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THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
DIPLOMA IN TECHNOLOGY

ECX 3234 – Electrical Technology
Final Examination – 2009/2010

Date:27.03.2010 Time:1400-1700 hrs

*This paper consists of two part: **part A** and **part B**.*
***Part A** contains five questions and **part B** contains three questions.*
*Answer any **three (3)** questions from **part A** and any **two (2)** questions from **part B**.*

PART – A

1)

a) What is an auto-transformer?
b) What are the advantages & disadvantages of an auto-transformer, when compared with two winding transformer.
c) Why is the auto-transformer not used as distribution transformer?
d) An auto-transformer is used to step-down voltage level from 230V to 200V, while the load is 20kW at unity power factor, neglecting losses and magnetizing current. Find the kVA rating and current in different sections of the winding.

2)

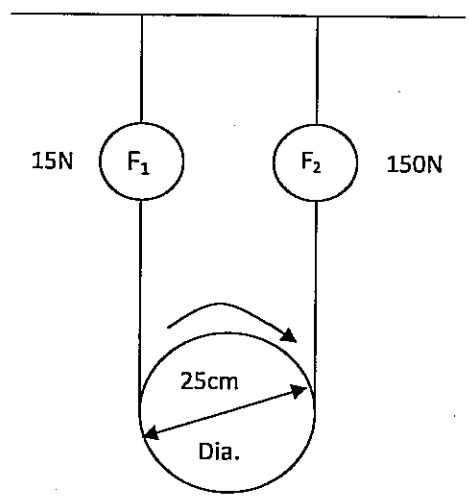
a) Name different types of DC motors.
b) Draw the mechanical characteristic of all types of DC motors in the same diagram.
c) In a load test on a 240V, DC series motor, the following data were recorded at one value of load;

Terminal voltage	238 V
Line current	6 A
Speed	700 r/min
Belt brake	15N, 150N

The resistance between terminals is 2.0Ω, and it has been found for this machine that the winding and friction losses are equal to $(1.8\times10^{-4})\ N^2$ watts, where N is the speed in revolutions per minute.

Evaluate;

i. The torque.
ii. The brake power.
iii. The input power.
iv. The efficiency.
v. The core loss for the load.



3).

a) What are the types of DC distributors?

b) The "Rajadani Express" electric train travels between two substations A and B. The distance between A and B is 8 km. While travelling between substations the train takes dc current of 600 A at the point where the potential is minimum between A and B. The voltage at substations A and B are maintained at 575V & 590V respectively. The track resistant is 0.04Ω/km both go and return.

I. Find the point of minimum potential along the track.

II. Current supplied by two substations at this instant.

4)

A load of 1000 kVA, 0.8 power factor lagging is to be fed via transformer. The load cycle is given below:

- 2000 hours per annum at full load
- 600 hours at half load
- 400 hours at 25kVA

Two tenders A & B were submitted for above and some of the technical specifications are as given below;

<u>Tender - A</u>		
Full load efficiency	=	97%
Iron loss	=	10kW at rated voltage
<u>Tender - B</u>		
Full load efficiency	=	98%
Iron loss	=	8kW at rated voltage
Extra cost	=	Rs. 5000 more than A

If annual charges for interest and depreciation are 12.5% of capital cost and energy costs 10% per kWh determine the most suitable tender. What would be the annual saving?

5)

a) What are the advantages of industrial drivers?

b) State the important factors affecting the selection of industrial drivers.

c) State the classification of industrial drivers.

d) A certain motor has to perform the following duty cycle:

- 100kW for 10 minutes — No- load for 5 minutes
- 75kW for 8 minutes — No- load for 4 minutes
- 50kW for 6 minutes — No- load for 3 minutes

The duty cycle is repeated indefinitely.

i. Draw the curve for the load cycle.

ii. Determine suitable size of a continuously-rated motor.

[Hint:

$$Size\ of\ motor\ = \sqrt{\frac{L_1^2 t_1 + L_2^2 t_2 + \cdots l_n^2 t_n}{t_1 + t_2 \cdots t_n}}$$

Assuming that the heating is proportional to the square of the load,
L - Motor Carries load and t –Time]

PART - B

PART - B

6)

a) AC voltage can be stepped down using a step down transformer. Transformer is connected to a rectifier circuit. Sketch the circuit diagrams and the output waveforms for
   i) Half wave rectifier
   ii) Full wave bridge rectifier

b) The bridge rectifier is connected to the input of the circuit shown in Figure 6. The zener voltage of the diode is 9V. (The diode operates with a reverse current between 10mA to 100mA. Reverse resistance of the zener is negligible.)

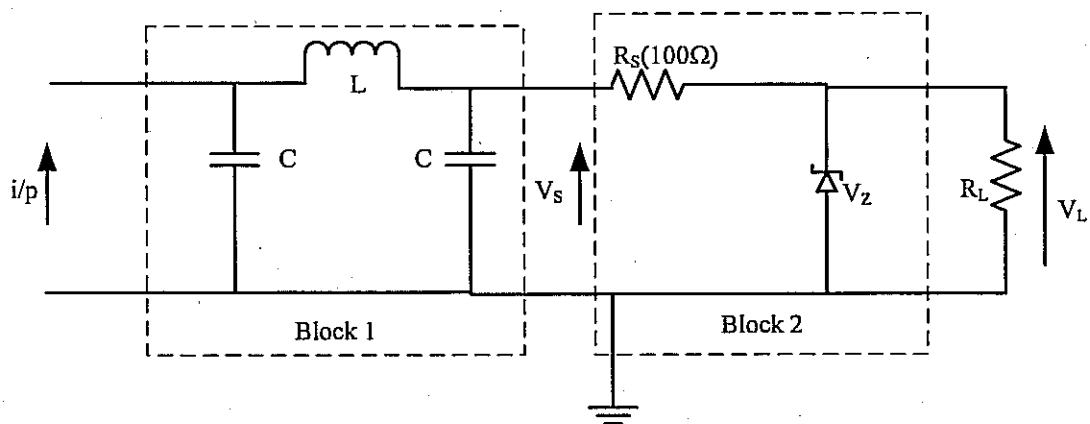


Figure 6

i) State the functions of the block1 and block2 of the circuit shown in Figure 6?
ii) Find the range of load resistance (R_L) that provides a stable V_L when V_S is 24V.
iii) If R_L is 600Ω, find the range of supply voltage (V_S) that provides a stable V_L

7)

a) An operational amplifier circuit is shown in Figure 7.1

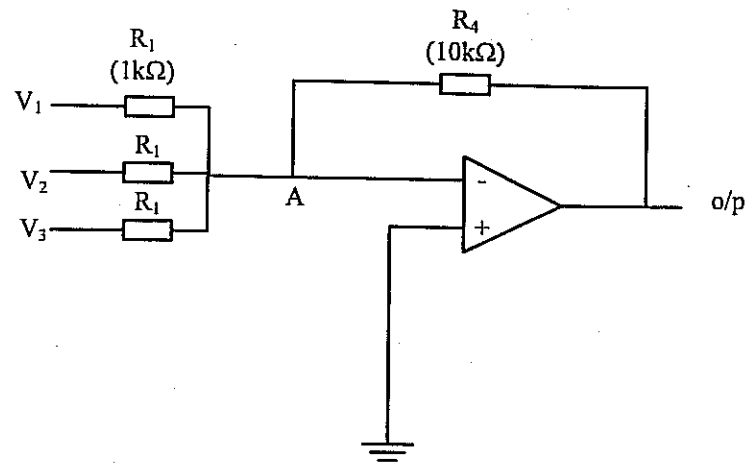


Figure 7.1

i) Write Kirchoff's current law to the node A.
ii) Hence, derive an expression for the output voltage of the circuit.
iii) Calculate the output voltage, if V_1= 2V, V_2= 1V and V_3 = 3V.
iv) State the function of the circuit shown in Figure 7.1.

b) Calculate the output voltage of the circuit shown in Figure 7.2, when a 5V input is a| at the input? (Assume the transistor current gain (β) = 30 and V_{BE} = 0.6V.)

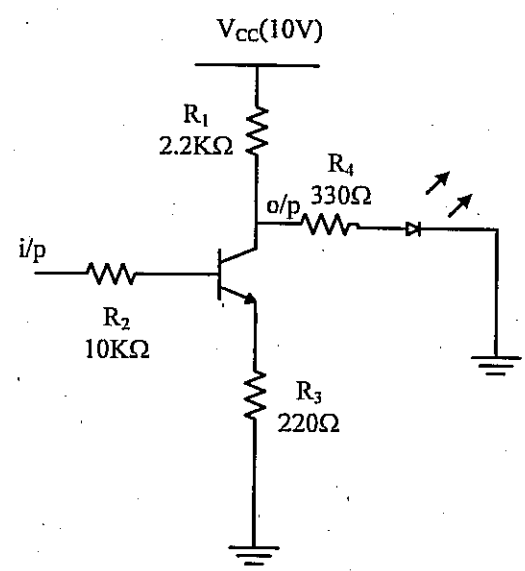


Figure 7.2

8)

a) Show following number conversions

i) 10.2453_{10} to binary
ii) 11010.0101_2 to decimal
iii) -65 in 2's compliment

b) Transient behavior of a capacitor can be observed using a circuit shown in Figure 8. Assume initially the capacitor has no charge.

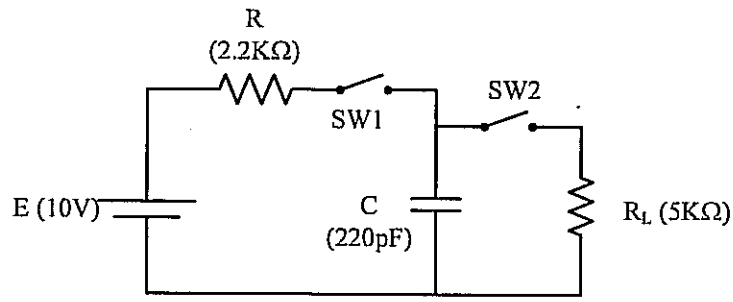


Figure 8

i) At t = 0, switch 1(SW1) is switched on till the capacitor is 99% fully charged.
   (1) Calculate the time taken to charge the capacitor.
   (2) Sketch the variation of the capacitor voltage.
ii) Now the switch 2(SW2) is switched on and the switch 1(SW1) is switched off.
   (1) Calculate the time taken to discharge the capacitor to 50% of its charge.
   (2) Sketch the variation of the capacitor voltage.