; 2, 15A sockets; 2, 5A, sockets; 3, electric ceiling fans 20W); two saw mills each consuming 5kW; a feedmill (20kW), a livestock farm (20kW), palm oil processing mill (50kW), 2 cassava processing centres (15Kw each), Village market/recreation centre and hall (100kW).

- i. Calculate the amount the PHCN will be realising from the settlement on a monthly basis assuming an average 8 operating hours for all the users. (PHCN TARRIF = ₦4.00 per kW-Hr)
- ii. As the only Agricultural Engineer in your states Rural Electrification Board, justify the reason why you are recommending that the 300kVA transformer in use should be changed.
- iii. Recommend and appropriate transformer to the Board.

QUESTION FOUR (25 Marks)

- a. Differentiate between the terms “Total Connected Load (TCL)” and “Probable Maximum Load (PML)”.
- b. Design the interior lighting system using “LUMEN method” for the fertilizer store with a floor dimension of 8m x 15m using Tungsten Lamp. Take $E = 50$ lux, $H_m = 3$, Coeff of utilization (C) for RI of 1.74 for medium surface = 0.55, Maintenance factor (M) = 0.7

QUESTION FIVE (25 Marks)

- b. The Farmstead layout shown in Figure 1 with the total connected loads for each unit indicated is the layout design developed by the UNAAB AGENG Consultancy Unit for an integrated farm for production and processing of selected arable crops for export. This is to be sited in all the states of the federation.
 - i. Explain briefly the steps to take in designing for the main service switch.

ii. If the length of run to the Service entrance meter (M) is 180m from any of the main PHCN overhead cable, calculate the wire size required for supply to the service meter. Measure the length of the path of run from the meter to each building and the feeder wire size required for each of the building. Assume 90% of the TCL is the PML in each of the building and the local service voltage supply is 240V.