

GUJARAT TECHNOLOGICAL UNIVERSITY

BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: 3141002

Date: 19/05/2026

Subject Name: Analog Circuit Design

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

- Q.1**
- (a) Compare ideal and practical Op-amp characteristics with typical values. **03**
 - (b) Compare Hybrid Pi model and h-parameter models with necessary diagrams. **04**
 - (c) Explain the working principle of a BJT-based Phase-Shift Oscillator with a neat circuit diagram, and derive the expression for its frequency of oscillation. **07**
- Q.2**
- (a) Draw the differential amplifier using two op-amps. Define differential and common-modes relative to it. **03**
 - (b) Definition of transconductance (g_m), Derive its dependence of BJT transconductance on $|I_c|$, $|V_{CE}|$, and temperature. How this is affected at high frequency. **04**
 - (c) Derive the expression for the closed-loop voltage gain of a voltage-series feedback amplifier using an operational amplifier (Op-Amp) and neat clean labelled diagram. Also, explain how feedback affects the input and output resistances of the amplifier. **07**
- OR**
- Q.2**
- (c) Define feedback and discuss various feedback topologies. In a negative feedback amplifier $A = 100$, $\beta = 0.02$, input signal voltage is 40mV. Determine : (i) voltage gain with feedback (ii) feedback voltage (iii) output voltage **07**
- Q.3**
- (a) For an inverting amplifier the input voltage is sinewave with a peak voltage of 1 volt and frequency of 1 KHz. Determine the value of output voltage and draw the input and output voltage waveforms. Assume $R_1 = 1K\Omega$, $R_f = 10K\Omega$ and the supply voltage to be $\pm 15V$. **03**
 - (b) Implement Op-amp based Integrator circuit. Derive expression for the output voltage V_o . Sketch the output waveform for square wave input. **04**
 - (c) Explain the working of op-amp based inverting comparator circuit with (i) Positive reference voltage (ii) Negative reference voltage. Show necessary waveforms. Also draw and explain the transfer characteristics. **07**
- OR**
- Q.3**
- (a) A non inverting amplifier with a gain of 10 is to be driven with 2 volts peak to peak sine wave of 20KHz frequency. What should be the minimum slew rate of the op-amp to have the distortion free output? **03**
 - (b) Explain the operation of an Averaging Amplifier using Op-Amp with necessary circuit diagram and derivations. **04**

	(c) Classify and explain mode of operation of the Power Amplifiers based on their mode of operation, efficiency, operating point, load line, characteristics and application. Also draw the relevant basic circuits and graphs. (in tabular format)	07
Q.4	(a) Draw the complete internal block diagram based circuit diagram of IC 555 based bi-stable multi-vibrator. Also draw the necessary waveforms.	03
	(b) With a neat circuit diagram, explain the working of a Schmitt Trigger. Draw the input and output waveforms.	04
	(c) Define active and passive filters. Discuss the merits and demerits of active filters over passive filters. Mention their applications also.	07
	OR	
Q.4	(a) Compare small signal and large signal amplifiers in tabular manner also mention the parameter of comparison.	03
	(b) Draw and explain the Block diagram of regulated DC power supply with necessary waveforms.	04
	(c) Draw and explain the working of Audio Power amplifier with relevant mathematics.	07
Q.5	(a) Draw the diagram and Explain AM detection using PLL.	03
	(b) Define and discuss relative to filters (i) Q factor (ii) Roll off (iii) Filter order (iv) 3dB Bandwidth with necessary diagrams.	04
	(c) Discuss the complete design procedure for 1st order HPF with suitable example. Also draw the frequency response.	07
	OR	
Q.5	(a) Draw and explain the working of Class B Push pull amplifier.	03
	(b) Explain Lock range and Capture range.	04
	(c) Draw the Block diagram and describe the operation of each block of phase lock loop. List out PLL applications.	07
