SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

IV SEMESTER

EC3462 – LINEAR INTEGRATED CIRCUITS

(COMMON TO IV SEMESTER ELECTRICAL & ELECTRONICS ENGINEERING)

Regulation – 2023

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SUBJECT : EC3462 - LINEAR INTEGRATED CIRCUITS

SEMESTER/YEAR : IV /II

Unit I - BASICS OF OPERATIONAL AMPLIFIERS

IC classification, fundamentals of monolithic IC technology, Realization of monolithic ICs and packaging, Current mirror and current sources, Current sources as active loads. Ideal Operational Amplifier. DC and AC performance characteristics, Open and closed loop configurations.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1.	What is current mirror?	CO1	BTL 1	Remembering
2.	Give the difference between monolithic and hybrid ICs	CO1	BTL 2	Understanding
3.	What are the major categories of integrated circuits?	CO1	BTL 1	Remembering
4.	Point out the limitation of current mirror circuits.	CO1	BTL 1	Remembering
5.	Generalize the steps involved in IC fabrication.	CO1	BTL 1	Remembering
6.	State the concept of metallization.	CO1	BTL 1	Remembering
7.	Classify ICs on the basic of application, device used and chip	CO1	BTL 2	Understanding
8.	Why ion implantation is preferred over diffusion process?	CO1	BTL 2	Understanding
9.	Differentiate the ideal and practical characteristics of an op amp.	CO1	BTL 2	Understanding
10.	Draw the internal block diagram of op amp IC 741.	CO1	BTL 2	Understanding
11.	Write about the characteristics of an op amp.	CO1	BTL 2	Understanding
12.	Write the AC characteristics of an op amp.	CO1	BTL 2	Understanding
13.	Summarize the DC characteristics of an op amp.	CO1	BTL 1	Remembering
14.	When does the op amp behave as a switch?	CO1	BTL 2	Understanding
15.	Justify that, why IC741 op-amp not used for high frequency applications?	CO1	BTL 2	Understanding
16.	Why the open loop op amp configurations are not used in linear applications.	CO1	BTL 2	Understanding

17.	Mention about the virtual ground of an op amp.		CO1	BTL 1	Remembering
18.	Define input offset current.		CO1	BTL 1	Remembering
19.	Why IC 741 is not used for high frequency applications?		CO1	BTL 2	Understanding
20.	State the reasons for the offset currents at the input of the op amp.		CO1	BTL 2	Understanding
21.	Predict the reasons for using current sources in integrated circuits.		CO1	BTL 1	Remembering
22.	Mention the advantage of Widlar current source over constant current Source.		CO1	BTL 1	Remembering
23.	List the advantages of current mirror.		CO1	BTL 1	Remembering
24.	What happens when the common terminal of V+ and V- sources is not grounded?		CO1	BTL 1	Remembering
	PART – B				
1.	Explain the classification of integrated circuits based on the scale of integration and functionality. Describe the advantages and limitations of monolithic ICs.	(16)	CO1	BTL 3	Applying
2.	Describe the fabrication process of monolithic ICs in detail. Highlight the steps involved, such as oxidation, photolithography, diffusion, and metallization.	(16)	CO1	BTL 3	Applying
3.	Illustrate the use of a current source as an active load in an amplifier circuit. Analyze how it improves the gain and overall performance of the circuit.	(16)	CO1	BTL 4	Analyzing
4.	Draw the circuit of basic current mirror and explain its operation with neat sketch.	(16)	CO1	BTL 4	Analyzing
5.	Discuss about how current ratio can be improved in the basic current mirror. Sketch the improved circuit and explain it.	(16)	CO1	BTL 2	Understanding
6.	Use appropriate block diagram and explain the operation of operational amplifier IC.	(16)	CO1	BTL 2	Understanding
7.	With a help of a block diagram, explain the various stages present in an op amp.	(16)	CO1	BTL 3	Applying
8.	Explain in detail about basic information about op amps with neat diagram.	(16)	CO1	BTL 4	Analyzing
9.	(i) Write down the characteristics and their respective values of an ideal op amp. (ii) Compare the ideal and practical characteristics of IC741.	(8) (8)	CO1	BTL 3	Applying
10.	(i) Describe in detail about output side of internal circuit diagrams of IC 741. (ii) With a neat diagram Explain the input side of the internal circuit diagram of IC741.	(8) (8)	CO1	BTL 3	Applying
11.	List and explain the DC characteristics of an operational amplifier.	(16)	CO1	BTL 3	Applying
12.	Explain in detail about Input Bias Current, Input offset Current, Input offset voltage and Thermal drift.	(16)	CO1	BTL 3	Applying
13.	With neat diagram derive the AC performance close loop characteristics of Op amp.	(16)	CO1	BTL 3	Applying

14.	Explain in detail about Open and closed loop configurations of operational amplifier.	(16)	CO1	BTL 3	Applying
15.	With the Schematic diagram, explain the effect of R_E on CMRR in differential amplifier.	(16)	CO1	BTL 4	Analyzing
16.	With the help of a neat circuit diagram, discuss the construction and working of Wilson current source?	(16)	CO1	BTL 4	Analyzing
17.	Design a Widlar current source for generating a constant current I_O = 10 µA. Assume Vcc = 10 V , V_{BE} = 0.7 V , β = 125. Use V_T = 25 mV.	(16)	CO1	BTL 3	Applying

UNIT II-APPLICATIONS OF OPERATIONAL AMPLIFIERS

Scale Changer, Phase Shift Circuits, Voltage Follower, adder, subtractor, Integrator, Differentiator, Instrumentation amplifier, V-to-I and I-to-V converters, Logarithmic amplifier, Comparators, Astable and Monostable Multivibrators, Schmitt trigger, clipper and clamper, Low and high pass filters.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	Brief the term voltage follower.	CO2	BTL 2	Understanding
2.	Mention the need for an instrumentation amplifier.	CO2	BTL 2	Understanding
3.	What is meant by V-to-I Converter?	CO2	BTL 2	Understanding
4.	Define differentiator.	CO2	BTL 1	Remembering
5.	Point out the main drawbacks of ideal differentiator.	CO2	BTL 2	Understanding
6.	List the characteristics of the comparator.	CO2	BTL 1	Remembering
7.	Write short note about Multivibrators.	CO2	BTL 2	Understanding
8.	Draw the Logarithmic amplifier circuit.	CO2	BTL 2	Understanding
9.	Interpret the important function of comparator circuit.	CO2	BTL 2	Understanding
10.	Define Schmitt trigger.	CO2	BTL 1	Remembering
11.	Give an application of inverting amplifier.	CO2	BTL 1	Remembering
12.	List the applications of Log amplifiers.	CO2	BTL 1	Remembering
13.	Mention the disadvantages of passive filters.	CO2	BTL 1	Remembering
14.	Classify the different types of filters.	CO2	BTL 2	Understanding
15.	Give the applications of V-I converter.	CO2	BTL 2	Understanding
16.	Draw the circuit diagram of Monostable Multivibrators	CO2	BTL 1	Remembering
17.	Cite few applications of clamper.	CO2	BTL 2	Understanding
18.	Summarize the features of differentiator circuit using op amp.	CO2	BTL 1	Remembering
19.	Brief the operation of linear op amp circuit.	CO2	BTL 2	Understanding
20.	Classify the different types of the linear op amp circuit.	CO2	BTL 2	Understanding
21.	Construct a non-linear op amp circuit.	CO2	BTL 1	Remembering
22.	Enumerate some non-linear op amp circuits.	CO2	BTL 2	Understanding
23.	Analyze the operation of a filter.	CO2	BTL 2	Understanding
24.	Name two application of Schmitt trigger.	CO2	BTL 1	Remembering

PART – B					
1.	Analyze the operation of Adder and Subtractor using op amp with circuit analysis.	(16)	CO2	BTL 4	Analyzing
2.	With a suitable circuit diagram, explain the operating principle of an instrumentation amplifier and derive its gain.	(16)	CO2	BTL 4	Analyzing
3.	Obtain a second order active low pass filter for a cut-off frequency of 2 KHz.	(16)	CO2	BTL 3	Applying
4.	Explain in detail about Astable Multivibrators with neat sketch.	(16)	CO2	BTL 3	Applying
5.	Write the operation of Current to Voltage and Voltage to current converter circuits.	(16)	CO2	BTL 3	Applying
6.	Describe the operation of Transconductance and Trans resistance amplifier.	(16)	CO2	BTL 3	Applying
7.	Explain the operation of Instrumentation amplifier and derive its output.	(16)	CO2	BTL 3	Applying
8.	(i)Discuss the working of Schmitt trigger with neat diagram. (ii)Describe the operation of voltage follower with neat diagram.	(8) (8)	CO2	BTL 3	Applying
9.	Explain the working of clipper and clamper circuits using an op amp.	(16)	CO2	BTL 3	Applying
10.	Derive the expression for log computation using op amp and explain with necessary circuit diagram.	(16)	CO2	BTL 3	Applying
11.	Explain the Monostable operation using IC741.	(16)	CO2	BTL 3	Analyzing
12.	Design an adder circuit using op – amp.	(16)	CO2	BTL 3	Applying
13.	Design a differentiator using Op amp to differentiate an input signal with f_{max} = 150 Hz.	(16)	CO2	BTL 4	Analyzing
14.	(i)With neat figures describe the working of an integrator using op amp. (ii)Derive the expression for output voltage of a practical integrator.	(8) (8)	CO2	BTL 3	Applying
15.	Discuss about the working of Comparator with neat circuit diagram.	(16)	CO2	BTL4	Analyzing
16.	Explain the working of Schmitt Trigger with neat sketch.	(16)	CO2	BTL 3	Applying
17.	(i)Construct the first order Low pass Butterworth filter and derive its voltage gain. (ii)Write the design steps for first order Low pass Butterworth filter	(8) (8)	CO2	BTL 3	Applying

UNIT III - ANALOG MULTIPLIER AND PLL

Analog Multiplier using Emitter Coupled Transistor Pair, analog multiplier ICs and their applications, Voltage controlled oscillator, Operation of the basic PLL, Closed loop analysis, Monolithic PLL IC 565, applications of PLL.

PART A					
Q.No	**Questions**		**CO**	**BT Level**	**Competence**
1.	Outline the basic building blocks of PLL.		CO3	BTL 1	Remembering
2.	Define lock-in range of PLL.		CO3	BTL 1	Remembering
3.	What is Pull- in time?		CO3	BTL 1	Remembering
4.	For perfect lock, what should be the phase relation between the incoming signal and VCO output signal?		CO3	BTL 2	Understanding
5.	Write the classification of phase detector.		CO3	BTL 2	Understanding
6.	Interpret the term capture range.		CO3	BTL 2	Understanding
7.	Why VCO is also called as V to F converter?		CO3	BTL 1	Remembering
8.	Examine the characteristics of an analog multiplier.		CO3	BTL 2	Understanding
9.	Give the applications of analog multipliers.		CO3	BTL 2	Understanding
10.	How the Voltage to Frequency conversion factor is calculated?		CO3	BTL 2	Understanding
11.	What is the role of a VCO in a PLL?		CO3	BTL 1	Remembering
12.	State the principle of operation of a VCO.		CO3	BTL 2	Understanding
13.	Summarize the advantages of variable transconductance technique.		CO3	BTL 2	Understanding
14.	How the square root and square of a signal is obtained with multiplier circuit?		CO3	BTL 1	Remembering
15.	What is meant by "modulation sensitivity" in a VCO?		CO3	BTL 1	Remembering
16.	List the three stages through which PLL operates.		CO3	BTL 1	Remembering
17.	What is two-quadrant multiplier?		CO3	BTL 2	Understanding
18.	How does temperature affect the performance of a VCO?		CO3	BTL 1	Remembering
19.	How PLL is used to design the frequency synthesizer?		CO3	BTL 2	Understanding
20.	Point out the basic function of phase detector.		CO3	BTL 1	Remembering
21.	Brief the function of the voltage-controlled oscillator,		CO3	BTL 1	Remembering
22.	Mention the typical applications of Phase-Locked Loop.		CO3	BTL 2	Understanding
23.	What are the factors affecting the stability of a PLL?		CO3	BTL 1	Remembering
24.	How a PLL is used in frequency modulation (FM) demodulation?		CO3	BTL 2	Understanding
PART – B					
1.	Describe the basic principle of analog multiplication techniques.	(16)	CO3	BTL 3	Applying

2.	Explain the following applications of Analog Multiplier ICs (i) Voltage squarer and Voltage divider (ii) Square rooter and Phase angle detector	 (8) (8)	CO3	BTL 3	Applying
3.	With a neat block diagram, explain the use of analog multipliers in phase detectors and discuss their significance in PLL systems.	(8) (8)	CO3	BTL 4	Analyzing
4.	(i) Outline the operation of the multiplier cell using Emitter- coupled transistor pair. (ii) How the output voltage of an analog multiplier is proportional to the product of the two input voltages and state their limitations.	(8) (8)	CO3	BTL 3	Applying
5.	With the necessary diagrams explain the closed loop analysis of PLL.	(16)	CO3	BTL 3	Applying
6.	How would you describe the block diagram of PLL with neat sketch?	(16)	CO3	BTL 3	Applying
7.	Examine the process of capturing the lock and derive for capture range and lock range.	(16)	CO3	BTL 4	Analyzing
8.	List the applications of PLL and explain any three in detail with neat diagram.	(16)	CO3	BTL 1	Remembering
9.	Discuss the operation of a basic Phase-Locked Loop with a block diagram. Explain the role of each block in the system.	(16)	CO3	BTL 3	Applying
10.	Illustrate the operation of VCO with neat block diagram. Also derive an expression for f0.	(16)	CO3	BTL 3	Applying
11.	For PLL 565, given the free-running frequency as 100KHz, the demodulation capacitor of 1μf and supply voltage is ±6V, determine the lock and capture frequencies and identify the component values.	(16)	CO3	BTL 3	Applying
12.	Discuss the importance of frequency stability in VCOs. What methods are used to improve frequency stability and minimize phase noise?	(16)	CO3	BTL 4	Analyzing
13.	Deduce the expression for free running frequency of voltage-controlled oscillator.	(16)	CO3	BTL 4	Analyzing
14.	A PLL IC565 connected as an FM demodulator has R1 = 10 kΩ, C1 = 0.01 μF and C2= 10 μF. The supply voltage is 10V. Determine the Free running Frequency, Lock range and capture range.	(16)	CO3	BTL 4	Analyzing
15.	Describe about PLL used with Digital phase Detector with neat sketch.	(16)	CO3	BTL 3	Applying
16.	Derive the expression for Lock range and capture range used in PLL.	(16)	CO3	BTL 3	Applying
17.	Explain how PLL is used in frequency modulation and demodulation with the help of relevant diagrams and mathematical expressions.	(16)	CO3	BTL 3	Applying

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type.

PART A

Q. No	Questions	CO	BT Level	Competence
1.	Mention any two specifications of D/A converter.	CO4	BTL 2	Understanding
2.	Classify the direct type ADCs.	CO4	BTL 2	Understanding
3.	What is the function of integrating type converter?	CO4	BTL 1	Remembering
4.	Specify the principle of operation of successive Approximation ADC.	CO4	BTL 2	Understanding
5.	Mention the main advantages of integrating type ADCs.	CO4	BTL 2	Understanding
6.	Write a short note on sampling.	CO4	BTL 2	Understanding
7.	State the main drawback of a dual-slop ADC.	CO4	BTL 1	Remembering
8.	Write note about conversion time.	CO4	BTL 2	Understanding
9.	Find the number of resistors required for an 8-bit weighted resistor D/A converter. Consider the smallest resistance is R and obtain those resistance values.	CO4	BTL 2	Understanding
10.	Give the advantages of inverted R-2R (current type) ladder D/A converter over R -2R (voltage type) D/A converter.	CO4	BTL 1	Remembering
11.	Brief the need for electronic switches in D/A converter.	CO4	BTL 1	Remembering
12.	What is meant by delta modulation?	CO4	BTL 1	Remembering
13.	Which is the fastest A/D converter? Give reason.	CO4	BTL 1	Remembering
14.	Outline the principle of operation of voltage to time conversion.	CO4	BTL 1	Remembering
15.	What would be produced by a DAC whose output range is 0-10v and whose input binary number is 10111100 (for a 8 bit DAC)?	CO4	BTL 1	Remembering
16.	Calculate the number of comparators required for realizing a 4-bit flash A/D converter.	CO4	BTL 2	Understanding
17.	A 12-bit D/A converter have resolution of 30 mV/ LSB. Find the full-scale output voltage.	CO4	BTL 2	Understanding
18.	How many comparators are required to build n –bit flash type A/D converter?	CO4	BTL 2	Understanding
19.	What output voltage would be produced by a D/A converter whose output range is 0 to 10 V and whose input binary number is 0110 for a 4-bit DAC?	CO4	BTL 2	Understanding
20.	Define gain error and monotonicity with respect to data converters.	CO4	BTL 1	Remembering
21.	For an n-bit flash type A/D converter, how many comparators are required? State the disadvantage of that type of converter.	CO4	BTL 2	Understanding
22.	List the advantages of dual slope ADC.	CO4	BTL 1	Remembering
23.	Compare single slope and dual slope A/D converters.	CO4	BTL 1	Remembering

24.	Calculate the values of LSB and MSB for an 8- bit DAC for 0V to 10V range.		CO4	BTL1	Remembering
	PART – B				
1.	Illustrate the operation of high-speed sample and hold circuits.	(16)	CO4	BTL 3	Applying
2.	Explain in detail about performance analysis of DAC.	(16)	CO4	BTL 3	Applying
3.	Describe Weighted resistor DAC with neat diagram.	(16)	CO4	BTL 4	Analyzing
4.	With a neat sketch explain the operational features of 4-bit weighted resistor type D/A converter.	(16)	CO4	BTL 4	Analyzing
5.	Analyze the working of R- 2R ladder type DAC.	(16)	CO4	BTL 4	Analyzing
6.	Describe the operation of voltage mode R- 2R ladder D/A converter.	(16)	CO4	BTL 3	Applying
7.	Explain the working of inverted R- 2R ladder type DAC.	(16)	CO4	BTL 3	Applying
8.	Design a suitable D/A converter to convert 8-bit binary input in parallel form. Binary '0' corresponds to 0V and binary '1' to 5V. Maximum output is +5V. Assume any other data that may be required. Explain its operation.	(16)	CO4	BTL 4	Analyzing
9.	Illustrate the operation of current mode R- 2R ladder D/A converter.	(16)	CO4	BTL 3	Applying
10.	Summarize the working of flash type ADC with its merits and demerits.	(16)	CO4	BTL 3	Applying
11.	Describe in detail about the single slope type ADC with neat sketch.	(16)	CO4	BTL 3	Applying
12.	A dual slope ADC has a full-scale input of 2 Volts. It uses an integrating time of 10ms and integrating capacitor of 0. 1µf.The maximum magnitude of the integrator output should not exceed 3V. Calculate the value of the integrating resistor.	(16)	CO4	BTL 4	Analyzing
12.	(i) Draw the diagram of sample and hold circuit (ii) State how you will reduce its hold mode droop. and output waveforms	(8) (8)	CO4	BTL 4	Analyzing
13.	Explain in detail about the dual slope type ADC with neat sketch.	(16)	CO4	BTL 3	Applying
14.	Write about the working principle of successive approximation type ADC.	(16)	CO4	BTL 3	Applying
15.	(i) With circuit, explain current mode type of DAC's. Compare with voltage mode type. (ii) What are oversampling data converters?	(10) (6)	CO4	BTL 3	Applying
16.	Describe the operation of any two direct type of ADCs.	(16)	CO4	BTL 3	Applying
17.	Explain in detail on the operational features of 4-bit weighted resistor type D/A converter	(16)	CO4	BTL 4	Analyzing

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, IC555 Timer, IC Voltage regulators, IC 723 general purpose regulator, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier.

PART A

Q. No	Questions	CO	BT Level	Competence
1.	State the need for current limiting in voltage regulators.	CO5	BTL 1	Remembering
2.	Hartley oscillator has L1=10mH, L2=5mH and C=200pF.calculate the frequency of oscillations.	CO5	BTL 1	Remembering
3.	Sketch a fixed voltage regulator circuit.	CO5	BTL 1	Remembering
4.	State the two conditions of oscillations.	CO5	BTL 2	Understanding
5.	Mention the basic blocks of 555 Timer.	CO5	BTL 2	Understanding
6.	Cite an application of 555 timer in Monostable mode of operation.	CO5	BTL 2	Understanding
7.	Draw the functional block diagram of 723 regulator.	CO5	BTL 2	Understanding
8.	What is the need for voltage regulator ICs?	CO5	BTL 2	Understanding
9.	Name some LC Oscillator circuits.	CO5	BTL 2	Understanding
10.	Examine the main function of a voltage regulator.	CO5	BTL 1	Remembering
11.	Draw the functional block diagram of IC 723 regulator.	CO5	BTL 1	Remembering
12.	Categorize the applications of multivibrator.	CO5	BTL 2	Understanding
13.	Draw a fixed voltage regulator circuit and state its operations.	CO5	BTL 2	Understanding
14.	Define line regulation of a regulator.	CO5	BTL 1	Remembering
15.	In a linear voltage regulator, the input voltage is 20V and output voltage is 15V, for a load current of 1 ampere, calculate the power dissipated in the series pass element.	CO5	BTL 2	Understanding
16.	How does switched capacitor emulate resistor?	CO5	BTL 1	Remembering
17.	Mention the applications of 555 Timer.	CO5	BTL 1	Remembering
18.	Name a few IC Voltage regulators.	CO5	BTL 2	Understanding
19.	Mention the applications of voltage to frequency converters.	CO5	BTL 2	Understanding
20.	What is the purpose of connecting the capacitor at the input and output side of an IC voltage regulator?	CO5	BTL 1	Remembering
21.	Summarize the basic principle of isolation amplifier.	CO5	BTL 1	Remembering
22.	Define load regulation of a regulator.	CO5	BTL 1	Remembering
23.	Draw the block schematic of IC 555 timer.	CO5	BTL 1	Remembering
24.	Mention the applications of isolation amplifier.	CO5	BTL 2	Understanding

PART – B

1.	Explain the operation of Sine-wave generator with neat circuit diagram.	(16)	CO5	BTL 3	Applying
2.	Assess the working principle of RC phase shift oscillator with neat sketch.	(16)	CO5	BTL 4	Analyzing
3.	Describe the function of Wien bridge oscillator and derive the frequency of oscillations.	(16)	CO5	BTL 3	Applying
4.	Interpret the working of Astable Multivibrator using op amp with applications in detail.	(16)	CO5	BTL 4	Analyzing
5.	With neat diagram, explain the operation of a monostable multivibrators using op amp.	(16)	CO5	BTL 4	Analyzing

6.	Find the expression for frequency of a triangular waveform generator and explain the circuit.	(16)	CO5	BTL 3	Applying
7.	Outline the operation of saw-tooth wave generator with neat diagram.	(16)	CO5	BTL 3	Applying
8.	Design a phase shift oscillator to oscillate at 100Hz.	(16)	CO5	BTL 4	Analyzing
9.	(i)Explain the working of 555 timer as Monostable Multivibrator. (ii)Derive an expression for the frequency of oscillation in Monostable Multivibrator.	(10) (6)	CO5	BTL 4	Analyzing
10.	(i)Describe the operation of 555 timer as Astable Multivibrator. (ii)Derive an expression for the frequency of oscillation in Astable Multivibrator.	(8) (8)	CO5	BTL 4	Analyzing
11.	With a neat circuit diagram, explain the working of Fixed voltage series regulator.	(16)	CO5	BTL 3	Applying
12.	Demonstrate the working of Fixed regulator used as adjustable regulator.	(16)	CO5	BTL 3	Applying
13.	Analyze the working of a general-purpose voltage regulator with necessary diagrams.	(16)	CO5	BTL 3	Applying
14.	Draw a square wave generator using 555 timer for a frequency of 120 hz and 60% duty cycle. Assume C=0.2 μF	(16)	CO5	BTL 4	Analyzing
15.	Design a frequency to voltage converter using IC voltage to frequency converter 32 for a full-scale output of 8 V for a full-scale input frequency of 80 kHz with a maximum ripple of 8 mV.	(16)	CO5	BTL 3	Applying
16.	With a neat diagram, explain the working linear voltage regulator using an operational amplifier.	(16)	CO5	BTL 4	Analyzing
17.	Describe the 555 timer IC. Design a astable multivibrator circuit to generate output pulses of 25%,50% duty cycle using a 555 Timer with the choice of C=0.01 μF, Frequency as 4KHz	(16)	CO5	BTL 3	Applying