Name:

Enrolment No:

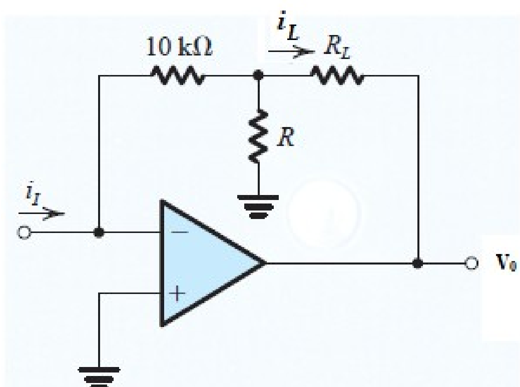
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

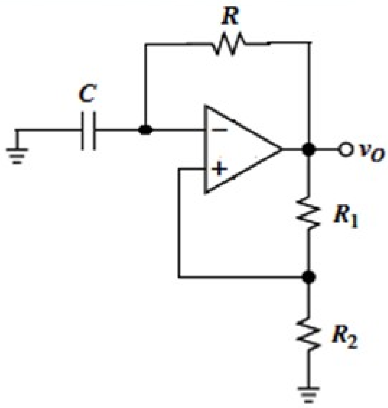
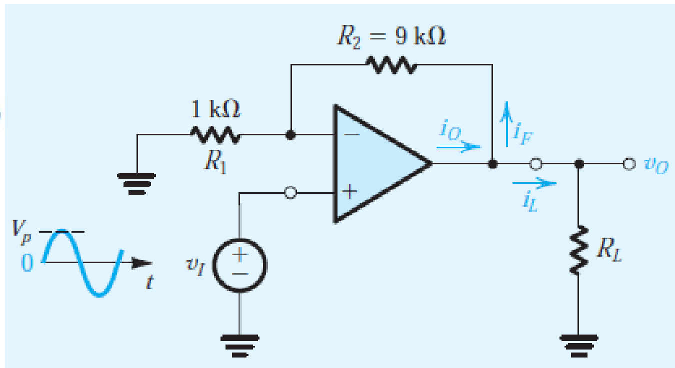
Course: Linear Integrated Circuits (ELEG263) **Semester: IV**
Program: B Tech Electrical
Time: 03 hrs. **Max. Marks: 100**
No. of page/s: 4

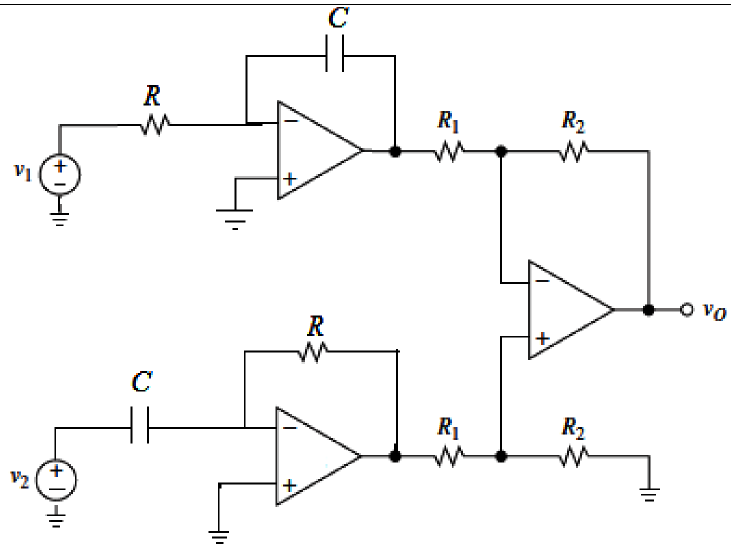
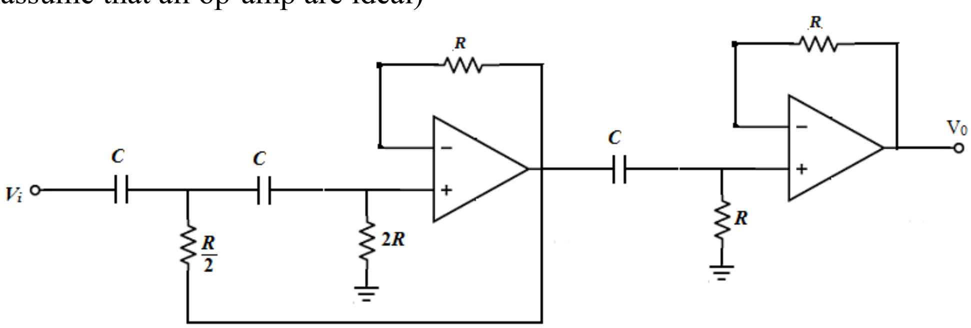
Instructions:

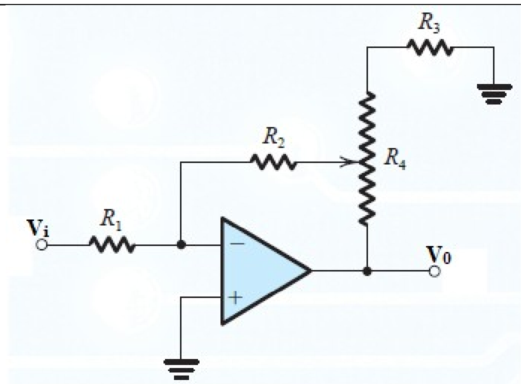
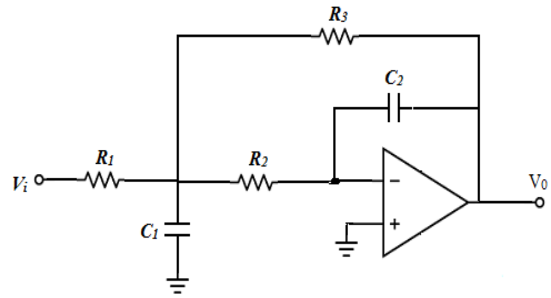
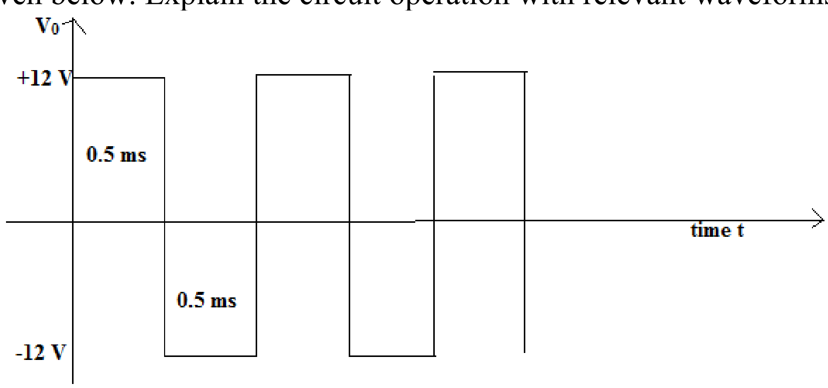
- The question paper contains three sections namely Section-A, Section-B and Section-C.
- Attempt all questions. The number of marks for each question is mentioned on the right side of it.
- Assume any data if required and indicate the same clearly. Unless otherwise indicated symbols and notations have their usual meanings.
- Strike off all unused blank pages

SECTION A (20 Marks)

S. No.		**Marks**	**CO**
Q 1	**(a)** The open loop gain of a certain op-amp is 1.75×10^{5} and its common mode gain is 0.18. find the CMRR in decibels **(b)** Distinguish between input bias current and input off-set current in op-amp. And then calculate the input bias and off-set currents for an op-amp with input currents 8.3 μA and 7.9 μA. **(c)** How long does it take the output voltage of an op-amp to go from $-10\,V$ ¿ $+10\,V$ if the slew rate is 0.5 V/μs	**1+3+1**	**CO1**
Q 2	Assuming the op amp to be ideal, it is required to design the circuit shown in **Fig.1** to implement a current amplifier with gain $i_L/i_L=10$. Find the required value for R.  **Fig. 1**	**5**	**CO2**
Q 3	**(a)** Draw a circuit of 4-bit R-2R ladder DAC using 15 kΩ and 30 kΩ resistors.	**5**	**CO5**

	(b) For a reference voltage of 16 V, calculate the output voltage for an input of 1101 to the above circuit from part (a)		
Q 4	For the circuit in **Fig.2**, let the op-amp has saturation voltages be ±10 V, R_1 =100 kΩ, $R_2 = R$ = 1 MΩ, and C = 0.01 μF. Find the frequency of oscillation.	**5**	**CO3**
	 **Fig. 2**  **Fig. 3**		
	SECTION B (40 Marks)		
Q 5	Consider the noninverting amplifier circuit shown in **Fig.3**. As shown, the circuit is designed for a nominal gain $1+\frac{R_2}{R_1}$ It is fed with a low-frequency sine-wave signal of peak voltage V_p and is connected to a load resistor R_L. The op amp is specified to have output saturation voltages of ±13 V and output current limits of ±20 mA. **(a)** For V_p = 1V and R_L = 1 kΩ, calculate v_0, i_L, i_F, i_0 for the signal resulting at the output of the amplifier. **(b)** For R_L = 1 kΩ, what is the maximum value of Vp for which an undistorted sine-wave output is obtained? **(c)** For V_p = 1 V, what is the lowest value of R_L for which an undistorted sine-wave output is obtained?	**4+2+2**	**CO1**
Q 6	**(a)** Sketch and explain operation of the circuit of a 555 timer connected as an astable multi-vibrator. **(b)** If the frequency of the oscillations of astable multi-vibrator using 555 timer is 350 kHz, determine the value of capacitor C needed using $R_A = R_B$ = 7.5 kΩ_.	**6+2**	**CO4**
Q 7	With neat block diagram, explain the operation of 8-bit successive approximation register type ADC. What is the maximum conversion time for this type of ADC.	**8**	**CO5**
Q 8	Determine the output V_0 of the following Op-amp circuit shown in **Fig. 4**. (Assume that all the Op-amps are ideal). Where $V_1 = 5+2\sin\omega t$, $V_2 = 3t+2\cos\omega t$, R = 100kΩ, C = 10μF, $R_2 = 2R_1$	**4+4**	**CO2**

	 **Fig.4**		
Q9	Determine the transfer function of 3rd order filter as shown in **Fig. 5** and then determine the type of filter (LP, HP, BP or BS filter) and its cut-off frequency. (assume that all op-amp are ideal)  **Fig.5**	**8**	**CO3**
SECTION-C (40 Marks) **Attempt any two questions from this section**			
Q 10	**(a)** Design an inverting op-amp circuit to form the weighted sum V_0 of two inputs V_1 and V_2. It is required that $V_0 = -(V_1 + 5\ V_2)$. Choose values for R_1, R_2, and R_F so that for a maximum output voltage of 10 V the current in the feedback resistor will not exceed 1 mA. **(b)** Design the circuit shown in **Fig. 6** to have an input resistance of 100 kΩ and a gain V_0/V_i that can be varied from −1 to −10 using the 10 kΩ potentiometer R_4. What voltage gain results when the potentiometer is set exactly at its middle value?	**10+10**	**CO2**

	 **Fig. 6**  **Fig. 7**		
Q 11	**(a)** Design a multi-feedback 2nd order low pass filter shown in **Fig. 7** with a cut-off frequency of 1 kHz, a voltage gain of 20 dB and a quality factor (Q) of 5. Given that $R_1 = R_2 = 1$ kΩ **(b)** Design an op-amp wave form generating circuit to produce the waveform as given below. Explain the circuit operation with relevant waveforms. 	**10+10**	**CO3**
Q 12	**(a)** Design an astable multi-vibrator using 555 timer for a frequency of 10 kHz and a duty cycle of 70%. Assume C = 0.1 μF **(b)** Design a Sallen key second order band pass filter shown in fig. with bandwidth 10% of center frequency. Given that the center frequency is 10 kHz and R = 1 kΩ	**10+10**	**CO4**