[This question paper contains 5 printed pages.]

3103 *Your Roll No.* .....

MEE **J**

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.*
All *questions carry equal marks.*

1. (a) Show that the circuit of Fig. 1(a) yields the relation

$$i_0 = A(v_2 - v_1) - \frac{1}{R_0} v_L.$$

Find expressions for A and R_0, as well as condition among the resistances that yields

$$R_0 = \infty$$

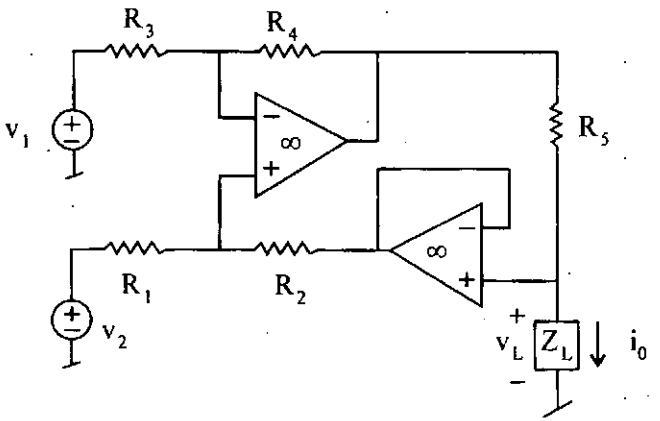

Fig. 1(a) (10)

P.T.O.

(b) Show that the floating-load V–I converter of Circuit in Fig. 1(b) yields

$$i_0 = V_1 \frac{K}{R_1}, \text{ where } K = 1 + \frac{R_2}{R_3}$$

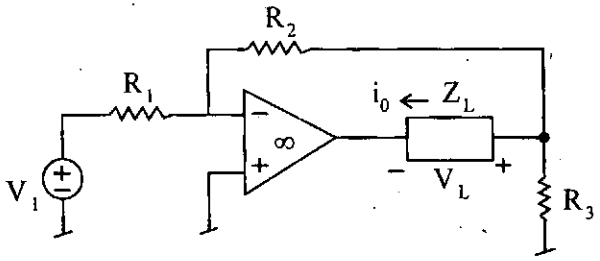

Fig. 1(b) (10)

2. (a) The circuit of Fig. 2(a) can be used to control the input resistance of the inverting amplifier based on op.-amps. Determine the expression for the input resistance, R_i, and also find the condition under which R_i becomes infinite.

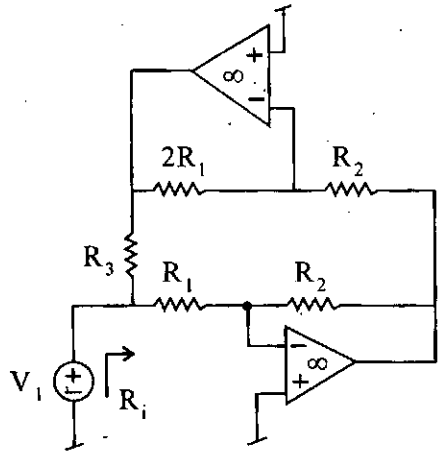

Fig. 2(a) (10)

(b) Determine the gain as well as the output impedance of the current amplifier circuit given in Fig. 2(b).

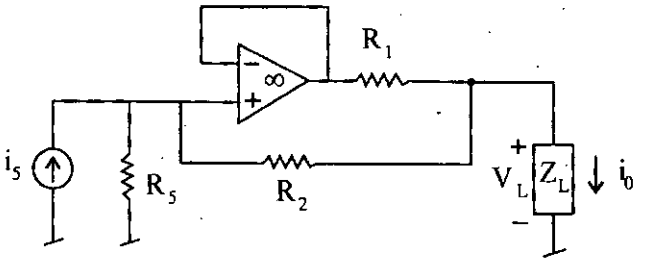

Fig. 2(b) (10)

3. (a) Determine the component values of the circuit given in Fig. 3(a) so that it could integrate a signal having frequency ≥ 100 Hz with a d.c. gain of 11

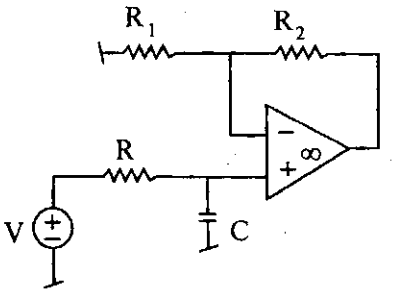

Fig. 3(a) (10)

(b) Show that the circuit given in Fig. 3(b) simulates a non-ideal inductor at its input.

P.T.O.

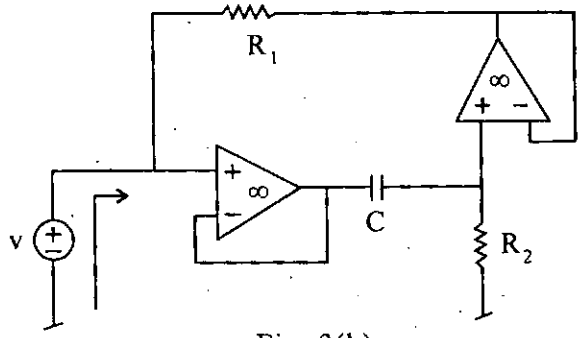

Fig. 3(b) (10)

4. Show that the state variable filter in Fig. 4 realizes a second order High-pass, Band-pass and low-pass filters.

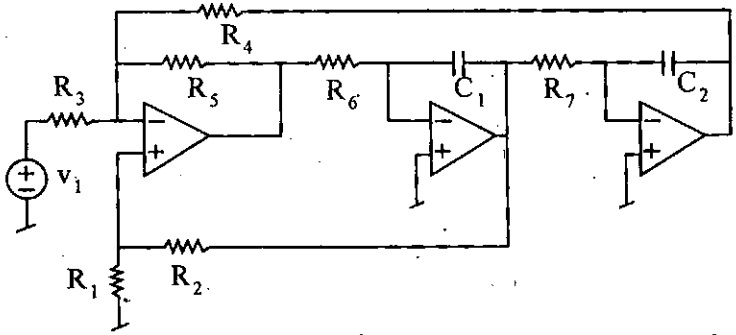

Fig. 4 (20)

5. (a) The circuit in Fig. 5(a) is a capacitance simulator. Determine the expression for C_{eq} (10)

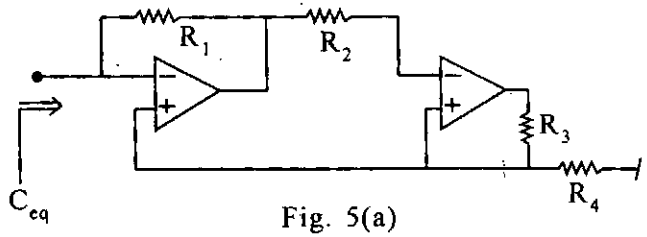

Fig. 5(a)

(b)

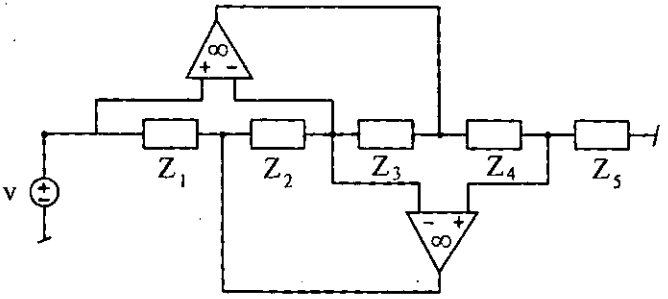

Fig. 5(b)

Determine the input impedance of the circuit of Fig. 5(b) and identify the impedance Z_i, $i = 1 \rightarrow 5$ so that it realizes an ideal grounded inductor, a grounded FDNR and a grounded FDNC. (10)

6. (a) Determine the transfer function of a normalized third order Butter worth low-pass filter. (10)

(b) Determine the order n of a Butterworth filter to satisfy the following conditions

$\alpha_{max} = 0.25$ dB, $\alpha_{min} = 15$ dB, $W_p = 10{,}000$ rad/s, $W_S = 14{,}000$ rad/s. (10)

7. Write short notes on any **two** of the following :

(a) Positive Real functions

(b) Synthesis of RC driving point functions

(c) Butterworth approximation (10+10)

(100)****