Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1

i. The output of a particular Op-amp increases 8V in 12µs. The slew rate is ……. **1**
(a) 90 V/µs   (b) 0.67 V/µs   (c) 1.5 V/µs   (d) None of these

ii. The purpose of level shifter in Op-amp internal circuit is to **1**
(a) Adjust DC voltage   (b) Increase impedance
(c) Provide high gain   (d) Decrease input resistance

iii. A certain non-inverting amplifier has R_i of 1 kΩ and R_f of 100 kΩ. The closed-loop voltage gain is ……… **1**
(a) 100,000   (b) 1000   (c) 101   (d) 100

iv. Find the output voltage of the log-amplifier **1**
(a) $V_O = -(kT) \times \ln(V_i/V_{ref})$ (b) $V_O = -(kT/q) \times \ln(V_i/V_{ref})$
(c) $V_O = -(kT/q) \times \ln(V_{ref}/V_i)$ (d) $V_O = (kT/q) \times \ln(V_i/V_{ref})$

v. Why inductors are not preferred for audio frequency? **1**
(a) Large and heavy   (b) High power dissipation
(c) High input impedance   (d) None of these

vi. Which filter type is called a flat-flat filter? **1**
(a) Cauer filter   (b) Butterworth filter
(c) Chebyshev filter   (d) Band – reject filter

vii. The clipping level in op-amp is determined by **1**
(a) AC supply voltage   (b) Control voltage
(c) Reference voltage   (d) Input voltage

viii. An astable multivibrator requires: **1**
(a) Balanced time constants   (b) A pair of matched transistors
(c) No input signal   (d) Dual J-K flip flops

ix. The switching regulators can operate in **1**
(a) Step up   (b) Step down
(c) Polarity inverting   (d) All of these

x. Voltage regulation requires **1**
(a) Only line regulation.   (b) Only load regulation.
(c) Load and line regulation.   (d) A constant load

Q.2 i. What is an operational amplifier? Give examples of linear circuits of op-amp. **2**

ii. Write six difference between Ideal and practical op-amp. **3**

iii. Derive expression for voltage gain, input impedance and output impedance of Dual input balanced output differential amplifier. **5**

OR iv. (a) Write advantages of IC Technology. **2**
(b) Define – **3**
   (I)   CMRR
   (II)   Gain - Bandwidth Product
   (III) Input offset voltage

Q.3 i. (a) Op-amp is used mostly as an integrator than a differentiator. Explain why? **4**
(b) Draw circuit diagram and output waveform of a comparator circuit.

ii. What is an instrumentation amplifier? Draw the circuit diagram and derive expression of output voltage for an instrumentation amplifier. **6**

OR iii. Draw Wien bridge oscillator circuit. Derive expression for oscillating frequency and required voltage gain. Also write its application. **6**

Q.4 i. What is Notch filter? Draw its circuit diagram. **2**

ii. Why do we use all pass filters? Draw its circuit diagram and derive its expression of gain and phase difference. **3**

iii. What are the advantages of active filters? How can you realize a low pass and high pass filter using op-amp? Derive their expression of gain. **5**

OR iv Draw the circuit diagram and frequency response of first order band pass filter. Design a band pass filter with following specifications: **5**
$F_L = 200Hz$, $F_H = 1KHz$ and pass band gain= 4.
Assume capacitor C= 0.05μF.

Q.5   Attempt any two:
i. Explain the working of monostable mode of 555 timer. Draw its circuit diagram and waveforms also derive the expression for the time period of pulse generated. **5**

ii. Draw and explain Peak detector circuit and sample and hold circuit with output waveform. Also write its limitation. **5**

iii. Draw and explain Schmitt trigger circuit with output waveform. Also explain hysteresis voltage plot with diagram. **5**

Q.6 i. What are the advantages of IC voltage regulators? **2**

ii. Define the terms: **3**
(a) Line regulation   (b) Load Regulation
(c) Ripple Rejection

iii. Explain the operation of a dual tracking voltage regulator using op-amp. **5**

OR iv. Explain the operation of a step up and step down switching regulator with a block diagram. **5**

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Sample Scheme of Marking
EI3CO02/EC3CO02

Q.1 i. The output of a particular Op-amp increases 8V in 12μs. The slew **1**
rate is …….
(b) 0.67 V/μs

ii. The purpose of level shifter in Op-amp internal circuit is to **1**
(a) Adjust DC voltage

iii. A certain noninverting amplifier has R_i of 1 kΩ and R_f of 100 kΩ. **1**
The closed-loop voltage gain is ………
(c) 101

iv. Find the output voltage of the log-amplifier **1**
(b) $V_O = -(kT/q) \times ln(V_i/V_{ref})$

v. Why inductors are not preferred for audio frequency? **1**
(a) Large and heavy

vi. Which filter type is called a flat-flat filter? **1**
(b) Butterworth filter

vii. The clipping level in op-amp is determined by **1**
(c) Reference voltage

viii. An astable multivibrator requires: **1**
(c) No input signal

ix. The switching regulators can operate in **1**
(d) All of these

x. Voltage regulation requires **1**
(c) Load and line regulation.

Q.2 i. An operational amplifier   -1 mark   **2**
Examples of linear circuits of op-amp   -1 mark

ii. One difference between Ideal and practical op-amp - 0.5 mark **3**
0.5*6=3 marks

iii. Ac equivalent diagram of Dual input balanced output **5**
differential amplifier   -1 mark
Derivation of expression for voltage gain   -2 marks
Input impedance   -1 marks
Output impedance   - 1 marks

OR iv. (a) Advantages of IC Technology(at least 4) - 2 marks **5**

(b) (I) CMRR   - 1 mark
(II) Gain - Bandwidth Product   - 1 mark
(III) Input offset voltage   - 1 mark

Q.3 i. (a) Explanation   - 2 mark   **4**
(b) Circuit diagram   - 1 marks
Output waveform   - 1 mark

ii. Definition   - 1 mark   **6**
Circuit diagram   - 2 marks
Derivation for expression of output voltage - 3 marks

OR iii. Wien bridge oscillator circuit diagram   - 1 mark   **6**
Derivation for expression for oscillating frequency - 2 marks
Voltage gain   - 2 marks
Application   - 1 mark

Q.4 i. Notch filter   - 1 marks **2**
Circuit diagram   - 1 marks

ii. Uses of all pass filter   - 1 mark   **3**
Circuit diagram   - 1 mark
Derivation of expression of gain and phase difference - 1 mark

iii. Advantages of active filters   - 1 mark   **5**
Realization of a low pass and high pass filter using op-amp
                                             - 2 marks
Derivation of expression of gain   - 2 marks

OR iv Circuit diagram   - 1 mark   **5**
Frequency response   - 1 mark
Design   - 3 marks

Q.5 i. Working of monostable mode of 555 timer - 2 marks **5**
Circuit diagram   -1 mark
Waveforms   -1 mark
Expression for the time period of pulse   -1 mark

ii. Peak detector circuit : Diagram   - 1mark   **5**
Explanation   - 1 mark
Output waveform   - 0.5 mark
Sample and hold circuit: Diagram   - 1 mark

		Explanation	- 1 mark	
		Output waveform	- 0.5 mark	
OR	iii.	Schmitt trigger circuit diagram	- 1 mark	**5**
		Output waveform	- 1 mark	
		Explanation	- 2 marks	
		Explanation & Diagram of hysteresis voltage plot	- 1 mark	
Q.6	i.	Advantages of IC voltage regulators(atleast 4)	-2 marks	**2**
	ii.	(I) Line regulation	- 1 mark	**3**
		(II) Load Regulation	-1 mark	
		(III) Ripple Rejection	-1 mark	
	iii.	Diagram	- 2 marks	**5**
		Operation	- 3 marks	
OR	iv.	Step up : Diagram	- 1 mark	**5**
		Operation	- 1.5 marks	
		Step down: Diagram	- 1 mark	
		Operation -	1.5 marks	

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