[This question paper contains 7 printed pages.]

Your Roll No. ....

3212 **J**

MEE

Paper–EE.555

NETWORK SYNTHESIS AND FILTER DESIGN

Time : 3 *Hours* *Maximum Marks* : 100

(*Write your Roll No. on the top immediately on receipt of this question paper.*)

*Attempt any **five** questions.*

*Assume suitable missing data (if **any**).*

***All** questions carry equal marks.*

1. (a) Test the given polynomial P(s) for Hurwitz property : 10

(i) $P(s) = s^3 + 2s^2 + 3s + 6$

(ii) $P(s) = s^7 + s^5 + s^3 + s$

(b) Test the given function for positive real function :

(i) $F(s) = \dfrac{s^3 - 1}{4s^3 - 3s^2 - 1}$

(ii) $F(s) = \dfrac{s^2 + 4}{s^3 + 3s^2 + 3s + 1}$ 10

2. (a) (i) For the network shown in fig. 2(a). Find Y(s) when

$$\frac{V_0}{V_i(s)} = \frac{s(s^2 + 3)}{2s^3 + s^2 + 6s + 1}$$

[P. T. O.

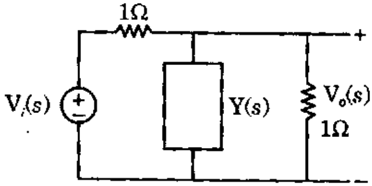

Fig. 2(a)

Synthesize Y(s) as the L–C admittance.

(ii) Which of the following functions are L–C driving point impedance ?

Justify your answer.

$$Z_1(s) = \frac{s(s^2+4)(s^2+16)}{(s^2+9)(s^2+25)}$$

$$Z_2(s) = \frac{(s^2+1)(s^2+8)}{s(s^2+4)}$$

and synthesize the realizable impedance in one Cauer form. 10

(b) (i) Which of the following function is R–L driving point impedance ?

Give justification. Synthesize the realizable impedance in Foster first form

$$F_1(s) = \frac{(s+1)(s+8)}{(s+2)(s+4)}, \quad F_2(s) = \frac{(s+2)(s+4)}{(s+3)(s+5)}$$

(ii) Verify that circuit in fig. 2(b) simulates a grounded inductance : 10

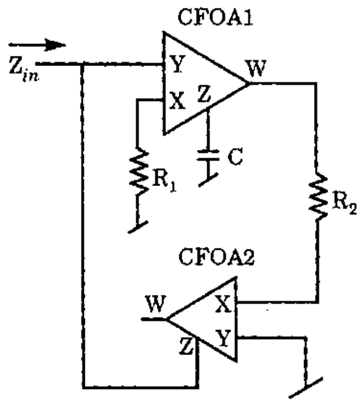

Fig. 2(b)

3. (a) Show that the circuit shown in fig. 3(a) acts as a PIC : 10

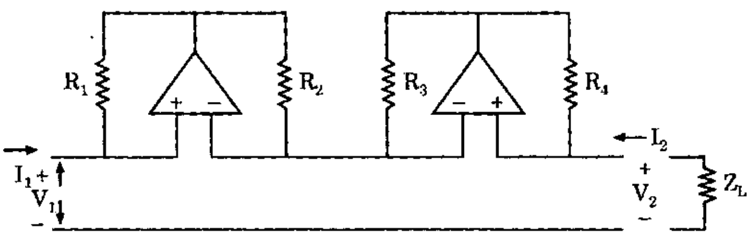

Fig. 3(a)

(b) Assuming $A = \frac{\omega_t}{s}$, what kind of filter can be realized by the circuit of fig. 3(b). Determine the filter parameters. 10

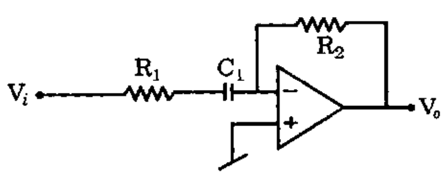

Fig. 3(b)

4. (a) Find the transfer function of the OTA based filter shown in fig. 4(a). Identify the filter and also find its parameters. 10

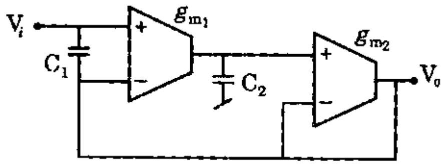

Fig. 4(a)

(b) Prove that in a given CFOA based circuit of fig. 4(b) frequency of oscillation (F.O.) and condition of oscillation (C.O.) are given by

$$\omega_0 = \frac{1}{\sqrt{C_1 C_2 R_1 R_2}} \qquad \text{(F.O.)}$$

$$\frac{R_1}{R_2} + \frac{C_2}{C_1} = \frac{R_1}{R_3} \qquad \text{(C.O.)}$$

10

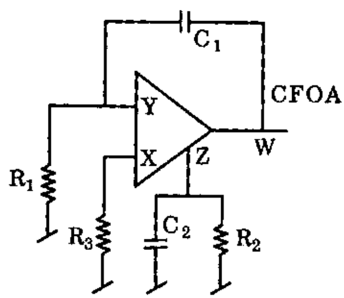

Fig. 4(b)

5. (a) Verify that under appropriate conditions the given circuit of fig. 5(a) can realize first order all pass filter. 8

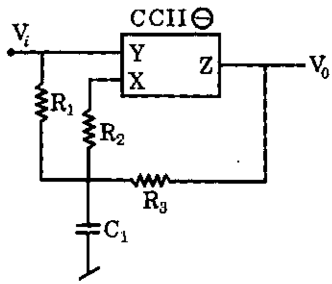

Fig. 5(a)

(b) For the circuit shown in fig. 5(b). Find the transfer function. Identify the type of filter realized.

Let $C_1 = nC_2$ where n is the capacitance spread

$$n \geq 4Q^2 (1+H_0),$$

$H_0 \rightarrow dC$ gain magnitude. Show that

$$R_3 = \frac{1+\sqrt{1-4Q^2(1+H_0)/n}}{Z\omega_0 QC_2}, \quad R_1 = \frac{R_3}{H_0},$$

$$R_2 = \frac{1}{\omega_0{}^2 R_3 C_1 C_2},$$

What is the disadvantage of this filter? 12

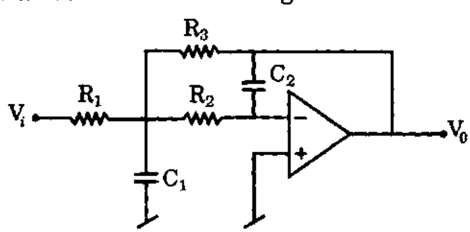

Fig. 5(b)

6. (a) A state variable filter is shown in fig 6(a). Show that the circuit realizes low, high and band pass responses simultaneously at the output of the three OP-AMPs. 12

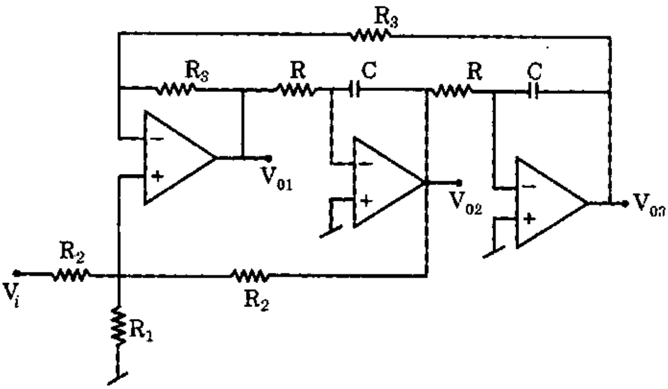

Fig. 6(a)

(b) Determine the ripple factor, the order of the network function that uses butterworth approximation for low pass filter to satisfy the specification :

$\alpha_{max} = 0.5$ dB $\alpha_{min} = 20$ dB

$\omega_p = 1000$ rad/s $\omega_s = 2000$ rad/s 4

(c) Find the input impedance of the circuit : 4

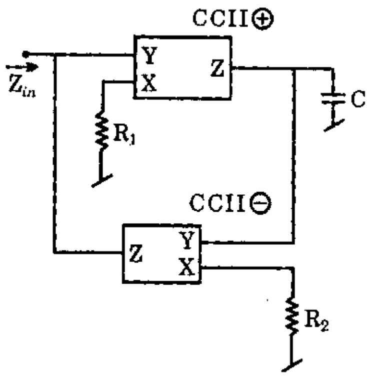

Fig. 6(c)

7. Write short notes on *any two* : 2×10

(a) Tow-Thomas biquad

(b) Chebyshev approximation

(c) Switched capacitor filter

(d) Passive and active filters.