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Daffodil International University
Department of Electrical and Electronic Engineering, Faculty of Engineering
Mid Term Examination, Fall – 2025

Course Code: 0714- 221 | Course Title: Electronics II
Section: A, B, C | Level-Term: L2-T2 | Teacher's Initial: SR
Full Marks: 25 | Date: Oct. 18, 2025 | Time: 1.5 Hours

[Notes: Answer all the following questions]

Q1. **Determine** the output voltage v_o in the Op-Amp circuit of below *Fig. 1.* **CO-1 (C3) 05**

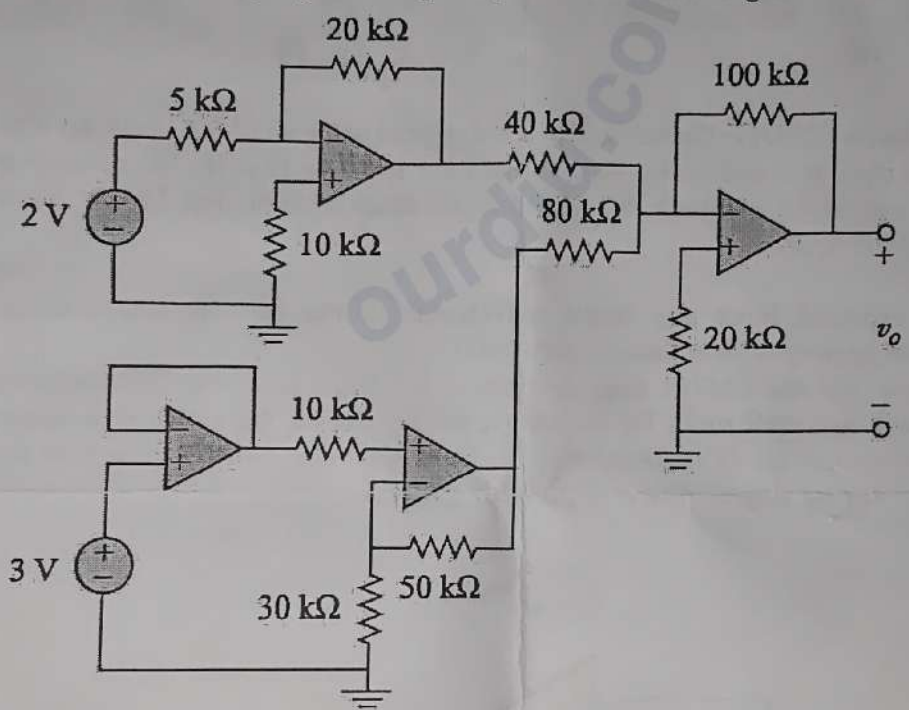


Fig. 1

Q2. **Design** a temperature threshold alarm using an LM741 as a comparator. **CO-1 (C4) 05**

- A sensor provides 10 mV/°C output (0 V at 0 °C).
- The system should trigger (output goes HIGH) when the temperature exceeds 40°C.
- The LM741 is powered from ±12 V.
- Assume the sensor output goes to the non-inverting input.
- Use a resistor divider from the +12 V supply to generate the reference voltage.

Tasks:

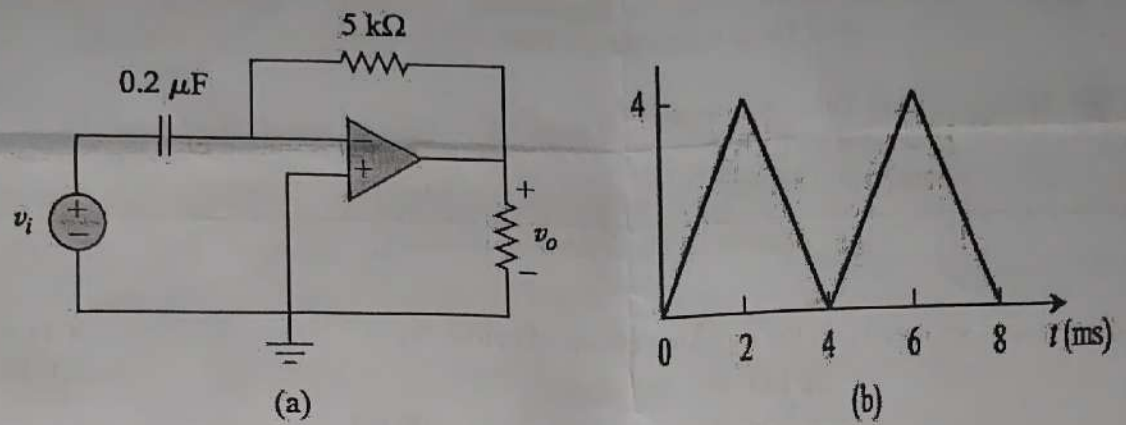
1. Draw the comparator circuit with LM741.
2. Calculate the reference voltage that corresponds to 40 °C.
3. Choose suitable resistor values (≥10 kΩ) for the divider to generate this reference voltage.
4. Show the output condition when the temperature is:
   - (a) 35 °C
   - (b) 45 °C

Q3 I. If an OP-Amp differential amplifier has Common-Mode Rejection Ratio (**CMRR**) = 80 dB and differential gain (A_d)=200, **determine** the common-mode gain (A_{cm}). **CO-1 (C4) 02**

II. **Design** a circuit to amplify the difference between two input signal by 2. (a) Use only one op amp. (b) Use two op amps. All resistances must be ≥ $10k\Omega$ in your design. **03**

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Q4. The waveform in Fig. (b) is applied to the input of the op amp differentiator in Fig. (a). **Calculate** the output and **show** the output waveform. **CO-1 (C3)** **05**



Q5. A zero-crossing detector (ZCD) in the below *Fig. 2* is designed using an LM741 op-amp with ±15 V supply. The input is a sine wave: $V_{in} = 5\sin(2\pi * 10kHz * t)\, volt$. The op-amp is configured as a comparator (open-loop ZCD) with no feedback resistor. The LM741 has a typical **slew rate** of 0.5 V/μs. **CO-1 (C3)** **05**

- Draw the expected input and output waveforms of the zero-crossing detector assuming the op-amp is ideal (infinite slew rate).
- Now consider the real LM741 with slew rate = 0.5 V/μs. Calculate the minimum transition time (rise/fall time) for the output swing. Sketch the actual (non-ideal) output waveform of the ZCD considering the finite slew rate. Clearly show how the output edges appear sloped instead of perfectly vertical.

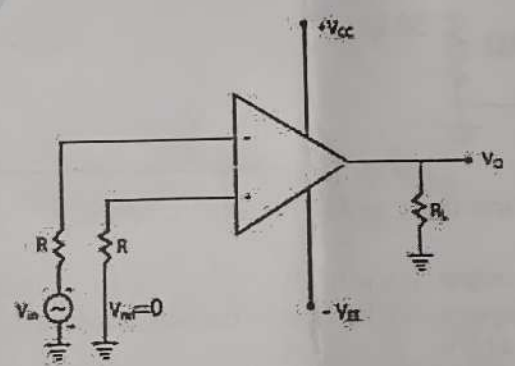


Fig. 2: zero-crossing detector (ZCD)