

T.E. Biomedical Engineering.
Sem -V (CBSGS)
Analog and Digital Circuit Design (solution)

- Q1 Attempt any **Four** of following. [20]
- MOSFET structure - 01 mark, working - 02 marks, characteristics - 02 marks
 - Block diagram - 02 marks and Explanation of block diagram - 03 marks.
 - Types of analog switches - 05 marks
 - Any 4 points with examples - 01 mark each. - 05 marks
 - GIC explanation - 03 marks and Examples - 02 marks
 - PLL block diagram - 02 marks, Explanation of block diagram - 02 marks and list applications - 01 marks.

- Q2 a. Equation for $V_o = 01$ mark and $I_{sc} - 01$ mark and solution - 03 marks [05]

$$V_o = V_{ref} \frac{R_2}{R_1 + R_2}$$

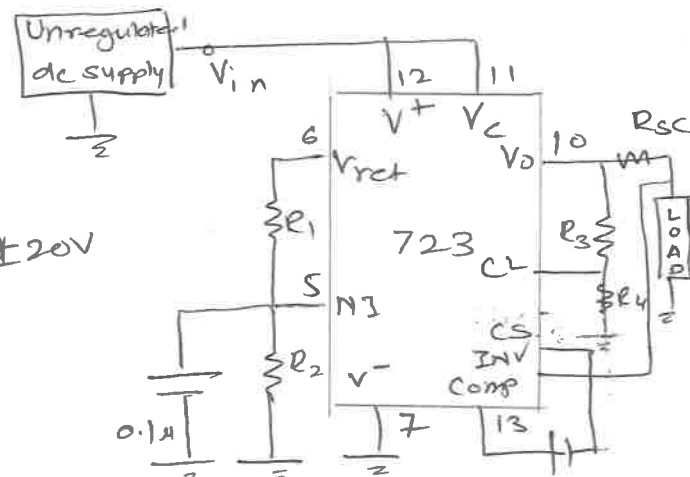
$$V_o = V_{NI} = V_{ref} \frac{R_2}{R_1 + R_2}$$

$$V^+ = +V_{cc} = V_{in} = 15 \pm 20V$$

$$R_3 = R_1 \parallel R_2$$

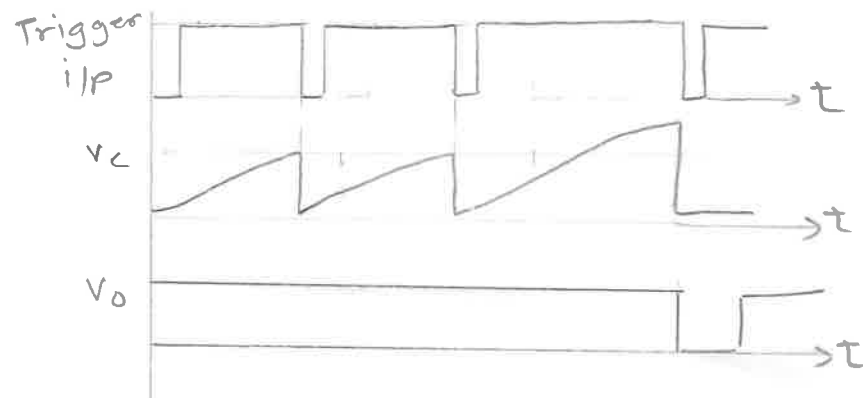
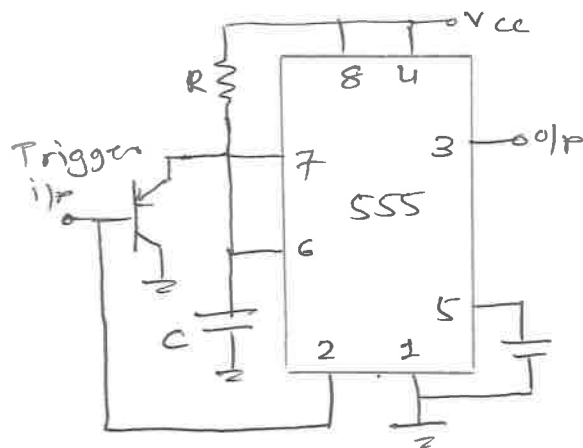
$$V^- = GND.$$

$$I_{sc} = \frac{V_{senc}}{R_{sc}} = \frac{0.5}{R_{sc}}$$



- UJT Relaxation oscillator circuit diagram - 02 mark, working - 02 marks, Derivation for Frequency - 03 marks [07]
- Stepper motor diagram - 03 mark, working - 05 marks. [08]

- Q3 a. Comparison between active and passive (3 points) - 02 marks [10]
KRC filter circuit - 2 marks, Explanation - 02 marks, Derivation of Q - 04 marks
- Lock Range - 02 marks, Capture range - 02 marks [05]
Pull in time - 01 marks.
 - Missing pulse circuit diagram - 01 mark, working - 02 marks, waveforms - 02 marks [05]

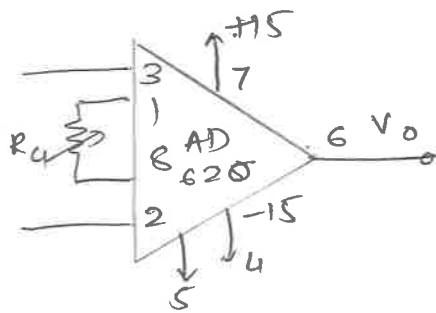


Q4 a. SCR Diagram -02 mark, equivalent model - 02 marks, Explanation - 04 marks. [08]

b. Design an Instrumentation Amplifier using AD620 for gain of 650 and explain its applications. [06]

Circuit Diagram -02 mark, Design for gain - 02 marks, application - 02 marks.

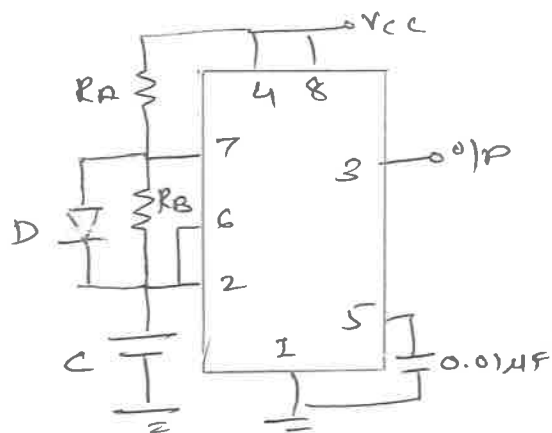
$$\text{Gain} = 1 + \frac{49,400}{R_4}$$



c. Design a timer for Duty cycle 40% for $T_{on} = 0.8\text{ms}$. Draw corresponding waveforms. [06]

Circuit Diagram -01 mark, Solution for R_A, R_B, C - 03 marks.

Waveforms for V_o (showing T_{on} and T_{off}) and capacitor - 02 marks



$$T = T_{on} + T_{off}$$

$$D = \frac{T_{on} \times 100}{T} = 40$$

$$T_{on} = 0.693 R_A C$$

$$T_{off} = 0.693 R_B C$$

[As Duty cycle is less than 50% diode is used for bypass R_B during charging time]

$$\therefore T = 2\text{ms} \quad \therefore T_{on} = 1.2\text{ms}$$

Assuming $C = 0.1\mu\text{F}$.

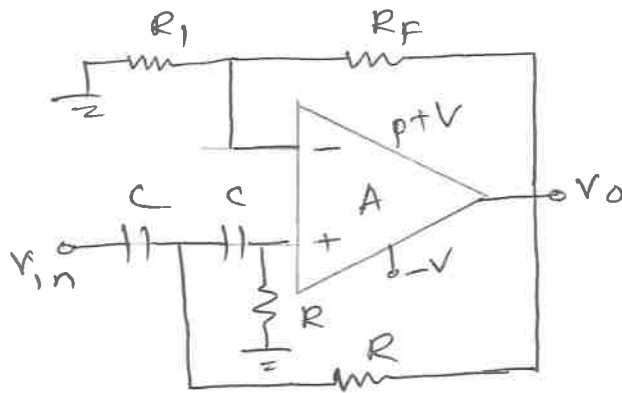
$$\therefore R_A = 17.32\text{k}\Omega \approx 18\text{k}$$

$$R_B = 11.54\text{k}\Omega \approx 12\text{k}$$

Q5 a. Functional Block diagram of IC8038 –02 mark, Explanation – 03 marks. [05]

b. A 2nd order Butterworth high pass filter for $f = 1.5$ KHz and also plot its frequency response. [05]

Circuit Diagram –01 mark, Solution – 02 marks, Plotting frequency response – 02 marks.



$$A_f = 1.586 = 1 + \frac{R_f}{R_1}$$

$$f = \frac{1}{2\pi RC} = 1.5k$$

Assume C then find R .

$$\left| \frac{V_o}{V_{in}} \right| = \frac{A_f}{\sqrt{1 + (f_c/f)^4}}$$

$A_f = 1.586 =$ passband gain for the 2nd order Butterworth response.

plot frequency response using $\left| \frac{V_o}{V_{in}} \right|$ eqⁿ.

c. Functional Block Diagram –04 mark, Explanation – 03 marks. [10]
Explanation for pin 2 and 5 – 03 marks

Q6. Attempt any **Four** of following:- [20]

a) Explain FSK using IC 555
Diagram – 02 marks, Explanation- 03 marks

b) Short note on :Switching Mode Power Supply
Diagram – 02 marks, Explanation- 03 marks

c) Short note on :Opto –Isolators and Opto -Couplers
Diagram – 02 marks, Explanation- 03 marks

d) Draw Symbol, structure and characteristics of DIAC and TRIAC.
symbol – 01 mark, structure -02 marks, Characteristics- 02 marks

e) Draw Frequency response of Butterworth, Chebyshev and Elliptical filters and compare them.
frequency response – 02 marks, Comparison- 03 marks