THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

FINAL EXAM – June / July 2015

EEE 3112

ELECTRICAL ENGINEERING PRACTICE

TIME	:	Three (3) hours
INSTRUCTIONS	:	Answer any four (4) questions in section A and one question in section B.
ADDITIONAL INFORMATION	:	1. **Submit SECTION A and SECTION B in Separate Answer Booklets.**

SECTION A: ANSWER AT LEAST Four (4) QUESTIONS FROM THIS SECTION

QUESTION 1

a) Briefly describe, giving two examples, what a standard is, and give the reason why we need to preserve it. **[3 Marks]**

b) Give four categories of standards with their specific functions. **[2 marks]**

c) Design an Aryton shunt to provide an ammeter with a current range of 0-1 mA, 5 mA, 10 mA and 20 mA. A D' Arsonval movement with an internal resistance of 60kΩ and full scale current of 50 μA is used. **[13 Marks]**

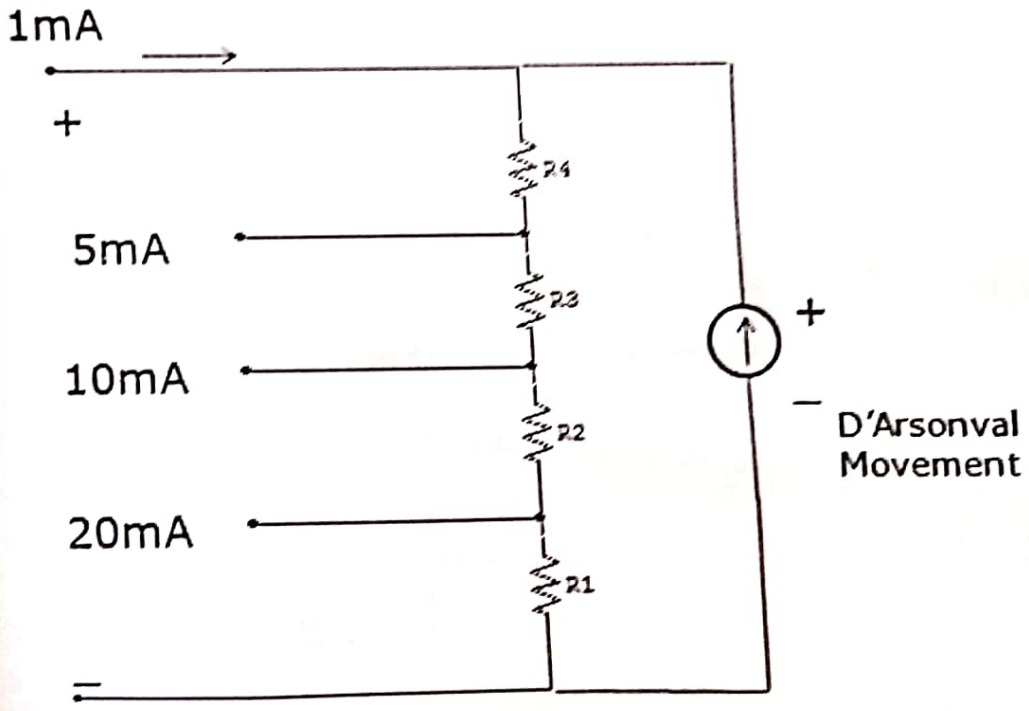

Figure Q1 Aryton Shunt

Question 2

a) Name any four classes of measuring instruments, giving one example for each. **[2 Marks]**

b) Describe briefly four performance characteristics of an instrument. **[4 marks]**

c) Outline four methods of fault finding. **[4 Marks]**

d) A 50μA full scale deflection current meter movement shown in figure Q5 is to be used in an Ohmmeter. The meter movement has an internal resistance $R_m = 2k\Omega$ and a 3V battery is used in the circuit. Determine R_2 at full scale deflection. **[3 Marks]**

e) A 100Ω basic movement is to be used as an ohmmeter requiring a full scale deflection of 1mA and internal battery voltage of 5V. A half scale deflection marking of 2k is desired. Calculate:

i. value of R1 and R2 **[4 Marks]**

ii. the maximum value of R2 to compensate for a 3% drop in battery voltage **[3 Marks]**

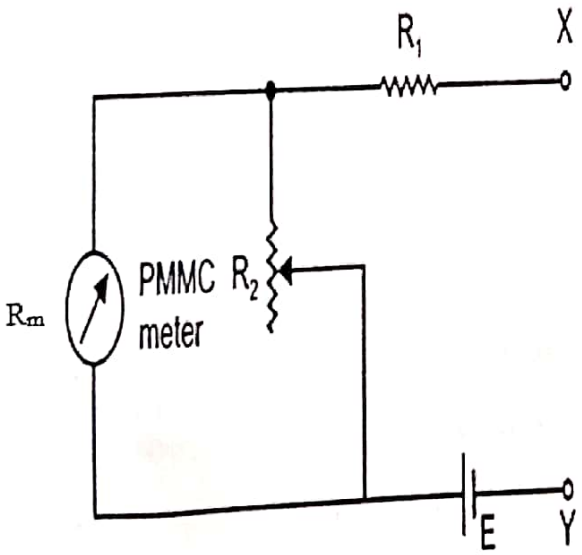

Figure Q5. Ohm meter

Question 3

1. A student in a laboratory was presented with three resistors and two capacitor having the following colour bands and other characteristics:

   - **Resistor 1:** Red, Green, Silver and Gold;

- **Resistor 2:** Violet, Grey, Gold and Silver;
- **Resistor 3:** Yellow, Black, Red and White;
- **Capacitor 1:** Red, Black and Orange;
- **Capacitor 2:** Small capacitor with number code printed on it, 472K.

i) Determine the resistance, capacitance and tolerance values of the above listed components. **[5 Marks]**

ii) State at least two functions of capacitors and one of resistors in electronic engineering. **[3 Marks]**

iii) Describe briefly the four main types of diagrams used in electrical and electronic engineering **[4 Marks]**

iv) Design and draw a circuit diagram of a simple 5 V regulated power supplier system and explain the functions of the devices (components) used. **[6Marks]**

v) Calculate for the power rating of a 480 Ω resistor with 10 V across it. **[2 Marks]**

Total [20 Marks]

Question 4

1. Figure 1 below shows a circuit diagram of a solar lamp. In the design three parallel high power white LEDs , each 2.7 V and 30 mA, are switched on in the evening and stay on for 10 hours using a 6 V 4.5 Ah rechargeable battery. During the day, the solar panel charges the battery as the white LEDs are switched off.

i) What are the functions of the following components:

(1) 12 V solar panel;

(2) 6 V 100 Ω PCB Relay;

(3) Charger controller resistor connected in series with a silicon diode D1 (0.7 V);

(4) 1.8 V, 15 mA Red LED, **[1x5 Marks]**

(5) High value 4700 μF capacitor C1

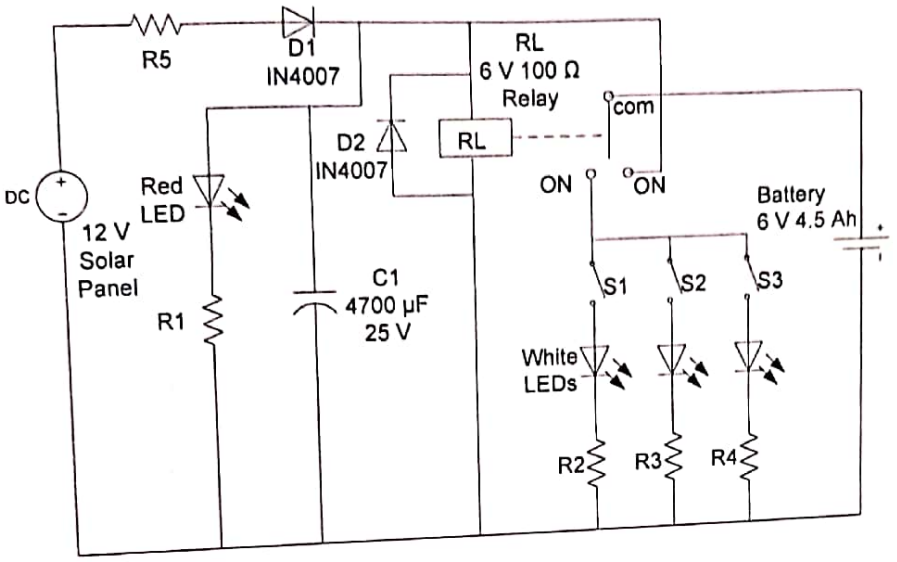

Figure 1: Solar lamp circuit diagram

ii) Calculate the size of resistors R2, R3 and R4 needed to be connected in series with the white LEDs. **[2 Marks]**

iii) Determine the size of resistor required to be connected in series with Red LED. **[2 Marks]**

iv) What size of solar panel power is needed to charge the batter for a period of 5hours after been used for 10 hours (Assume that the battery was initially fully charged before use). **[6 Marks]**

v) Briefly describe five main uses of electronic circuit diagrams. **[5 Marks]**

Total [20 Marks

Question 5

1. Draw a block diagram of a radio receiver system and explain the main functions of the components in it. **[6 Marks]**
2. What are the three main differences between average (mean) and rms values of a time varying current on an interval? Define form factor. **[4 Marks]**
3. Determine the colour bands for a 1.5 Ω ±5% resistor. **[2 Marks]**
4. State the three uses of capacitor banks and one use of recloses in electrical power system. **[4 Marks]**
5. Figure 2, below, shows a solar charger monitor circuit diagram. Identify the components making up the circuit and make a bill of quantity. **[4 Marks]**

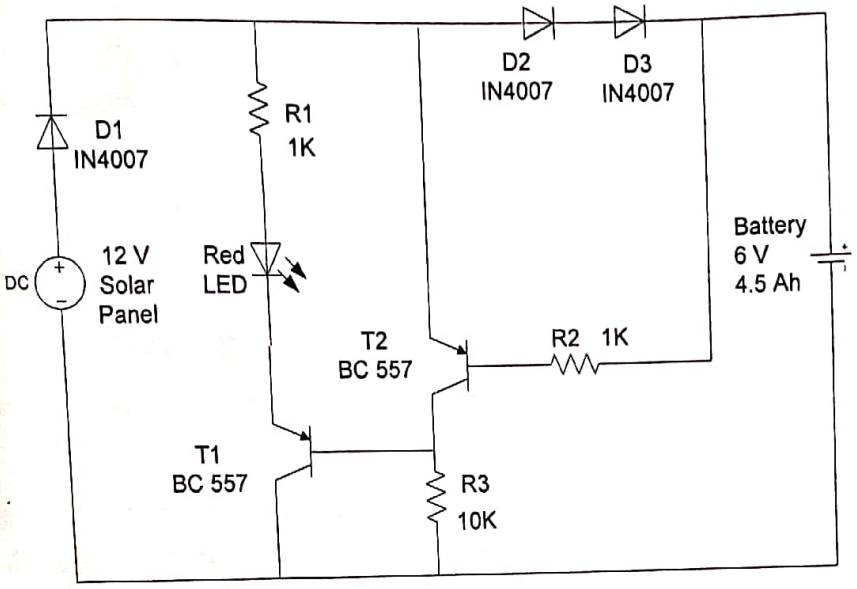

Figure 2: Solar charger monitor circuit diagram.

Total [20 Marks]

SECTION B: ANSWER AT LEAST ONE (1) QUESTION FROM THIS SECTION

Question 6

(a) In a stone crusher at Chilanga Cement a steel shaft of 4m long, having a diameter of 60mm, is used to transmit power at a rotational speed of 600rev/min. If the maximum shear stress for the material of the shaft is limited to 75MN/m2. Determine the following

(i) The maximum power that can be transmitted

(ii) The corresponding angle of twist

Assume the modulus of rigidity for steel is 95GN/m2.

(b) Define the modulus of rigidity, G.

[16+4=20 Marks]

Question 7

(a) The mass of a gear A in ***Figure Q8 (a)***, is $20kg$ and its centroidal radius of gyration, k_A is 160 mm. The mass of gear B is $8Kg$ and its centroidal radius of gyration k_B is 100mm.

(i) Determine the mass moments of inertia of the two gears

(ii) Write the differential equation of motion of the entire system given that the bearings have friction coefficients $C_A = 0.05Nm.s/rad$ and $C_B = 0.07Nm.s/rad$

(iii) Calculate the angular acceleration of gear B when a torque of 16 N.m is applied to the shaft of gear A. Neglect friction.

(iv) What is backlash in gearing systems

(b) Define vibration resonance in forced vibration

[16+4=20 Marks]

END OF EEE3112 – Electrical Engineering Practice