Printed Pages : 7 TEC23

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PAPER ID : 0312 Roll No. | | | | | | | | | | |

B.Tech

(SEM VII) ODD SEMESTER THEORY EXAMINATION 2009-10

FILTER DESIGN

Time : 3 Hours] *[Total Marks : 100*

Note : Attempt all questions. Missing data, if any, may be suitably assumed.

1 Attempt any **two** of the following : 10×2

(a) Find the transfer function of the circuit shown in **Fig. 1**, identify the type of filter and also design for center frequency = 10 kHz, Quality factor = 10 and maximum gain =1.

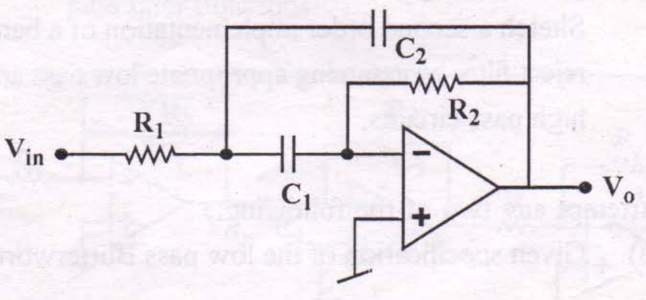

Fig.1

(b) Derive an expression for V_o/V_{in} for the circuit shown in **Fig. 2** assuming non-ideal op-amps having gain $A=\omega_t/s$ where ω_t is the gain-band-width product of the op-amps. Indetify the type of filter realized and determine its parameters.

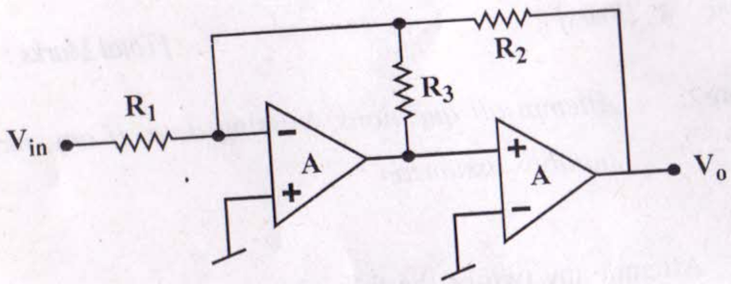

Fig. 2

(c) Show that a second-order band reject filter can be realized as the sum of a second order low pass and second order high pass filter functions. Sketch a second order implementation of a band reject filter by assuming appropriate low pass and high pass circuits.

2 Attempt any two of the following : 10×2

(a) Given specification of the low pass Butterworth filter are $\omega_p=200$ rad/s, $\omega_s=600$ rad/s, $A_{max}=0.5$ dB and $A_{min}=20$ dB. Find normalized and denormalised transfer functions.

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(b) Transform the following normalized low pass function into a symmetrical band reject function that has its center frequency 1000 Hz and its low frequency pass band edge at 100 Hz.

$$T_{LP}(S)=\frac{1}{S+1}.$$

(c) Derive the gain deviation for the function

$$T_{LP}(S)=\frac{1}{S^2+S\left(\frac{\omega_p}{Q_p}\right)+\omega_p^2}.$$

3 Attempt any two of the following :

(a) Derive an expression for low pass and band pass transfer functions for the circuit shown in **Fig. 3.** Modify the circuit by using appropriate additional circuitry to realize high pass, band stop and all pass filter functions.

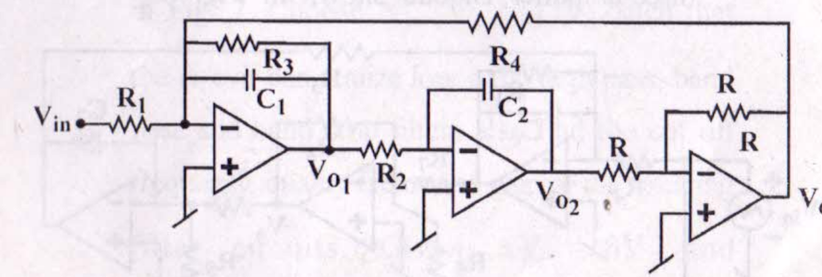

Fig. 3

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(b) For the circuit shown in **Fig. 4** use the concept of FDNR to convert it into an active 'inductor'less' low pass filter and show its complete op-amp implementation.

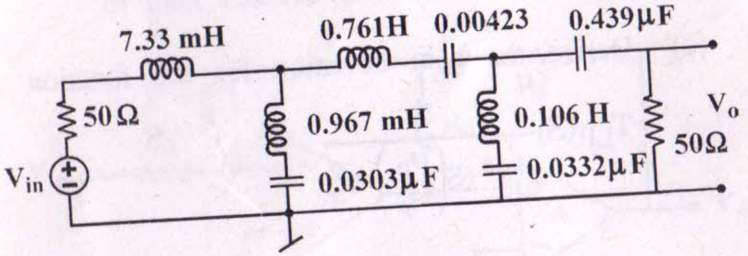

Fig. 4

(c) Synthesize the Transfer function

$$T(S)=\frac{-10(S^2-20S+4000)}{S^2+5S+4000}$$ using feed forward three-amplifier Biquad shown in **Fig. 5**

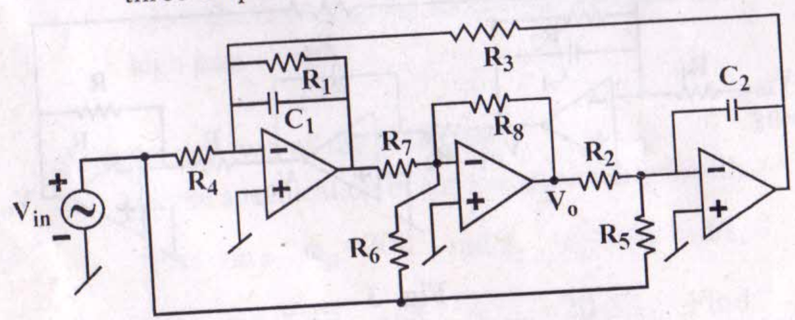

Fig. 5

4 Attempt any two of the following :

(a) Show that the circuit of **Fig. 6** realizes a grounded inductor. Use a minimum number of OTAs to convert the circuit into a floating inductor. Find the value of L equivalent in both grounded and floating cases.

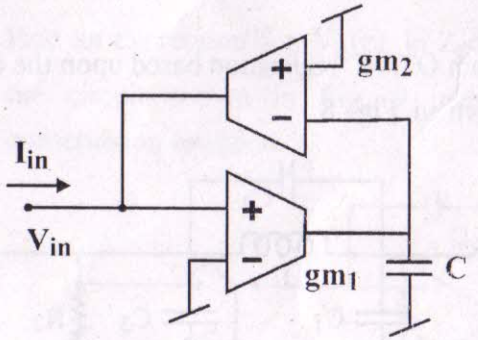

Fig. 6

(b) Derive an expression for V_o for the circuit shown in **Fig.** 7. Choose V_1, V_2 and V_3 such that the circuit can realize low pass, high pass, band pass and band stop filters also find the cut off frequency, quality factor and gain of the resulting filter circuits. Given $\pm V_{cc}=\pm 6V$ and $C_1=C_2=1$ nF. Assume CA3080 type OTAs.

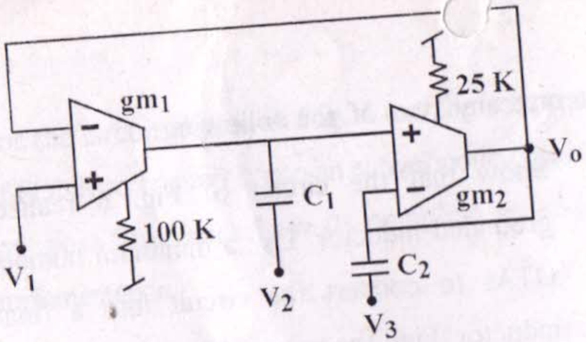

Fig. 7

(c) Obtain OTA-C realization based upon the circuit shown in **Fig. 8**.

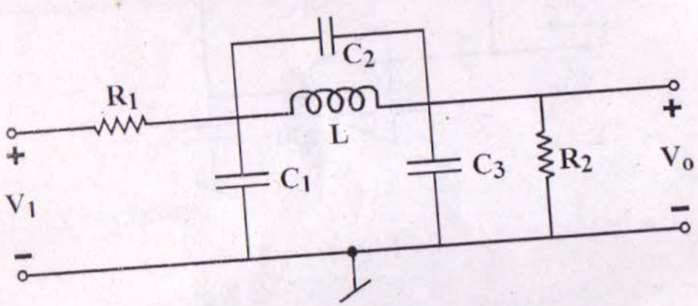

Fig. 8

5 Attempt any two of the following :

(a) What are the advantage and disadvantage of the switched capacitor (SC) filters over opamp-RC filters ? Draw the equivalents of the following :

(i) Series SC

(ii) Series parallel SC and

(iii) Bilinear SC.

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(b) Obtain switched capacitor KHN Biquad from the op-amp RC KHN Biquad using any number of ideal op-amps, but a minimum number of switches and a minimum number of capacitors. Find V_{01}/V_{in}, V_{02}/V_{in} and V_{03}/V_{in} for the derived SC-equivalent KHN Biquad.

(c) Find an expression for $V_o(z)$ in Z-domain for the circuit shown in **Fig. 9** using 'charge conservation equation'.

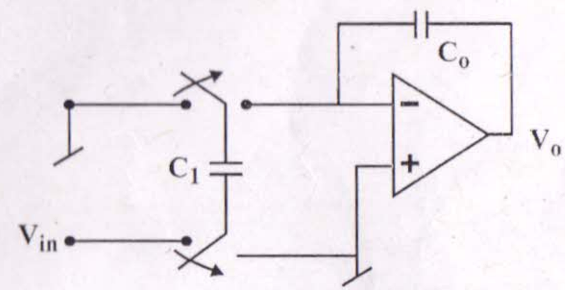

Fig.9