* 1 1 0 *

110

Electronics & Communication Engineering

TIME : **3** HOURS

MAXIMUM MARKS : **300**

INSTRUCTIONS :

1. *All questions are **compulsory**.*
2. *Question Paper may be divided into **4 (four)** Sections from **Section-A** to **Section-D** and carry marks as under :*
   - **a.** ***Section - A** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **12** marks × 3 Questions = Total **36** Marks.*
   - **b.** ***Section - B** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **20** marks × 3 Questions = Total **60** Marks.*
   - **c.** ***Section - C** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **28** marks × 3 Questions = Total **84** Marks.*
   - **d.** ***Section - D** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **40** marks × 3 Questions = Total **120** Marks.*

SECTION - A

(Each question is of **12** marks and each sub part **(a)** and **(b)** are of **6** marks each)

1 (a) Draw the Boolean circuit for the following situation. "If the room is not locked and the lights are ON and the safety latch is open, then open the door and go inside the house." a = room locked; b = lights are on; c = safety latch is open and v = go inside the room.

(b) Simplify the following Boolean expression.

$$x.y + \overline{y}.z + x.z + x.y.z$$

2 For a given complex valued signal $y(t) = Ae^{j2\pi\beta t}$,

(a) Indicate whether it is an energy signal or a power signal.

(b) Compute the signal energy and the signal power.

3 (a) A 256 × 8 SRAM chip holds 256 8-bit words in a total of 2 Mb of total storage. Calculate the width of the address word.

(b) Simplify the following Boolean expression.

$$\left(a.c.\left(c+\overline{b}.\overline{d}\right)+\overline{a}.\overline{b}\right).b.d$$

SECTION - B

(Each question is of **20** marks and each sub part **(a)** and **(b)** are of **10** marks each)

4 (a) A signal ranges between –0.2 V to 1.05 V. An A/D converter with an input range of 0 to 5 V is used to sample the signal. The signal needs to be conditioned such that it fits the full input range of the A/D converter. Determine the DC offset and the amplification gain required for signal conditioning.

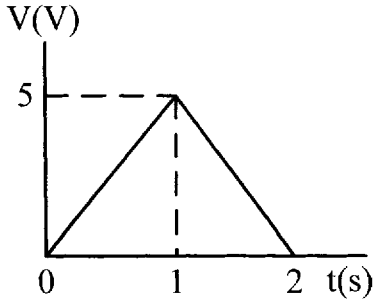
(b) A temperature sensitive transducer experiences a sudden change in temperature. It takes 20 seconds (5 time constants) for the transducer to reach steady state. Assuming the device to be a first order linear system, calculate the time it took the transducer to read half the temperature difference.

5 Find the z-transform for the sinusoidal signals

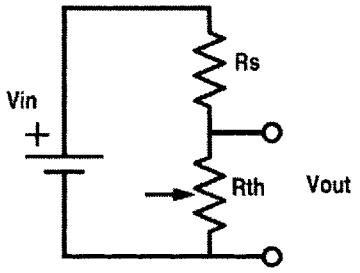
(a) $x_T(n)=\sin(an)u(n)$

(b) $x_T(n)=b^n\sin(an)u(n)$

6 (a) Find the current flowing through a capacitor of $1\,\mu F$ and plot it, when the voltage across the capacitor is represented by the signal shown in figure below.



(b) A linear thermistor has a resistance of 15000 Ω at 0°C and 5000 Ω at 40°C. It is used in a voltage divider circuit as shown in the following figure.



The input voltage V_{in} = 10 V, and at 0°C, the output voltage Vout = 5 V.

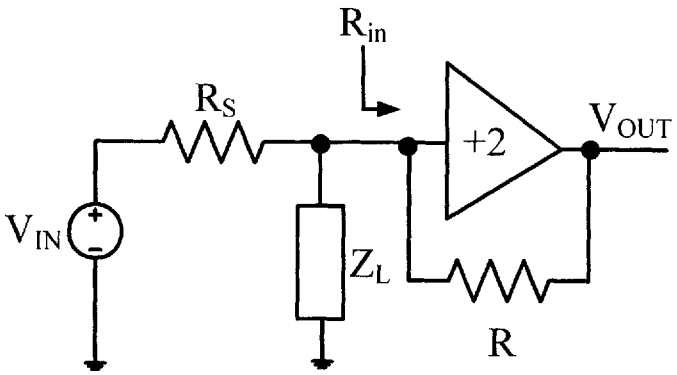
(i) Calculate the output voltage at 40.°C.

(ii) Determine the temperature, when the output voltage of the thermistor measures V_{out} = 3.25 V.

SECTION - C

(Each question is of **28** marks and each sub part **(a)** and **(b)** are of **14** marks each)

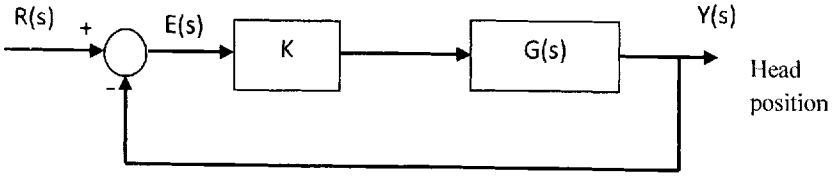
7 For the circuit shown below :



(a) Using Miller Theorem show that the input resistance $R_{in} = -R$.

(b) If Z_L is a capacitor, find the transfer function $\frac{V_{OUT}}{V_{IN}}$.

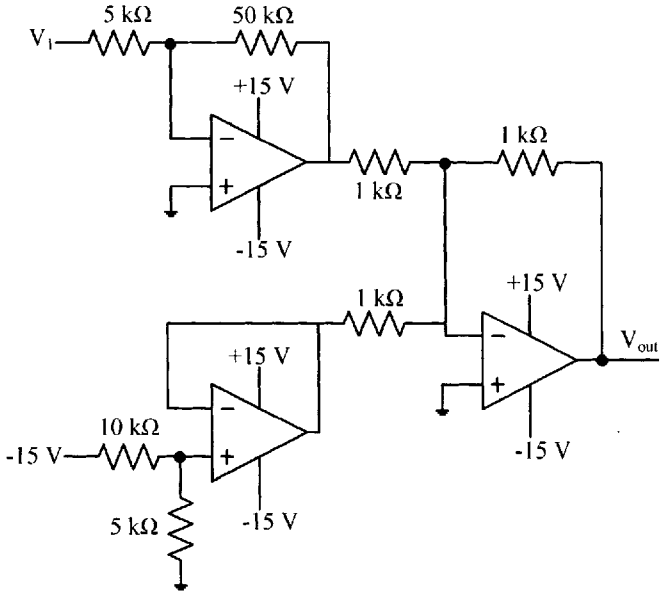
8 A motor is used to position a read/write head over a magnetic disk drive. The transfer function of the motor and head is given by $G(s)=\frac{100}{s(\tau s+1)}$, where τ = 0.001 second. A proportional controller is used for position control, as shown in the figure :



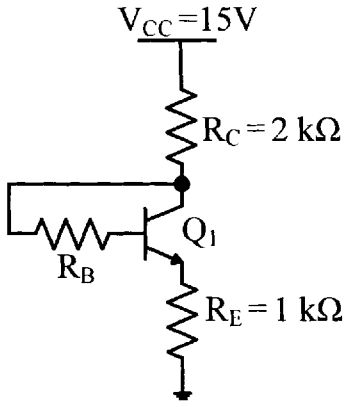
(a) Determine the steady-state error in the head position when a step reference input is applied.

(b) Find the minimum value of K to yield a steady-state error of 0.01 mm for a ramp input of 1 cm/s.

9 (a) For the circuit shown below, calculate the output voltage if V_1 is $1V$. Assume all operational amplifier are ideal.



(b) In a self biased circuit shown below, determine R_B for an emitter current of 1 *mA*. Assume a silicon transistor and $\beta = 99$.



SECTION - D

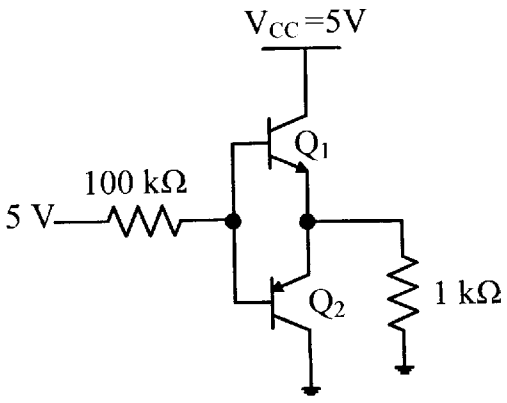
(Each question is of **40** marks and each sub part **(a)** and **(b)** are of **20** marks each)

10 (a) Design an integrator satisfying both

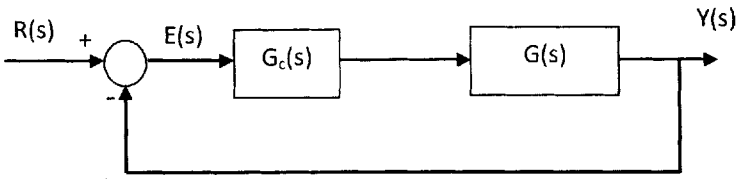
$K = 20/s$ and $V_0(t_1) = 0$;

where K is the integrator transfer function and V_0 is the output voltage of the integrator.

(b) For the circuit shown, determine the voltages and currents at all nodes. Assume a silicon transistor and $\beta = 100$.



11 Consider the feedback system

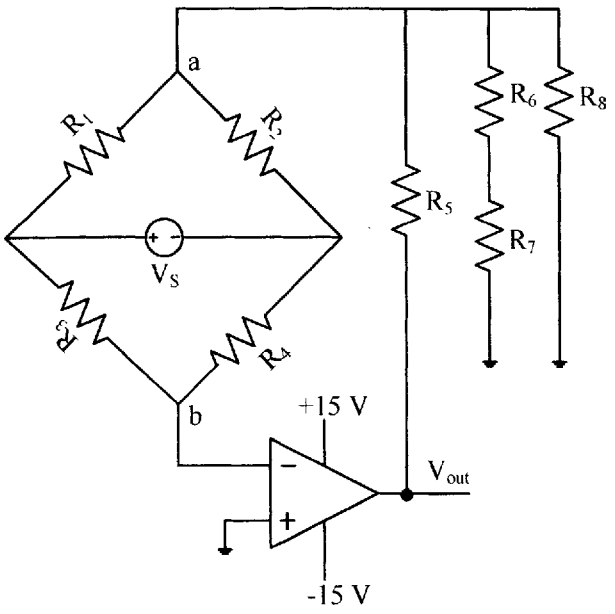


where the plant transfer function is given by $G(s)=\dfrac{s+1}{(s^2+4)(s+3)}$.

(a) For a proportional controller (static) $G_c(s)=K$, compute the steady-state error for a unit step input.

(b) Design a dynamical controller $G_c(s)$ to completely eliminate the steady-state error.

12 The operational amplifier in the circuit shown below is ideal. Compute



(a) The Thevenin resistance and open circuit voltage between node a and b. Also determine the voltages at node a and b.

(b) The voltage gain of the circuit.
