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M.Sc. TE (2 Year), 2nd Sem. Date: May 23, 2024

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Summer Semester, A. Y. 2022-2023
Course No.: EEE 6295 — Time: 3 Hours
Course Title: Advanced Electronics — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) An instrumentation amplifier shown in Fig. 1.a is an amplifier of low-level signals used in process control or measurement applications and commercially available in single-package units. Show that 15

$$v_0 = \frac{R_2}{R_1}\left(1 + \frac{2R_3}{R_4}\right) v_2 - v_1.$$

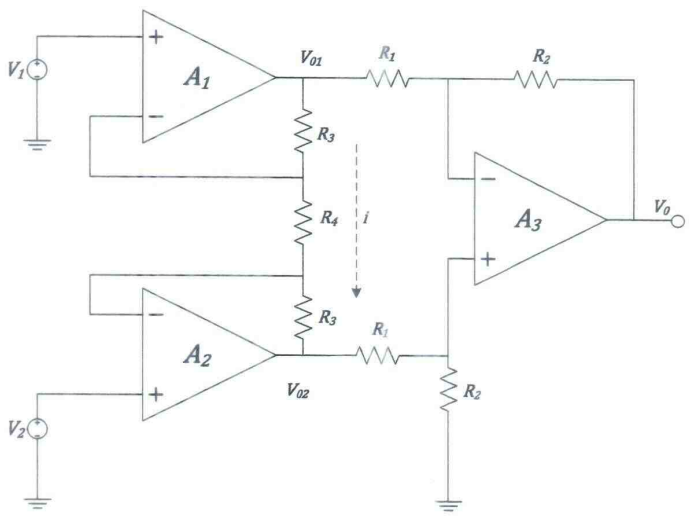

Fig. 1.a

b) Design an operational amplifier circuit with inputs v_1 and v_2 such that $v_0 = 20v_1 - 12v_2$. Use only one op-amp in the design. 10

2. Draw the circuit diagram and derive the output for the following circuits considering ideal operational amplifier. 5×5= 25

   i. Voltage follower circuit,
   ii. Summing amplifier circuit,
   iii. Inverting amplifier circuit,
   iv. Differentiator circuit and
   v. Integrator circuit.

3. a) The digital-to-analog converter (DAC) transforms digital signals into analog form. A typical example of a four-bit DAC is illustrated in Fig. 3.a. Now, in the op-amp circuit of Fig. 3.a, let $R_f = 10k\Omega, R_1 = 10k\Omega$, $R_2 = 20k\Omega, R_3 = 40k\Omega$, and $R_4 = 80k\Omega$. Obtain the analog output for binary inputs [0000], [0001], [0010], . . . , [1111]. 20

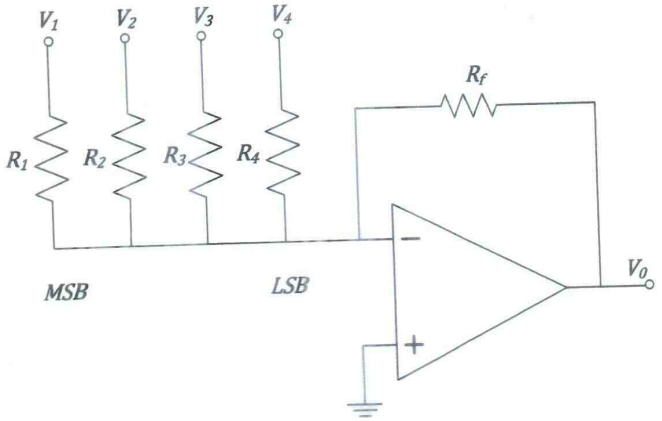

Fig. 3.a

b) Construct an one-shot multivibrator circuit. 5

4. Draw the circuit diagram, input-output relation with time, and transfer function for the following detector circuits. 5×5= 25
   i. Non-inverting zero-crossing detector,
   ii. Inverting zero-crossing detector,
   iii. Unipolar Triangular wave generator,
   iv. Third order high pass filter and
   v. Non-inverting negative level detector.

5. a) Draw a square wave generator circuit when the input is a triangular wave and discuss its input-output relation with time. Calculate the upper and lower threshold of the circuit. 15

   b) Design an operational amplifier circuit with inputs v_1 , v_2, v_3 and v_4 such that output is $v_0 = 3v_1 + 5v_2 - 10\int v_3 - 20\frac{dv_4}{dx}$. 10

6. a) Discuss the operation of a free running multi-vibrator circuit with the help of a diagram. Derive the equation for the time period (T). 15

   b) Design an astable multi-vibrator circuit to generate a square wave with 1 kHz frequency (*f*). 10

7. a) What is a passive filter? Draw a passive low-pass and analyze its output relation with frequency. Discuss its disadvantages. 15

   b) Draw an active high-pass and low-pass filter and find their gains. 10

8. a) Draw an active band-reject filter and find its gain, quality factor. 10

   b) Design an active bandpass voice filter that has lower and upper cutoff frequencies of 500 Hz and 5 kHz respectively. Use first order low pass and high pass filter. Draw the circuit diagram of your design. 15