JEPPIAAR ENGINEERING COLLEGE

Jeppiaar Nagar, Rajiv Gandhi Salai – 600 119

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

IV SEMESTER

MA6451 – Probability and Random Processes

Regulation – 2013(Batch: 2016 -2020)

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QUESTION BANK

SUBJECT : EC6404 – Linear Integrated Circuits

YEAR /SEM: II /IV

UNIT I :BASICS OF OPERATIONAL AMPLIFIERS				
Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.				
PART-A				
CO Mapping : C213.1				
Q.NO	**Questions**	**BT Level**	**Competence**	**PO**
1.	Draw the dc transfer characteristics of a BJT differential amplifier and define differential mode input voltage	BTL-3	Applying	PO1
2.	Write down the characteristics of ideal operational amplifier?	BTL-4	Analyzing	PO1
3.	Why is the current mirror circuit used in differential amplifier stages?	BTL-2	Understanding	PO1
4.	Differentiate the ideal and practical characteristics of an op-amp	BTL-3	Analyzing	PO1
5.	Draw the circuit diagram of a symmetrical emitter coupled differential amplifier.	BTL-3	Applying	PO1
6.	Draw the Internal Block diagram of Op – Amp	BTL-3	Applying	PO1
7.	An operational amplifier has a slew rate of 4v/μs .Determine the maximum frequency of operation to produce distortion less output swing of 12V	BTL-6	Creating	PO1,PO2
8.	What is the cause for slew rate and how it can be made faster?	BTL-2	Understanding	PO1.PO2.PO3
9.	Define input bias current and input offset current of an operational amplifier	BTL-1	Remembering	PO1
10.	A differential amplifier has a differential voltage gain of 2000 and a common mode gain of 0.2.Determine the CMRR in dB	BTL-6	Creating	PO1,PO2
11.	Define Slew rate and what causes slew rate?	BTL	Remembering	PO1
12.	Define CMRR of an operational amplifier?	BTL	Remembering	PO1
13.	What is current mirror?	BTL-2	Understanding	PO1

14.	Explain the limitation of current mirror circuits?	BTL-2	Understanding	PO1
15.	Draw the circuit of a Widlar current source and write the exp for its output current	BTL-3	Applying	PO1
16.	Define Thermal Drift	BTL-1	Remembering	PO1
17.	What is an operational amplifier?	BTL-2	Understanding	PO1
18.	What are the AC characteristics of an op-amp?	BTL-2	Understanding	PO1
19.	What are the DC characteristics of an op-amp? Give the typical values for an IC741?	BTL-2	Understanding	PO1,PO2
20.	When does the op-amp behave as a switch?	BTL-2	Understanding	PO1
21.	In response to square wave input, the output of an op-amp changed from –3V to +3V over a time interval of 0.25μs. Determine the slew rate of the op-amp.	BTL-6	Creating	PO1,PO2,
22.	Define integrated circuit.	BTL-1	Remembering	PO1
23.	What are the advantages of integrated circuits over discrete components?	BTL-2	Understanding	PO1
24.	What are the disadvantages of integrated circuits?	BTL-2	Understanding	PO1
25.	What is meant by monolithic IC	BTL-2	Understanding	PO1
26.	What are the two requirements to be met for a good current source?	BTL-2	Understanding	PO1,PO2
27.	List the various methods of realizing high input resistance in a differential amplifier	BTL-2	Understanding	PO1
28.	Mention two advantages of active load over passive load in an operational amplifier	BTL-4	Analyzing	PO1
29.	What is active load? Where it is used and why?	BTL-2	Understanding	PO1
30.	Define supply voltage rejection ratio (SVRR)	BTL-1	Remembering	PO1,PO2
31.	Define input offset voltage	BTL-1	Remembering	PO1
32.	Define Frequency Response	BTL-1	Remembering	PO1
33.	Define unity gain bandwidth of a Op-Amp	BTL-1	Remembering	PO1

PART B &C

Q.NO	Questions	BT Level	Competence	PO
1.	i)With a help of a block diagram ,explain the various stages present in an operational amplifier ii)Draw the transfer characteristics of an operational amplifier and explain the linear and non-linear operation	BTL-2 BTL-3	Understanding Applying	PO1 PO1
2.	i)What is the input and output voltage and current offsets? How are they compensated? ii) With neat diagram derive the AC performance close loop characteristics of Op-Amp to discuss on the circuit Bandwidth, Frequency response and slew rate	BTL-2 BTL-3	Understanding Applying	PO1 PO1,PO2
3.	i)With a schematic diagram, explain the effect of R_E on CMRR in differential amplifier ii)Discuss about the methods to improve CMRR	BTL-2 BTL-3	Understanding Applying	PO1 PO1
4.	i)With simple schematic of differential amplifier explain the function of Operational Amplifier ii)Briefly Explain about constant current source	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
5.	i)Briefly explain the techniques used for frequency compensation ii)How do the open loop gain and the closed loop gain of an op-amp differ?	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
6.	With a neat diagram Explain the input side of the internal circuit diagram of IC741	BTL-2	Understanding	PO1
7.	What is the need for frequency compensation in an OPAMP? With a suitable illustration, explain the pole-zero frequency compensation technique.	BTL-2	Understanding	PO1
8.	Draw the circuit of basic current mirror and explain	BTL-3	Applying	PO1

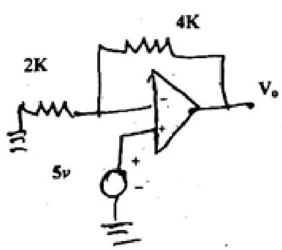
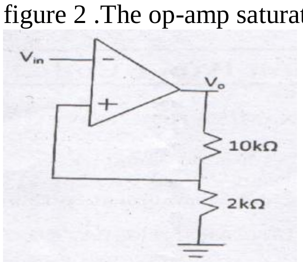
	its operation. Also discuss about how current ratio can be improved in the basic current mirror. Sketch the improved circuit and explain			
9.	i)Define and explain slew rate. What is full power bandwidth? Also explain the method adopted to improve slew rate ii)Define output off set voltage. Explain methods to nullify offset voltage	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
10.	Explain in detail wilson current source and widlar current source and derive necessary equations	BTL-2	Understanding	

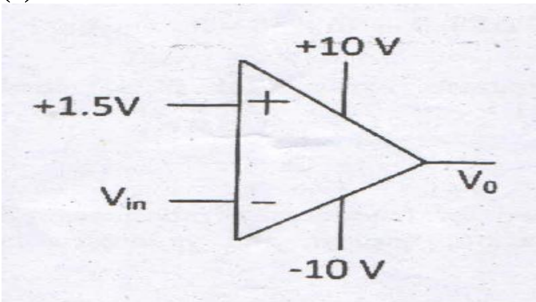
UNIT II : APPLICATIONS OF OPERATIONAL AMPLIFIERS

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

PART-A

CO Mapping : C213.2

Q.NO	Questions	BT Level	Competence	PO
1.	State the limitations of an ideal integrator.	BTL-1	Remembering	PO1
2.	How will you realize a peak detector using a precision rectifier?	BTL-5	Evaluating	PO1
3.	What is the need for converting a first order filter into a second order filter?	BTL-2	Understanding	PO1
4.	How is the current characteristic of a PN junction employed in a Log amplifier?	BTL-5	Evaluating	PO1
5.	For the op-amp shown in figure determine the voltage gain 	BTL-6	Creating	PO1,PO2
6.	Draw the circuit diagram of a peak detector with waveforms.	BTL-3	Applying	PO1
7.	Give any four applications of comparators.	BTL-1	Remembering	PO1
8.	What is hysteresis and mention the purpose of hysteresis in a comparator?	BTL-2	Understanding	PO1
9.	What is the difference between normal rectifier and precision rectifier?	BTL-2	Understanding	PO1
10.	Plot the transfer characteristics of the circuit shown in figure 2 .The op-amp saturates at +/-12V  Figure 2	BTL-3	Applying	PO1,PO2
11.	Define inverting amplifier and draw the circuit?	BTL-1	Remembering	PO1
12.	Define non-inverting amplifier and draw the circuit?	BTL-1	Remembering	PO1
13.	What is meant by voltage follower?	BTL-2	Understanding	PO1

14.	Draw the circuit diagram of an op-amp integrator. Mention its applications	BTL-3	Applying	PO1
15.	Draw the circuit diagram of an op-amp differential amplifier. Mention its o/p equation	BTL-3	Applying	PO1
16.	For the op-amp shown in figure, determine the voltage gain.	BTL-3	Applying	PO1
17.	Explain the voltage to current convertor	BTL-2	Understanding	PO1
18.	Draw the circuit of a voltage follower using op-amp and prove that its gain is exactly equal to unity	BTL-3	Applying	PO1
19.	An ac signal has got a magnitude of 0.1 volt peak to peak. Suggest a suitable half wave rectifier for this signal.	BTL-4	Analyzing	PO1,PO2
20.	Derive the expression for voltage gain of an inverting operational amplifier?	BTL-5	Evaluating	PO1
21.	Mention two linear and two non- linear operations performed by an operational amplifier?	BTL-4	Analyzing	PO1
22.	Explain the current to voltage convertor?	BTL-2	Understanding	PO1
23.	Mention two application of Schmitt trigger?	BTL-4	Analyzing	PO1
24.	Mention the characteristics of Instrumentation amplifier?	BTL-4	Analyzing	PO1
25.	State the disadvantages of passive filters?	BTL-2	Understanding	PO1
26.	What is Precision rectifier?	BTL-2	Understanding	PO1
27.	Define precision half wave rectifier with diagram?	BTL-1	Remembering	PO1
28.	What are the main drawbacks of ideal differentiator?	BTL-2	Understanding	PO1
29.	What are the steps to be followed while designing a good differentiator?	BTL-2	Understanding	PO1
30.	What are the main drawbacks of ideal integrator circuit?	BTL-2	Understanding	PO1
31.	Give the output voltage when V_i is positive and negative in a precision diode.	BTL-3	Applying	PO1
32.	Give an application of an Inverting Amplifier	BTL-3	Applying	PO1
33.	Draw the circuit diagram of a schmitt trigger	BTL-3	Applying	PO1,PO2
34.	Draw the circuit diagram of differentiators and give its output equation	BTL-3	Applying	PO1,PO2
35.	Determine the output voltage for the circuit shown in figure 1 when (a)Vin=-2V (b)Vin=3V  Figure 1	BTL-6	Creating	PO1,PO2

PART:B & C

Q.NO		BT Level	Competence	PO
1.	i)For performing differentiation in an operational amplifier, integrator is preferred to differentiator-Explain ii) What is instrumentation amplifier? Draw a system whose gain is controlled by a variable resistance	BTL-2 BTL-3	Understanding Applying	PO1 PO1

2.	Explain the operation of differentiator and integrator with relevant waveforms and equations	BTL-1	Understanding	PO1
3.	i) What is a precision rectifier? Explain the working of Full wave precision rectifier? ii) Write short notes on Clipper and clamper circuits	BTL-2 BTL-2	Understanding Remembering	PO1 PO1
4.	i)Draw the circuit of a second order Butterworth active low pass filter and derive its transfer function ii) Design a second order active low pass filter for a cut-off frequency of 1 KHz.	BTL-3 BTL-6	Applying Creating	PO1 PO1,PO2
5.	i) Briefly explain the working principle of Schmitt trigger. ii) Design a wide band pass filter having f_L=400 Hz f_H=2kHz and pass band gain of 4.Find the value of Q of the filter	BTL-2 BTL-6	Understanding Creating	PO1 PO1,PO2
6.	With a circuit diagram discuss the following applications of op-amp. a.Voltage to current converter. b.Precision rectifier.	BTL-3	Applying	PO1
7.	Explain the working of 3 op-amp Instrumentation amplifier?	BTL-2	Understanding	PO1
8.	Explain the working of Log amplifier and antilog amplifier?	BTL-2	Understanding	PO1
9.	i) Explain the operation of current to voltage converter ii) Differentiate between low pass ,high pass ,band pass and band reject filter. Sketch the frequency plot	BTL-2	Understanding	PO1

UNIT III ANALOG MULTIPLIER AND PLL

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing

PART-A

CO Mapping : C213.3

Q.NO	**Questions**	**BT Level**	**Competence**	**PO**
1.	Define capture range of a PLL?	BTL-1	Remembering	PO1
2.	How are square root and square of a signal obtained with multiplier Circuit	BTL-5	Evaluating	PO1
3.	How is frequency stability obtained in a PLL by use of a VCO?	BTL-5	Evaluating	PO1
4.	Draw the block diagram of PLL for AM detection?	BTL-3	Applying	PO1
5.	What is a four-quadrant multiplier?	BTL-2	Understanding	PO1
6.	Calculate the lock range and the capture range of the PLL	BTL-6	Creating	PO1
7.	The lock range of a certain general purpose PLL with a free running frequency of 50MHz is specified to be +/- 10% what is its lock range?	BTL-5	Evaluating	PO1,PO2
8.	What are the essential building blocks of a PLL?	BTL-2	Understanding	PO1
9.	What is a two quadrant multiplier?	BTL-2	Understanding	PO1
10.	What is compander?	BTL-2	Understanding	PO1
11.	State why the phase detector output in a PLL should be followed by a low pass filter?	BTL-4	Analyzing	PO1
12.	Draw the block diagram of a multiplier using log and antilog amplifiers.	BTL-3	Applying	PO1

13.	What is frequency synthesizer?	BTL-2	Understanding	PO1
14.	Draw the basic block diagram of PLL?	BTL-3	Applying	PO1
15.	What is amplitude modulation?	BTL-2	Understanding	PO1
16.	Define voltage to frequency conversion factor kv?	BTL-1	Remembering	PO1
17.	Give two application of PLL?	BTL-2	Understanding	PO1
18.	What is a voltage-controlled oscillator?	BTL-2	Understanding	PO1
19.	When an amplifier is also called an error amplifier?	BTL-2	Understanding	PO1
20.	What are the merits of companding?	BTL-2	Understanding	PO1
21.	List the applications of OTA:	BTL-4	Analyzing	PO1
22.	Mention some areas where PLL is widely used	BTL-4	Analyzing	PO1
23.	Define lock-in range of a PLL	BTL-1	Remembering	PO1
24.	Define free running mode.	BTL-1	Remembering	PO1
25.	What are the advantages of variable transconductance technique?	BTL-2	Understanding	PO1
26.	With reference to a VCO, define voltage to frequency conversion factor Kv.	BTL-1	Remembering	PO1
27.	Draw the relation between the capture ranges and lock range in a PLL.	BTL-3	Applying	PO1
28.	Mention two applications of analog multiplier	BTL-4	Analyzing	PO1
29.	VCO is called as V-F converter why?	BTL-2	Understanding	PO1
30.	Define FSK		Remembering	PO1
31.	What is the need for frequency synthesizer	BTL-2	Understanding	PO1
PART:B & C				
Q.NO		**BT Level**	**Competence**	**PO**
1.	With neat diagram explain the design of (i) Frequency Synthesizer (ii) Frequency Division circuit using PLL IC 565	BTL-2	Understanding	PO1
2.	i) Discuss the principle of operation of NE 565 PLL circuit ii) How can PLL be modeled as a frequency multiplier?	BTL-1 BTL-5	Understanding Evaluating	PO1 PO2
3.	Explain the Application of PLL as AM detection, FM detection and FSK demodulation	BTL-2	Understanding	PO1
4.	Explain the basic blocks of PLL and determine expressions for lock in range and capture range	BTL-2	Understanding	PO1
5.	i) With neat simplified internal diagram explain the working principle of Operational Transconductance Amplifier(OTA) ii) Explain the application of VCO for FM generation	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
6.	With suitable block diagram explain the operation of 566 voltage controlled oscillator. Also derive an expression for the frequency of the output waveform generated	BTL-2	Understanding	PO1
7.	Explain the working principle of four quadrant variable form transconductance multiplier	BTL-2	Understanding	PO1
8.	Draw the analog multiplier IC and explain its features and Explain the application of analog multiplier IC	BTL-2	Understanding	PO1
9.	i) Explain Analog Multiplier using Emitter Coupled Transistor ii) Explain Gilbert Multiplier cell in detail	BTL-2 BTL-2	Understanding Understanding	PO1 PO1

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS				
Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R-2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.				
PART-A				
CO Mapping : C213.4				
Q.NO	**Questions**	**BT Level**	**Competence**	**PO**
1.	How is the classification of A/D converters carried out based on their operational features?	BTL-1	Remembering	PO1
2.	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.	BTL-6	Creating	PO1
3.	Why are Scottky diodes used in sample and hold circuits?	BTL-5	Evaluating	PO1
4.	What are the advantages of inverted R-2R (current type) ladder D/A converter over R-2R (voltage type) D/A converter	BTL-2	Understanding	PO1
5.	What is the need for electronic switches in D/A converter?	BTL-2	Understanding	PO1
6.	A 12 bit D/A converter has a resolution of 20mv/LSB.Find the full scale output voltage.	BTL-6	Creating	PO1
7.	Draw the binary ladder network of DAC, If the value of the smaller resistance is 10K.What is the value of other resistance?	BTL-3	Applying	PO1,PO2
8.	Determine the number of comparators and resistors required for 8 bit flash type ADC	BTL-6	Creating	PO1
9.	Mention two advantages of R-2R ladder type DAC when compared to weighted resistor type DAC	BTL-4	Analyzing	PO1
10.	What would be produced by a DAC whose output ranges is 0 to 10V and whose input binary number is 10111100(for a 8 bit DAC)?	BTL-2	Understanding	PO1.PO2
11.	What is over sampling?	BTL-2	Understanding	PO1
12.	State the reason for keeping the integrating time in the dual slope analog to digital converter equal to that of mains supply period	BTL-2	Understanding	PO1
13.	Which is the fastest A/D converter? Give reason	BTL-5	Evaluating	PO1
14.	A 12 bit D/A converter have resolution of 30 mV/ LSB. Find the full scale output voltage.	BTL-6	Creating	PO1
15.	Calculate the number of comparators required for realizing a 4 bit flash A/D converter.	BTL-6	Creating	PO1
16.	Draw a sample and hold circuit.		Applying	PO1
17.	Define resolution of a D/A converter?	BTL-1	Remembering	PO1
18.	How many comparators are required to build n –bit flash type A/D converter?		Evaluating	PO1
19.	Define monotonicity with respect to D/A converter?	BTL-1	Remembering	PO1
20.	Why is R-2R ladder network DAC better than weighted resistor DAC?	BTL-5	Evaluating	PO1,PO3
21.	Which type of ADC is used in all digital voltmeter?	BTL-5	Evaluating	PO1
22.	What do you mean by delta modulation?	BTL-2	Understanding	PO1
23.	List the application of sample and Hold circuits?	BTL-4	Analyzing	PO1
24.	Mention the types of DAC techniques?	BTL-4	Analyzing	PO1
25.	Define the resolution of DAC?		Remembering	PO1
26.	Explain in brief stability of a converter:	BTL-2	Understanding	PO1
27.	What is meant by linearity?	BTL-2	Understanding	PO1
28.	What is monotonic DAC?	BTL-2	Understanding	PO1

29.	What is multiplying DAC?	BTL-2	Understanding	PO1
30.	What is a sample and hold circuit? Where it is used?	BTL-2	Understanding	PO1
31.	Define accuracy of converter.	BTL-1	Remembering	PO1
32.	Define sample period and hold period.	BTL-1	Remembering	PO1
33.	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.	BTL-2	Understanding	PO1,PO2
34.	What is the main drawback of dual slope ADC?	BTL-2	Understanding	PO1
35.	Define settling time	BTL-1	Remembering	PO1
36.	A 12 bit D/A converter has resolution of 20mV/LSB.Find the full scale output voltage	BTL-6	Creating	PO1
37.	Draw the weighted resistor network of DAC	BTL-3	Applying	PO1
38.	Draw the functional diagram of the successive approximation ADC	BTL-3	Applying	PO1
PART:B & C				
Q.NO		**BT Level**	**Competence**	**PO**
1.	Describe the operation of dual slope and successive approximation type ADC .What are the advantages of dual slope ADC	BTL-2	Understanding	PO1
2.	i)What is meant by resolution ,offset error in ADC ii)Discuss on the single slope type ADC	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
3.	i)Explain the successive approximation type A/D converter ii)Narrate the functions of Analog switches	BTL-2 BTL-2	Understanding Understanding	PO1 PO1
4.	i)How are A/D converters categorized? ii)Write Short Note on high speed sample and hold circuits	BTL-5 BTL-2	Evaluating Understanding	PO1 PO1
5.	i)Explain voltage mode and current mode operations of R-2R ladder type DAC ii) Explain over sampling type analog to digital converters	BTL-2 BTL-2	Understanding Understanding	PO1,PO2,PO3 PO1
6.	Draw the block diagram and explain the working of i)Charge Balancing VFCS ii)Voltage to Time converter	BTL-2	Understanding	PO1
7.	Explain the following type DAC with suitable diagrams i)Binary weighted resistor DAC ii)R-2R Ladder DAC iii)Inverted R-2R ladder DAC	BTL-2	Understanding	PO1
8.	i)Explain the following type of electronic switches used in D/A converter with suitable diagrams 1) Totem pole MOSFET switch(4) 2)CMOS inverter as a switch(4) ii)Compare Flash type ,Dual slope and successive approximation ADC in terms of parameters like speed ,accuracy, resolution ,input hold time	BTL-2 BTL-4	Understanding Analyzing	PO1,PO2 PO1
9.	With a neat block diagram explain the working of three bit flash type analog to digital converter	BTL-2	Understanding	PO1

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

PART-A

CO Mapping : C213.5

Q.NO	Questions	BT Level	Competence	PO
1.	Define current transfer ratio of an opto coupler	BTL-1	Remembering	PO1
2.	Draw a fixed voltage regulator circuit and state its operation	BTL-1	Remembering	PO1
3.	What is a voltage regulator?	BTL-2	Understanding	PO1
4.	Distinguish the principle of linear regulator and a switched mode power supply.	BTL-4	Analyzing	PO1
5.	Draw the block schematic of IC 555 timer.	BTL-1	Remembering	PO1,PO2
6.	Draw the internal circuit for audio power amplifier	BTL-1	Remembering	PO1
7.	What is the function of a voltage regulator? Name few IC voltage regulators.	BTL-1	Remembering	PO1
8.	Give the classification of voltage regulators:	BTL-2	Understanding	PO1
9.	Mention some applications of 555 timer:	BTL-4	Analyzing	PO1
10.	List the applications of 555 timer in monostable mode of operation:	BTL-1	Remembering	PO1,PO2,PO3
11.	List the applications of 555 timer in Astable mode of operation:	BTL-1	Remembering	PO1,PO2,PO3
12.	What is a linear voltage regulator?	BTL-2	Understanding	PO1
13.	What is a switching regulator?	BTL-2	Understanding	PO1
14.	What is the purpose of having input and output capacitors in three terminal IC regulators?	BTL-2	Understanding	PO1
15.	Define line regulation.	BTL-1	Remembering	PO1
16.	Define load regulation	BTL-1	Remembering	PO1
17.	What is meant by current limiting?	BTL-2	Understanding	PO1
18.	Give the drawbacks of linear regulators:	BTL-3	Applying	PO1
19.	What is the advantage of switching regulators?	BTL-2	Understanding	PO1
20.	What is an opto-coupler IC? Give examples.	BTL-2	Understanding	PO1
21.	Mention the advantages of opto-couplers:		Analyzing	PO1
22.	What is an isolation amplifier?	BTL-2	Understanding	PO1
23.	What is the need for a tuned amplifier?	BTL-2	Understanding	PO1
24.	Give the classification of tuned amplifier	BTL-2	Understanding	PO1
25.	State the two conditions for oscillation.	BTL-2	Understanding	PO1
26.	Draw the functional block diagram of 723 regulator.	BTL-3	Applying	PO1
27.	Why is the monostable multivibrator circuit called time delay circuit and gating circuit?	BTL-2	Understanding	PO1,PO2
28.	Why there is no phase shift provided in the feedback network in Wein-Bridge oscillator?	BTL-2	Understanding	PO1
29.	Give the formula for period of oscillations in an op-amp astable circuit.	BTL-3	Applying	PO1
30.	Define duty cycle for a periodic pulse waveform.	BTL-1	Remembering	PO1
31.	What is meant by thermal shutdown applied to voltage regulators?	BTL-2	Understanding	PO1
32.	What are the three waveforms generated by ICL8038?	BTL-2	Understanding	PO1
33.	List the characteristics of optocoupler	BTL-1	Remembering	PO1
34.	Mention two applications of frequency to voltage converter	BTL-4	Analyzing	PO1
35.	What is the advantage of switching regulators?	BTL-2	Understanding	PO1

PART:B & C

Q.NO		BT	Competence	PO

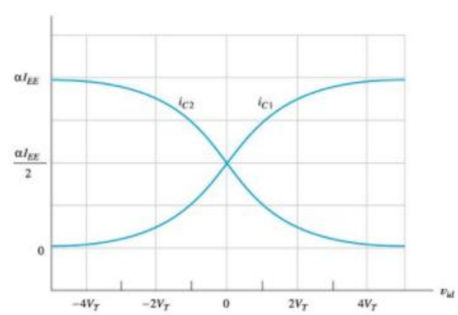
		Level		
1.	i)With neat diagram explain the operation of an astable and monostablemultivibrators ii)Draw the functional diagram and connection diagram of a low voltage regulator and explain	BTL-2 BTL-3	Understanding Applying	PO1,PO12 PO1
2.	Answer any two of the following1) Switched capacitor filters 2)Audio power amplifier 3)Opto coupler	BTL-2	Understanding	PO1
3.	With neat diagram explain IC723 general purpose voltage regulator	BTL-2	Understanding	PO1
4.	Explain Sawtooth waveform generator and LM 380Audio amplifier in detail	BTL-2	Understanding	PO1
5.	Describe the working of a astable multivibrator using 555 timer	BTL-2	Understanding	PO1
6.	Explain in detail Voltage to frequency and frequency to voltage converter	BTL-2	Understanding	PO1
7.	i)Design a phase shift oscillate at 100Hz ii)Describe monostablemultivibrator with necessary diagrams and derive for ON time and recovery time	BTL-6 BTL-2	Creating Understanding	PO1,PO2 PO1
8.	i)Briefly describe about monolithic switching regulators ii)Draw the schematic of ICL 8038 function generator and discuss its features	BTL-2 BTL-3	Understanding Applying	PO1 PO2
9.	Describe the working of a Astablemultivibrator using op-amp	BTL-2	Understanding	PO1
10.	Describe the working of a monostablemultivibrator using 555 timer	BTL-2	Understanding	PO1
11.	Explain Video amplifier and opto-couplers	BTL-2	Understanding	PO1

UNIT I- BASICS OF OPERATIONAL AMPLIFIERS

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

PART-A

1.Draw the dc transfer characteristics of a BJT differential amplifier and define differential mode input voltage [Nov/Dec 2017]



2. Write down the characteristics of ideal operational amplifier? [April/May 2017][April/May 16]

- Open loop voltage gain, (AOL) = ∞
- Input impedance (Ri) = ∞
- Output impedance (Ro) = 0
- Bandwidth (BW) = ∞
- Zero offset Vo = 0, when V1 = V2 = 0

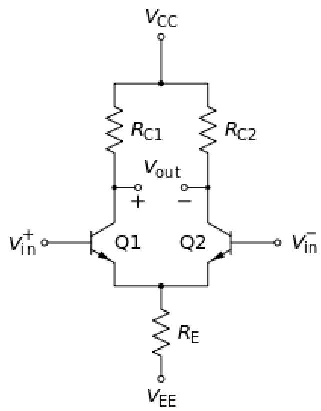
3.Why is the current mirror circuit used in differential amplifier stages? [April/May 2017]

The current mirror is a special case of constant current bias and the current mirror bias requires of constant current bias and therefore can be used to set up currents in differential amplifier stages

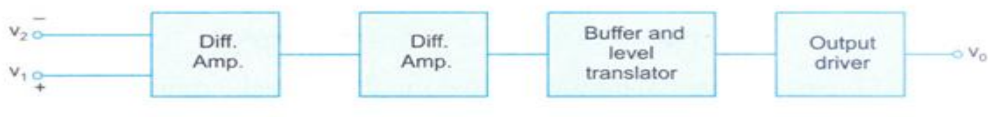
4. Differentiate the ideal and practical characteristics of an op-amp[MAY/JUNE 2016]

Characteristics	Ideal	Practical
Open loop voltage gain	∞	High
5. Input impedance (Ri)	**6.** ∞	**7.** High
Output impedance (Ro)	0	Low
Bandwidth (BW)	∞	High
Zero offset	Vo = 0, when V1 = V2 = 0	Non zero

8.Draw the circuit diagram of a symmetrical emitter coupled differential amplifier. [Nov/Dec 2016]



9.Draw the Internal Block diagram of Op – Amp (IC 741) [Nov/Dec 2016]



10. An operational amplifier has a slew rate of 4v/μs .Determine the maximum frequency of operation to produce distortion less output swing of 12V [APRIL/MAY 16]

Frequency f = slewrate(SR) / 2ΠVm
= 4 / (2* Π*12)
= 0.013 Hz

11. What is the cause for slew rate and how it can be made faster? [APRIL/MAY 2015]

There is a capacitor within or outside an op-amp to prevent oscillation. It is this capacitor which prevents the output voltage from responding immediately to a fast changing input .The slew rate can be made faster by having a higher current or a small compensating capacitor

12. Define input bias current and input offset current of an operational amplifier[Nov/Dec 2015]

Input bias current is the average value of the base current entering in to the i/p terminals of an opamp.Its typical value is 500nA

Input offset current is the algebraic difference between the current into the inverting and non-inverting terminals is referred to as input offset current Iio. Mathematically it is represented as

Iio = |IB+- IB-|

Where IB+ is the current into the non-inverting input terminals.

IB- is the current into the inverting input terminals.

13. A differential amplifier has a differential voltage gain of 2000 and a common mode gain of 0.2.Determine the CMRR in dB [April/May 2015]

Given common mode gain Acm=0.2

Difference mode gain Adm=2000

CMRR= Adm/ Acm= 2000/0.2 =10000=10log10000=80dB

14. Define Slew rate and what causes slew rate?[April/May 2015]

The slew rate of an op amp or any amplifier circuit is the rate of change in the output voltage caused by a step change on the input.

There is usually a capacitor within or outside an op-amp to prevent oscillation. It is this capacitor which prevents the output voltage from responding immediately to a fast changing input

15. Define CMRR of an operational amplifier? [May/June 2013]

The common mode rejection ratio (CMRR) can be defined as the ratio of differential gain to common mode gain.

CMRR = |Ad/Ac|

16. What is current mirror?[Nov/Dec 2011]

The circuit in which the output current is forced to equal the input current is called as current mirror circuit. The current mirror makes use of the fact that for a transistor in the active mode of operation, the collector current is relatively independent of the collector voltage. In this the output current is a reflection or mirror of the reference current.

17. Explain the limitation of current mirror circuits?

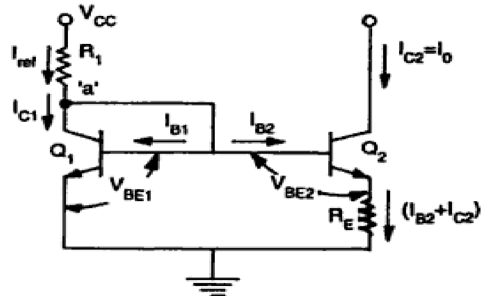
For low value of current source, the value of resistance R should be high which can't be fabricated economically in an IC circuits.Widlar current source is suitable for low value.

18. Draw the circuit of a Widlar current source and write the exp for its output current. (May 2007)

Ic1 = (β/β+1) Iref

Iref = VCC –VBE / R1 For β>>1,

Ic1 = Iref



Widlar current source

19. Define Thermal Drift.

The change in bias current ,offset voltage and offset voltage for each degree Celsius change in temperature .The offset current drift is expressed in A/oC and offset voltage drift in V/ oC

20. What is an operational amplifier?

The operational amplifier is a multi-terminal device, which is quite complex internally. An operational amplifier is a direct coupled high gain amplifier usually consisting of one or more differential amplifiers and usually followed by a level translator and an output stage. An operational amplifier is available as a single integrated circuit package. It is a versatile device that can be used to amplify dc as well as ac input signals and was originally designed for computing such mathematical functions.

21. What are the AC characteristics of an op-amp?

- Frequency response
- Slew rate

22. What are the DC characteristics of an op-amp? Give the typical values for an IC741?

- Input bias current: 500 nA
- Input offset current: 200 nA
- Input offset voltage: 6m
- Thermal drift

23. When does the op-amp behave as a switch?

When op-amp is operating in open loop mode it acts as a switch. Consider two signals V1 and V2 applied at both inverting and non-inverting terminal respectively. Since the gain of the op-amp is infinite, the output V0 is either at its positive saturation voltage (+Vsat) or negative saturation voltage (-Vsat) as V1 > V2 or V2 – V1 respectively. Therefore amplifier acts as a switch.

24. When does the op-amp behave as a switch?

When op-amp is operating in open loop mode it acts as a switch. Consider two signals V1 and V2 applied at both inverting and non-inverting terminal respectively. Since the gain of the op-amp is infinite, the output V0 is either at its positive saturation voltage (+Vsat) or negative saturation voltage (-Vsat) as V1 > V2 or V2 – V1 respectively. Therefore amplifier acts as a switch.

25. When does the op-amp behave as a switch?

When op-amp is operating in open loop mode it acts as a switch. Consider two signals V1 and V2 applied at both inverting and non-inverting terminal respectively. Since the gain of the op-amp is infinite, the output V0 is either at its positive saturation voltage (+Vsat) or negative saturation voltage (-Vsat) as V1 > V2 or V2 – V1 respectively. Therefore amplifier acts as a switch.

26. Define integrated circuit.

An integrated circuit (IC) is a miniature, low cost electronic circuit consisting of active and passive components fabricated together on a single crystal of silicon. The active components are transistors and diodes and passive components are resistors inductors and capacitors

27. What are the advantages of integrated circuits over discrete components?

- Miniaturization and hence increased equipment density.
- Cost reduction due to batch processing.
- Increased system reliability due to the elimination of soldered joints.
- Improved functional performance.
- Matched devices.
- Increased operating speeds.
- Reduction in power consumption

28. What are the disadvantages of integrated circuits

- Inductors can't be fabricated
- IC's function at fairly low voltage
- They can handle only limited amount of power.
- It can't withstand for rough handling and excessive heat

29. What is meant by monolithic IC

A monolithic integrated circuit (IC) is an electronic circuit that is built on a single semiconductor base material or single chip

30. What are the two requirements to be met for a good current source?

A good current source must meet two requirements:

- Output current IO should not depend on β;
- Output Resistance (RO) of the current source should be very high;

31. List the various methods of realizing high input resistance in a differential amplifier.

The various methods of realizing high input resistance in a differential amplifier circuits are

- Use of Darlington pair
- Use of FET
- Use of swamping resistors

32. Mention two advantages of active load over passive load in an operational amplifier[NOV/DEC 2015]

- Larger gain
- Larger Bandwidth

33. What is active load? Where it is used and why?

In circuit design, an active load is a circuit component made up of active devices, such as transistors, intended to present a high small-signal impedance yet not requiring a large DC voltage drop, as would occur if a large resistor were used instead. Such large AC load impedances may be desirable, for example, to increase the AC gain of some types of amplifier.

Most commonly the active load is the output part of a current mirror and is represented in an idealized manner as a current source. Usually, it is only a constant-current resistor that is a part of the whole current source including a constant voltage source as well

34. Define supply voltage rejection ratio (SVRR)

The change in OPAMP's input offset voltage due to variations in supply voltage is called the supply voltage rejection ratio. It is also called Power Supply Rejection Ratio (PSRR) or Power Supply Sensitivity (PSS)

35. Define input offset voltage

The input offset voltage is a parameter defining the differential DC voltage required between the inputs of an amplifier, especially an operational amplifier (op-amp), to make the output zero

36. Define Frequency Response

Frequency response is the quantitative measure of the output spectrum of a system or device in response to a stimulus, and is used to characterize the dynamics of the system. It is a measure of magnitude and phase of the output as a function of frequency, in comparison to the input

37. Define unity gain bandwidth of a Op-Amp

The GBWP (Gain Band Width Product) of an operational amplifier is 1 MHz, it means that the gain of the device falls to unity at 1 MHz. Hence, when the device is wired for unity gain, it will work up to 1 MHz (GBWP = gain × bandwidth, therefore if BW = 1 MHz, then gain = 1) without excessively distorting the signal.

PART B& C

1.i) With a help of a block diagram ,explain the various stages present in an operational amplifier[Nov/Dec 2017]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 108]

ii) Draw the transfer characteristics of an operational amplifier and explain the linear and non-linear operation[Nov/Dec 2017]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 108]

2.i) What is the input and output voltage and current offsets? How are they compensated? [April/May 2017**]**

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 108]

ii) With neat diagram derive the AC performance close loop characteristics of Op-Amp to discuss on the circuit Bandwidth, Frequency response and slew rate[April/May 2017]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 111]

3.i) With a schematic diagram,explain the effect of RE on CMRR in differential amplifier[April/May 16]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 63].

ii) Discuss about the methods to improve CMRR[April/May 16]

4.i) With simple schematic of differential amplifier explain the function of Operational Amplifier [April/May 2015]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 63]

ii) Briefly Explain about constant current source[April/May2015](8)

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 73]

5.i) Briefly explain the techniques used for frequency compensation[April/May2015] (12)

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 135]

ii) How do the open loop gain and the closed loop gain of an op-amp differ? [April/May2015] (4)

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 225]

6.With a neat diagram Explain the input side of the internal circuit diagram of IC741[Nov/dec 15]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 96**]**

7.What is the need for frequency compensation in an OPAMP? With a suitable illustration, explain the pole-zero frequency compensation technique. [Nov/dec 15][April/May 2017]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 135**]**

8.Draw the circuit of basic current mirror and explain its operation. Also discuss about how current ratio can be improved in the basic current mirror.Sketch the improved circuit and explain[Nov/dec 12]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 73]

9.(i) Define and explain slew rate. What is full power bandwidth? Also explain the method adopted to improve slew rate[Nov/dec 12]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 140]

(ii) Define output off set voltage. Explain methods to nullify offset voltage[Nov/dec 12]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 123]

10.Explain in detail wilson current source and widlar current source and derive necessary equations

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 75]

UNIT II -APPLICATIONS OF OPERATIONAL AMPLIFIERS

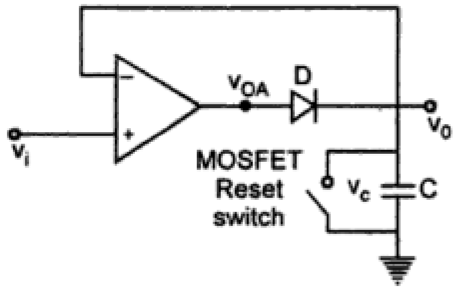
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

PART-A

1.State the limitations of an ideal integrator.[Nov/Dec 2017]

- Bandwidth is very small and used for only small range of input frequencies.
- For dc input (f = 0), reactance of capacitance, Xc is infinite. Because of this op-amp goes into open loop configuration. In open loop configuration the gain is infinite and hence the small input offset voltages are also amplified and appears at output as error

2.How will you realize a peak detector using a precision rectifier?[Nov/Dec 2017]



3.What is the need for converting a first order filter into a second order filter?[April/May 2017]

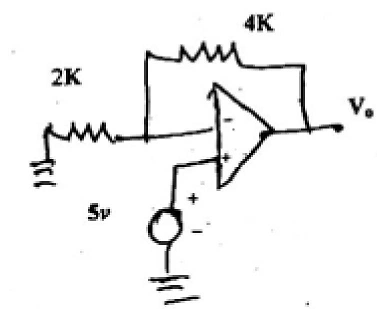
A first order active filter has one pole which is defined by a capacitor/resistor pair. A second order filter has two capacitors and resistors. This gives the filters frequency response a steeper slope as it transitions from pass band to stop band

4.How is the current characteristic of a PN junction employed in a Log amplifier?

[April/May 2017]

The voltage across the diode will be always proportional to the log of the current through it and when a diode is placed in the feedback path of an op-amp in inverting mode, the output voltage will be proportional to the negative log of the input current. Since the input current is proportional to the input voltage, we can say that the output voltage will be proportional to the negative log of the input voltage

3.For the op-amp shown in figure determine the voltage gain[Nov/Dec 2016]

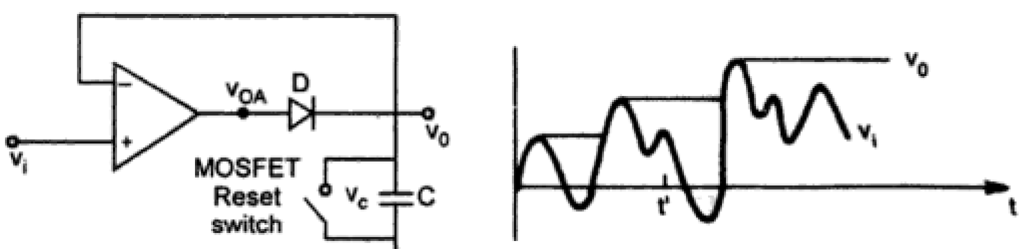


The given circuit is inverting amplifier

For inverting amplifier voltage gain $= -\frac{R_f}{R_i}$

$= -\frac{4k}{2k} = -2$

4.Draw the circuit diagram of a peak detector with waveforms. [Nov/Dec 2016]



Output v_0 corresponding to arbitrary input v_i

5.Give any four applications of comparators.[May/June 2016]

- Zero crossing detector
- Window detector
- Time marker generator
- Phase meter

6.What is hysteresis and mention the purpose of hysteresis in a comparator?[April/May 2015]

Hysteresis is the time-based dependence of a system's output on present and past inputs. The dependence arises because the history affects the value of an internal state. To predict its future outputs, either its internal state or its history must be known.

In comparator hysteresis has the effect of separating the up-going and down-going switching points so that, once a transition has started, the input must undergo a significant reversal before the reverse transition can occur.

7.What is the difference between normal rectifier and precision rectifier?[April/May 2015]

A simple rectifier circuit uses a diode. The input voltage has to exceed the turn-on voltage (0.6V for ordinary Si diode) before rectification is achieved.
A precision rectifier is an active circuit using an opamp and a diode in the feedback loop. This overcomes the turn-on "knee" voltage

8. Plot the transfer characteristics of the circuit shown in figure 2 .The op-amp saturates at +/-12V [Nov/Dec 2015]

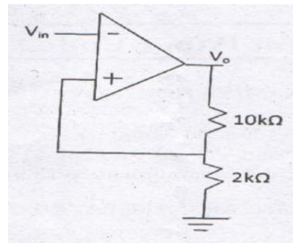
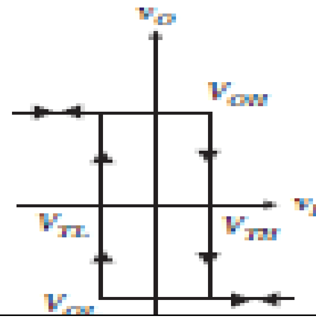


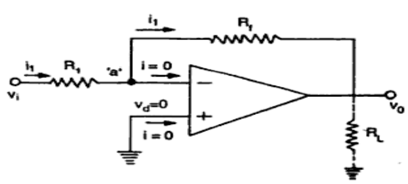
Figure 2



9.Define inverting amplifier and draw the circuit?

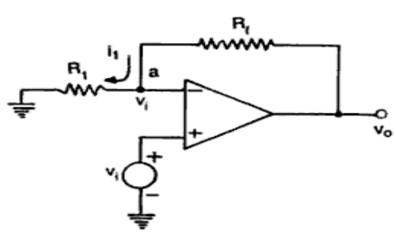
The input v_{in} is given to the second pin of op-amp through the input resistanceR_1 the feedback resistor R_f connects the output and input pin and the output is always reversed or inverted.

$$A_{CL} = \frac{v_o}{v_i} = -\frac{R_f}{R_1}$$



(a) Inverting amplifier

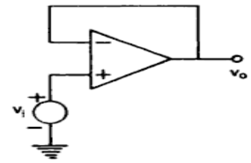
10. The input v_{in} is given to the non-inverting terminal **Define non-inverting amplifier and draw the circuit?** pin 3 of op-amp.The input resistor R1 & the feedback resistor R_f are connected to the inverting input only ,the input pin and the output is always same phase.



(a) Non-inverting amplifier

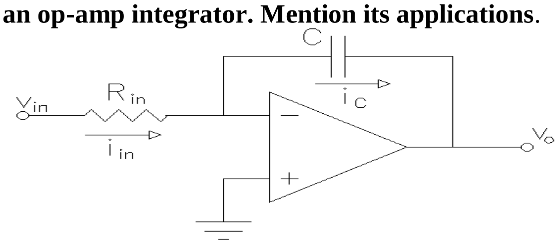
11.What is meant by voltage follower?

In the non-inverting amplifier, if R_f=0 and R1=∞ then the modified circuit is called voltage follower or unity gain amplifier.



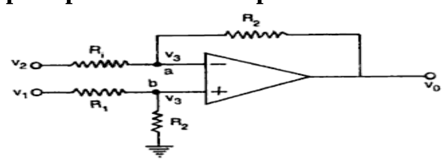
Voltage follower

12.Draw the circuit diagram of an op-amp integrator. Mention its applications.



Application:
1. It is generally used in analog computer and analog to digital converter.
2. It also used in wave shaping circuits

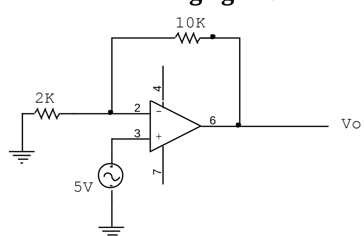
13.Draw the circuit diagram of an op-amp differential amplifier. Mention its o/p equation. [NOV/DEC2016]



A differential amplifier

$$v_o = \frac{R_2}{R_1}(v_1 - v_2)$$

14.For the op-amp shown in figure, determine the voltage gain.



Vo / Vin = 1+Rf / R1

= 1+ 10K / 2K

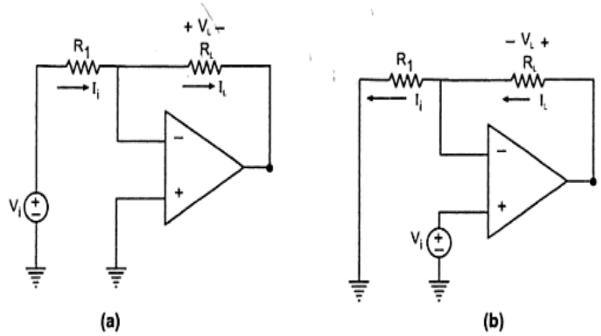
= 6

15.Explain the voltage to current convertor

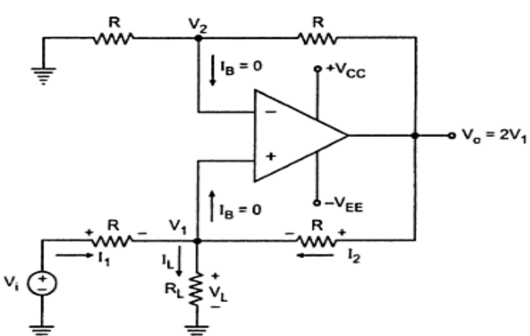
Voltage to current convertor converts an input signal voltage to a proportional output current

According to the connection of load there are two types of voltage to current convertor

1. Floating type
2. Grounded type

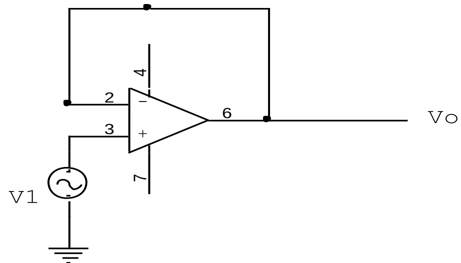


Floating load V-I converters



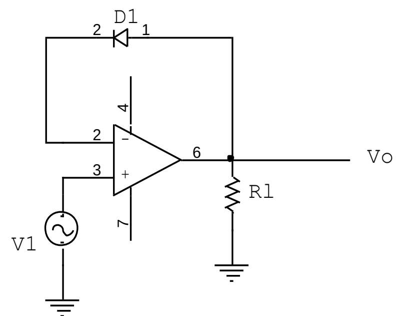
Voltage to current converter with grounded load

16.Draw the circuit of a voltage follower using op-amp and prove that its gain is exactly equal to unity.



Vo / Vin = 1+Rf / R1;   Vo / Vin = 1+ 0;   Vo / Vin = 1.

17.An ac signal has got a magnitude of 0.1 volt peak to peak. Suggest a suitable half wave rectifier for this signal.



18.Derive the expression for voltage gain of an inverting operational amplifier?

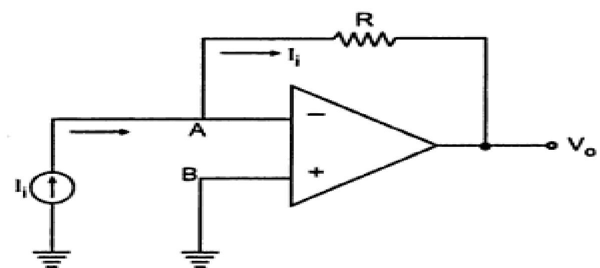
ACL = Vo/Vi = -Rf / R1

19.Mention two linear and two non- linear operations performed by an operational amplifier?

Linear operations: Adder, Subtractor, Voltage to current converter, Current to voltage converter, Instrumentation amplifier, Analog computation, and Power amplifier.

Non-linear operations: Rectifier, Peak detector, Clipper, Clamper, Sample and hold circuits, Log and antilog amplifier and Multiplier.

20.Explain the current to voltage convertor?



Current to voltage converter

21.Mention two application of Schmitt trigger?

- For eliminating comparator chatter.
- In ON/ OFF controller.
- Square wave generation

22.Mention two application of Schmitt trigger?

- For eliminating comparator chatter.
- In ON/ OFF controller.
- Square wave generation

23.State the disadvantages of passive filters?

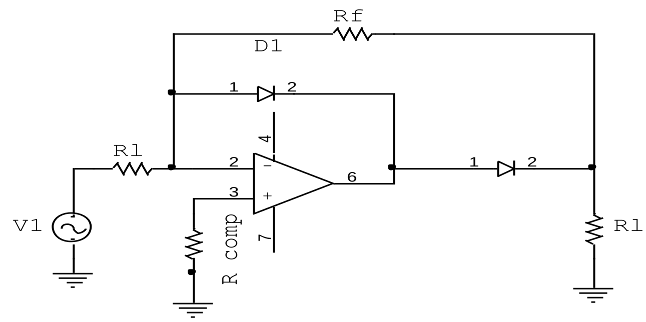
At audio frequencies inductors becomes problematic, as the inductors become large, heavy and expensive. For low frequency application, more number of turns of wire must be used which in turn adds to the series resistance degrading inductors performance.

24.What is Precision rectifier?

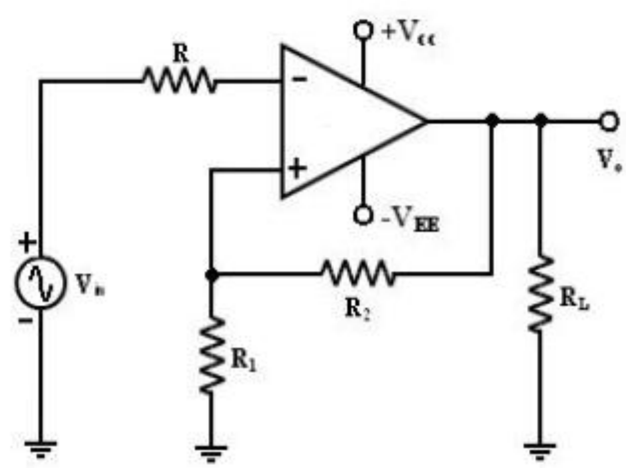
It is a rectifier circuit which utilities precision diode instead of usual diodes for rectification purpose in order to operate them for cut-in voltages in the order of microvolt.

25.Define precision half wave rectifier with diagram?

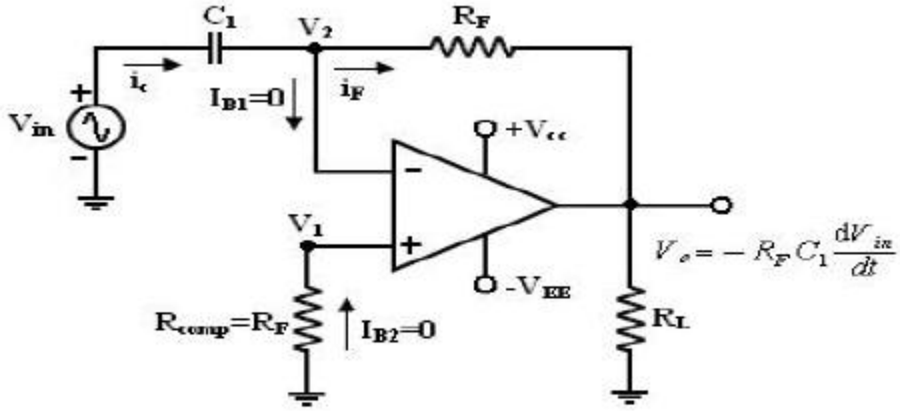
It is defined as a circuit, which utilizes two precision diodes instead of usual diodes for rectification purpose in order to operate them for, cut in voltages in the order of micro volts.



26.What are the main drawbacks of ideal differentiator? At high frequency, differentiators may become unstable and break into oscillation. The input impedance i.e. (1/ωC1) decreases with increase in frequency, thereby making the circuit sensitive to high frequency noise
27.What are the steps to be followed while designing a good differentiator? Choose f_a equal to highest frequency of the input signal. Assume a practical value of C1 (<1μF) and then calculate Rf. Choose f_b=10f_a (Say). Now calculate the values of R1 and C1. R1C1 = RfCf.
28.What are the main drawbacks of ideal integrator circuit? At low frequencies such as dc (ω ≈ 0) the gain becomes infinite. When the op-amp saturates i.e. the capacitor is fully charged it behaves like an open circuit.
29.Give the output voltage when V_i is positive and negative in a precision diode. When Vi is positive, diode D1 conducts causing V0 to negative by one diode drop (Vr =0.6v). Hence, diode D2 is reverse biased. The output voltage V0 is zero. When Vi is negative ie Vi < 0, diode D2 conducts D1 is off. The negative input Vi forces the op-amp circuit VON positive and causes D2 to conduct. Output V0 becomes positive.
30.Give an application of an Inverting Amplifier. ➢Sign Changer ➢Scale changer
31.Draw the circuit diagram of a schmitt trigger



32.Draw the circuit diagram of differentiators and give its output equation



33.Determine the output voltage for the circuit shown in figure 1 when

(a)Vin=-2V

(b)Vin=3V[Nov/Dec 2015]

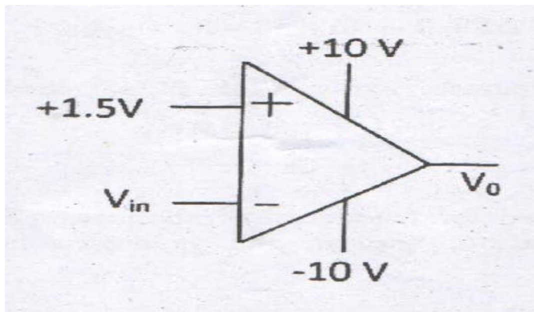


Figure 1

This is basic comparator circuit
when Vin=-2V then Vo=10V
When Vin =3V then Vo=-10V

34. What is a filter?

Filter is a frequency selective circuit that passes signal of specified band of frequencies and attenuates the signals of frequencies outside the band

PART-B&C

1. i) **For performing differentiation in an operational amplifier, integrator is preferred to differentiator-Explain[Nov/Dec 2017]**
[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 168]

ii) **What is instrumentation amplifier? Draw a system whose gain is controlled by a variable resistance[Nov/Dec 2017]**
[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 141 &142]

2.Explain the operation of differentiator and integrator with relevant waveforms and equations[April/May 2017]

3. i) **What is a precision rectifier? Explain the working of Full wave precision rectifier? [Nov/Dec14]**
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 170]

ii) **Write short notes on Clipper and clamper circuits [April /May 2017]**
[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 151]

4. i) Draw the circuit of a second order Butterworth active low pass filter and derive its transfer function. (May 2006) [April/May 16]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 293]

ii**) Design a second order active low pass filter for a cut-off frequency of 1 KHz. [April/May 16] (May 2006**)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 293]

5. i) Briefly explain the working principle of Schmitt trigger. (Apr08) (Nov 2006)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 237]

ii) Design a wide band pass filter having f_L=400 Hz f_H=2kHz and pass band gain of 4.Find the value of Q of the filter (April/May 2015)

[Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 306]

6.With a circuit diagram discuss the following applications of op-amp. (Nov 2006)

c. Voltage to current converter.

d. Precision rectifier.

[Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 166 &169]

7.Explain the working of 3 op-amp Instrumentation amplifier? [Nov/Dec 14] [April/May 16]

[Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 161]

8.Explain the working of Log amplifier and antilog amplifier? [May/June 14]

[Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 178]

9.i) Explain the operation of current to voltage converter

[Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 147]

ii) **Differentiate between low pass ,high pass ,band pass and band reject filter.Sketch the frequency plot**

[Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 263]

UNIT III-ANALOG MULTIPLIER AND PLL

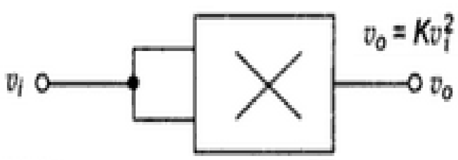
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing

PART-A

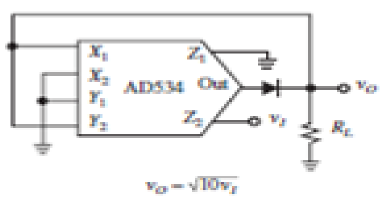
1.Define capture range of a PLL? [Nov/Dec 2017]

The range of frequency over which the PLL can acquire lock with an input signal is called capture range. The PLL cannot acquire a signal outside the capture range, but once captured, it will hold on till the signal frequency goes beyond the lock-in range, larger capture range is required.

2.How are square root and square of a signal obtained with multiplier Circuit ?[April/May 2017] [April/May 2015]



Voltage squarer using multiplier



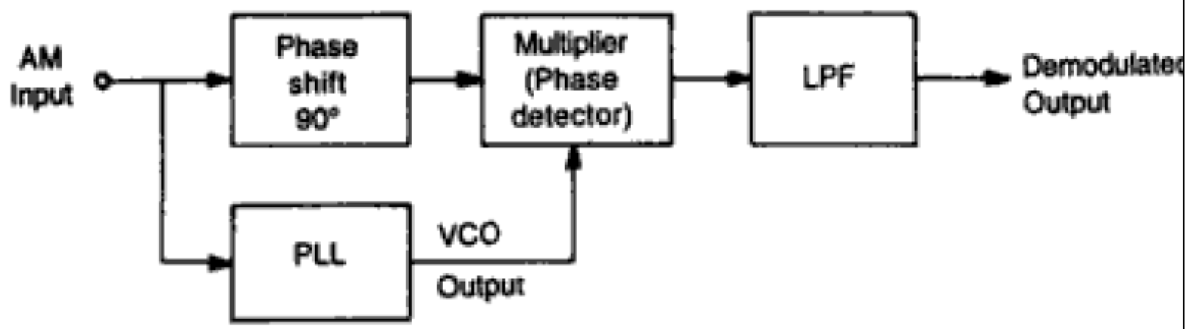
Square root circuit using multiplier

3.How is frequency stability obtained in a PLL by use of a VCO?[April/May 2017]

A voltage controlled oscillator is an oscillator circuit in which the frequency of oscillation can be controlled by an externally applied voltage. It provides the linear relationship between the applied voltage and the oscillation frequency.

VCO is a free running multivibrator and operates at a set of frequency fo called free running frequency. This frequency is determined by an external timing capacitor and an external resistor. It can also be shifted to either side by applying a dc control voltage Vc to an appropriate terminal of the IC.The frequency deviation is directly proportional to the dc control voltage and hence it is called a “Voltage Controlled Oscillator

4.Draw the block diagram of PLL for AM detection? [APRIL/MAY 16]



5.What is a four-quadrant multiplier?[NOV/DEC 2016]

It is a multiplier circuit with two inputs being both positive and both negative, then the multiplier is called as four-quadrant multiplier

6.Calculate the lock range and the capture range of the PLL.

Lock in range Δf_L= +/- 7.8 f_o/ V

$f_o$is free running frequency

Capture range = +/- = $[\Delta f_L/ (2*\prod*R*C)]^{1/2}$

7.What are the essential building blocks of a PLL?

a. The essential building blocks of PLL are
b. Phase detector
c. Low pass filter
d. Amplifier
e. Voltage Controlled Oscillator

8.What is a two quadrant multiplier?

It is a multiplier one input must be held positive and other can change to positive or negative it is called two quadrant multiplier.

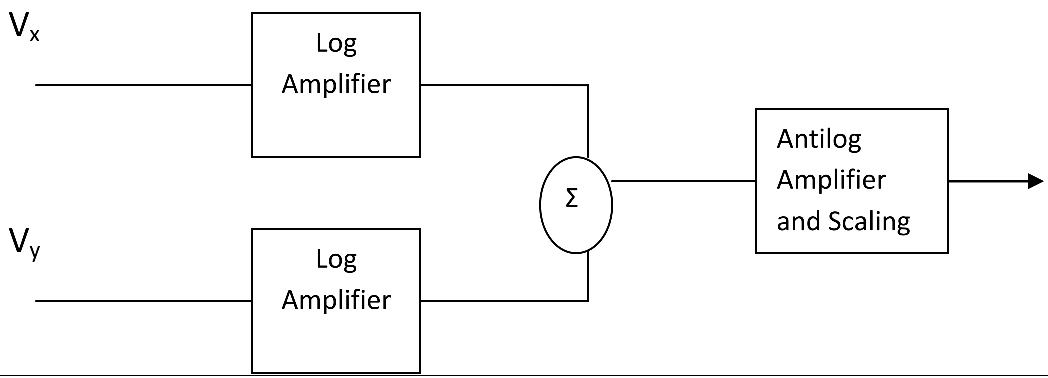
9.What is compander?

The signal is compressed at the transmitter and expanded at the receiver. This is called as companding. The combination of a compressor and expander is called a compander.

10.State why the phase detector output in a PLL should be followed by a low pass filter?

The phase detector is basically a multiplier and produces the sum (f_s+f_o) and the difference (f_s-f_o) components at its output. The high frequency component is removed by the low pass filter and the difference frequency component is applied as control voltage v_c to VCO.

11.Draw the block diagram of a multiplier using log and antilog amplifiers.

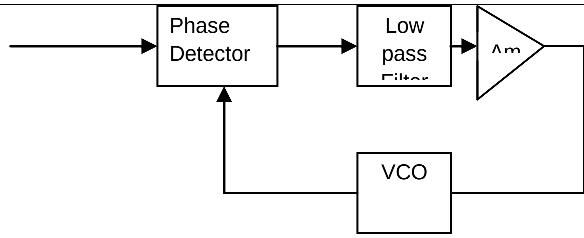


12.What is frequency synthesizer?

Frequency synthesizer is a circuit here each frequency is selected by closing the desired program switches to program a particular frequency output.

Period = Tsum + T

13.Draw the basic block diagram of PLL?



14.What is amplitude modulation?

It is the process of amplitude of carrier wave varies in accordance with the instantaneous value of the amplitude of message signal.

15.Define voltage to frequency conversion factor kv?

It is given as

$K_v = \Delta f_o / \Delta v_c$

Here K_v is the modulation voltage required to produce the frequency shift Δf_o for a VCO.

16.Give two application of PLL?

i. Frequency multiplication and division
ii. Frequency translation.
iii. AM detection.
iv. FM demodulation

17.What is a voltage-controlled oscillator?

A voltage controlled oscillator is an oscillator circuit in which the frequency of oscillation can be controlled by an externally applied voltage. It provides the linear relationship between the applied voltage and the oscillation frequency.

VCO is a free running multivibrator and operates at a set of frequency fo called free running frequency. This frequency is determined by an external timing capacitor and an external resistor. It can also be shifted to either side by applying a dc control voltage Vc to an appropriate terminal of the IC.The frequency deviation is directly proportional to the dc control voltage and hence it is called a "Voltage Controlled Oscillator".

18.When an amplifier is also called an error amplifier?

An amplifier also called an error amplifier in control theory, which accepts the signal X_d and yields the output signal X_0=a.Xd, where a is the forward gain of the amplifier is called the open-loop gain of the circuit.

19.What are the merits of companding?

- The compression process reduces the dynamic range of the signal before it is transmitted.
- Companding preserves the signal to noise ratio of the original signal and avoids non linear distortion of the signal when the input amplitude is large.
- It also reduces buzz, bias and low level audio tones caused by mild interference.

20.List the applications of OTA:

OTA can be used in

- programmable gain voltage amplifier
- sample and hold circuits
- voltage controlled state variable filter
- current controlled relaxation oscillator

21.Mention some areas where PLL is widely used.

Radar synchronization
Satellite communication systems
Air borne navigational systems
FM communication systems

22.Define lock-in range of a PLL.

The range of frequencies over which the PLL can maintain lock with the incoming signal is called the lock-in range or tracking range. It is expressed as a percentage of the VCO free running frequency

23. Define free running mode.

In a PLL if the error control voltage is zero then the PLL is said to be operated in free running mode and its output frequency is called its center frequency f_0.

24.What are the advantages of variable transconductance technique?

The advantages of variable transconductance technique are:

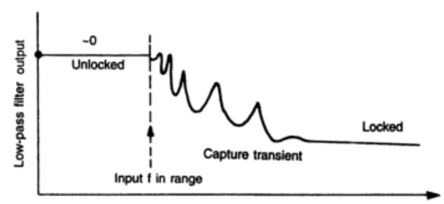
1)Simple to integrate into monolithic chip
2)Provides very good accuracy.
3)Very cheap hence economical.
4)Provides four quadrant operations.
5)It provides high speed of operation which is 2 to 3 times more than the logarithmic method.
6)Reduced error at least by 10 times.

25.With reference to a VCO, define voltage to frequency conversion factor Kv.

Voltage to frequency conversion factor Kv is defind as Kv=Δfo/ Δvc

Here Δvc is the modulation voltage required to produce the frequency shift of Δfo for a VCO

26.Draw the relation between the capture ranges and lock range in a PLL.



27.Mention two applications of analog multiplier

- Variable-gain amplifier
- Ring modulator
- Product detector
- Frequency mixer

28.VCO is called as V-F converter why?

A voltage-controlled oscillator or VCO is an electronic oscillator whose oscillation frequency is controlled by a voltage input ie the change in input voltage results in change in output frequency hence it is called as V-F converter

29.Define FSK

Frequency shift keying is a digital modulation technique in which the frequency of carrier signal is varied in accordance with the amplitude of digital modulating signal

30. What is the need for frequency synthesizer

A frequency synthesizer is an electronic system for generating any of a range of frequencies from a single fixed time base or oscillator. They are found in many modern devices, including radio receivers, mobile telephones, radiotelephones, walkie-talkies, CB radios, satellite receivers, GPS systems, etc

PART-B&C

1.With neat diagram explain the design of (i) Frequency Synthesizer (ii) Frequency Division circuit using PLL IC 565[April/May 2017]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 342]

2.i) Discuss the principle of operation of NE 565 PLL circuit[Nov/Dec 2016]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 337]

ii)How can PLL be modeled as a frequency multiplier?[Nov/Dec 2016]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 342

3.Explain the Application of PLL as AM detection,FM detection and FSK demodulation [April/May 16]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 375]

4.Explain the basic blocks of PLL and determine expressions for lock in range and capture range [April/May 15]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 353& 370]

5.i) With neat simplified internal diagram explain the working principle of Operational Transconductance Amplifier(OTA)[April/May15]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 210]

ii) Explain the application of VCO for FM generation[April /May15

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 225]

6.With suitable block diagram explain the operation of 566 voltage controlled oscillator. Also derive an expression for the frequency of the output waveform generated[Nov/Dec 10]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 363]

7.Explain the working principle of four quadrant variable form transconductance multiplier [May/June 2016]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 210]

8.Draw the analog multiplier IC and explain its features and Explain the application of analog multiplier IC[April/May 2015]

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 183]

9.i)Explain Analog Multiplier using Emitter Coupled Transistor Pair

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 183]

ii)Explain Gilbert Multiplier cell in detail

[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 183]

UNIT IV-ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R-2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

PART-B&C

1.**How is the classification of A/D converters carried out based on their operational** features? [Nov/Dec 2017]

A/D converter are classified into two groups according to their conversion

i)Direct type ADC

ii)Integrating type ADC

Direct Type ADC

(i)Flash Type converter

(ii)Counter type converter

(iii)Tracking or servo converter

(iv)Successive approximation type converter

Integrating type ADC

(i)Charge balancing ADC

(ii)Dual slope ADC

2.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.[Nov/Dec 2017]

The No of Resistors required =8

The resistance values are $2^1R, 2^2R, 2^3R, 2^4R, 2^5R, 2^6R, 2^7R, 2^8R$

3.Why are Scottky diodes used in sample and hold circuits?[April/May 2017]

Schottky diodes can be used in diode-bridge based sample and hold circuits. When compared to regular p-n junction based diode bridges, Schottky diodes can offer advantages. A forward-biased Schottky diode does not have any minority carrier charge storage. This allows them to switch more quickly than regular diodes, resulting in lower transition time from the sample to the hold step. The absence of minority carrier charge storage also results in a lower hold step or sampling error, resulting in a more accurate sample at the output

4.What are the advantages of inverted R-2R (current type) ladder D/A converter over R-2R (voltage type) D/A converter?[Nov/Dec 2016]

In R-2R ladder type DAC current flowing in the resistors changes as the input data changes. More power dissipation causes heating which in turn creates non-linearity in DAC.This problem can be avoided in inverted R-2R ladder type as the current divides equally at each node.

5.What is the need for electronic switches in D/A converter?[Nov/Dec 2016]

The Switches which connects the digital binary input to the nodes of a D/A converter is an electronic switch

6.A 12 bit D/A converter has a resolution of 20mv/LSB.Find the full scale output voltage.[May/June 2016]

$$\mathrm{Re}\,solution = \frac{V_{oFS}}{2^n - 1}$$

Where, V_{oFS} is the full scale output voltage

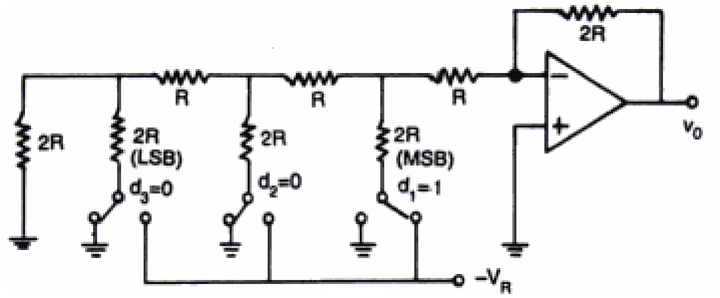
n is the number of bits

$$V_{oFS} = \mathrm{Re}\,solution * (2^n - 1)$$

$$V_{oFS} = 20*10^{-3}*(2^{12}-1)$$

$$V_{oFS} = 81.9V$$

7.Draw the binary ladder network of DAC, If the value of the smaller resistance is 10K.What is the value of other resistance?[May/June 2016]



The value of other resistance=2R=20 Kohm

8.Determine the number of comparators and resistors required for 8 bit flash type ADC[Nov/Dec2015]
No Of comparators required is $=2^8-1=255$

9.Mention two advantages of R-2R ladder type DAC when compared to weighted resistor type DAC [Nov/Dec 2015]

- Only two resistor values are used in R-2R ladder type.
- It does not need as precision resistors as Binary weighted DACs.
- It is cheap and easy to manufacture.

10. What would be produced by a DAC whose output ranges is 0 to 10V and whose input binary number is 10111100(for a 8 bit DAC)?[April/May 2015]

$V_o=10V(1x(1/2)+0x(1/2)^2+1x(1/2)^3+1x(1/2)^4+1x(1/2)^5+1x(1/2)^6+0x(1/2)^7+0x(1/2)^8)$

$V_o=7.34V$

11.What is over sampling?[April/May 2015]

The technique of increasing the apparent sampling frequency of a digital signal by repeating each digit a number of times, in order to facilitate the subsequent filtering of unwanted noise.

In signal processing, oversampling is the process of sampling a signal with a sampling frequency significantly higher than the Nyquist rate. Theoretically a bandwidth-limited signal can be perfectly reconstructed if sampled above the Nyquist rate, which is twice the highest frequency in the signal. Oversampling improves resolution, reduces noise and helps avoid aliasing and phase distortion by relaxing anti-aliasing filter performance requirements.

12.State the reason for keeping the integrating time in the dual slope analog to digital converter equal to that of mains supply period.

The dual slope ADC integrates the input signal for a fixed time, hence it provides excellent noise rejection of ac signals whose periods are integral multiples of the integration time Ti. Thus as noise superimposed on the input signal such as 50Hz power link pick-up will be averaged during the input integration time. So choose clock period T, so that 2^nT is an exact integral multiple of the line period (1/50) second = 20 ms.

13.Which is the fastest A/D converter? Give reason.

Parallel comparator A/D is the fastest and most expansive comparator. Because it consists of a resistive divider network, 8 op-amp comparators and a 8 line to 3 line encoder.

14.A 12 bit D/A converter have resolution of 30 mV/ LSB. Find the full scale output voltage.

Vo = Vfs/2

Vfs = 2xVo

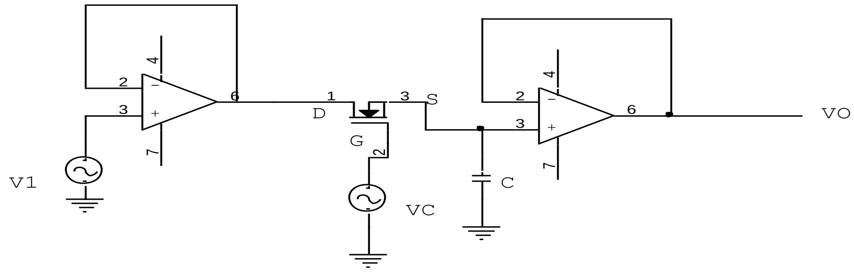
= 2x30 = 60 mv.

15.Calculate the number of comparators required for realizing a 4 bit flash A/D converter.

Numbers of comparators required are $2^n - 1$

$2^4 - 1 = 16 - 1 = 15$.

16.Draw a sample and hold circuit.



17.Define resolution of a D/A converter?

The resolution of a DAC is defined as the smallest change in voltage, which may be produced at the output or input of the converter.

18.How many comparators are required to build n –bit flash type A/D converter?

Comparator required to build n –bit flash type A/D converter is $2^n – 1$

Where n is the desired number of bits.

19.Define monotonicity with respect to D/A converter?

A DAC is said to be monotonic if the analog output increases or remains the same as the digital input increases. This results in the output always being single – valued.

20.Why is R-2R ladder network DAC better than weighted resistor DAC?

Wide ranges of resistors are required in binary weighted resistor type DAC.

This can be avoided by using R-2R ladder type DAC.

i. Easier to build accurately as only two precision metal film resistors are required.
ii. Number of bits can be expanded by adding more sections of same R-2R values.
iii. In inverted R-2R ladder DAC, node voltages remain constant with changing input binary words. This avoids any slowdown effects by stray capacitances.

21.Which type of ADC is used in all digital voltmeter?

Dual slope ADC converters are particularly suitable for accurate measurement of slowly varying signals, such as digital panel meters and multimeters.

22.What do you mean by delta modulation?

Delta modulation is a method of information transmission with the help of pulses. It is one type of digital modulation and it determines the increase or decrease of the signal sample with respect to previous sample. And encodes this rise or fall of amplitude by 1 bit.

23.List the application of sample and Hold circuits?

i. It is used in ADC.
ii. It is used in digital interfacing
iii. It is used in pulse modulation system
iv. It is used in analog demultiplexer

24.Mention the types of DAC techniques?

ii. Weighted resistance
iii. Inverted R_2R ladder
iv. Multiplying.

25.Define the resolution of DAC?

Resolution of DAC is defined as the change in the output voltage corresponding to the change of one bit in the digital input.

26.Explain in brief stability of a converter:

The performance of converter changes with temperature age & power supply variation . So all the relevant parameters such as offset, gain, linearity error& monotonicity must be specified over the full temperature & power supply ranges to have better stability performances.

27.What is meant by linearity?

The linearity of an ADC/DAC is an important measure of its accuracy & tells us how close the converter output is to its ideal transfer characteristics. The linearity error is usually expressed as a fraction of LSB increment or percentage of full-scale voltage. A good converter exhibits a linearity error of less than ±½LSB.

28.What is monotonic DAC?

A monotonic DAC is one whose analog output increases for an increase in digital input.

29.What is multiplying DAC?

A digital to analog converter which uses a varying reference voltage VR is called a multiplying DAC (MDAC). If the reference voltage of a DAC, VR is a sine wave given by:

$V(t) = V_{in} \cos 2\pi ft$;

Then, $V_o(t) = V_{om} \cos (2\pi ft + 180^o)$

30.What is a sample and hold circuit? Where it is used?

A sample and hold circuit is one which samples an input signal and holds on to its last sampled value until the input is sampled again. This circuit is mainly used in digital interfacing, analog to digital systems, and pulse code modulation systems.

31.Define sample period and hold period.

The time during which the voltage across the capacitor in sample and hold circuit is equal to the input voltage is called sample period. The time period during which the voltage across the capacitor is held constant is called hold period.

32.Define accuracy of converter.

Absolute accuracy:

It is the maximum deviation between the actual converter output & the ideal converter output.

Relative accuracy:

It is the maximum deviation after gain & offset errors have been removed. The accuracy of a converter is also specified in form of LSB increments or % of full scale voltage.

33.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.

Given $V_{o\ FS} = 10V$

$$Resolution = \frac{10}{10^4 - 1} = 0.6667\ V$$

The output voltage at 0110=0.6667*6=4V

34.What is the main drawback of dual slope ADC?

The conversion time of dual slope ADC is high .This is the main drawback of dual slope ADC.

35.Define settling time

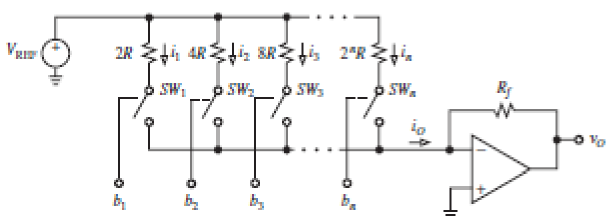
It is the time the converter takes for the output to settle within a specified band +/-(1/2)LSB

36.A 12 bit D/A converter has resolution of 20mV/LSB.Find the full scale output voltage[APRIL/MAY 16]

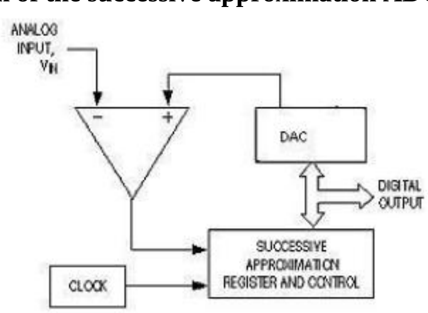
Given resolution = 20mV/LSB

Full scale output voltage =Resolution(10^{12}-1)=20*10^{-3} (10^{12}-1)

37.Draw the weighted resistor network of DAC[APRIL/MAY 16]



38.Draw the functional diagram of the successive approximation ADC



PART-B&C

1.Describe the operation of dual slope and successive approximation type ADC .What are the advantages of dual slope ADC[April/May 2017][Nov/Dec 10

2.i) What is meant by resolution ,offset error in ADC[April/May 2017]

[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 366]

ii)Discuss on the single slope type ADC
[Ref .Roy Choudhry, ShailB.Jain, "Linear Integrated Circuits (Fourth Edition)", Page 363]

3.i) Explain the successive approximation type A/D converter[APRIL/MAY 16]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 396]
ii) Narrate the functions of Analog switches
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 383]

4.i)How are A/D converters categorized? [April/May 2017]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 393]
ii)Write Short Note on high speed sample and hold circuits[April/May 15] [April/May 16] (6)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 176]

5.i) Explain voltage mode and current mode operations of R-2R ladder type DAC[Nov/Dec 10]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 386]
ii)Explain over sampling type analog to digital converters
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 176]

6.Draw the block diagram and explain the working of
i)Charge Balancing VFCS(8)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 225]
ii)Voltage to Time converter(8)[May/June 13]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 225]

7.Explain the following type DAC with suitable diagrams
i)Binary weighted resistor DAC(6)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 382]
ii)R-2R Ladder DAC(5)
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 385]
iii)Inverted R-2R ladder DAC(5)[Nov/Dec 11]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 386]

8.i) Explain the following type of electronic switches used in D/A converter with suitable diagrams
1.Totem pole MOSFET switch(4)
2.CMOS inverter as a switch(4)[May/June 12]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 384]
ii) Compare Flash type ,Dual slope and successive approximation ADC in terms of parameters like speed ,accuracy, resolution ,input hold time(8)[May/June 12]
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 393]
9.With a neat block diagram explain the working of three bit flash type analog to digital converter
[Ref .Roy Choudhry, Shail B.Jain, "Linear Integrated Circuits (Second Edition)", Page 393]

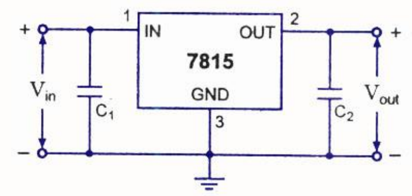
UNIT V-WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC

PART-A

1.Define current transfer ratio of an opto coupler[Nov/Dec 2017]
The current transfer ratio (CTR) is a parameter similar to the DC current amplification ratio of a transistor (hFE) and is expressed as a percentage indicating the ratio of the output current (IC) to the input current (IF).
CTR(%)=(IC/IF) x 100

2.Draw a fixed voltage regulator circuit and state its operation[Nov/Dec 2017]



Connection of 7815 Voltage Regulator

3.What is a voltage regulator?[April/May 2017]

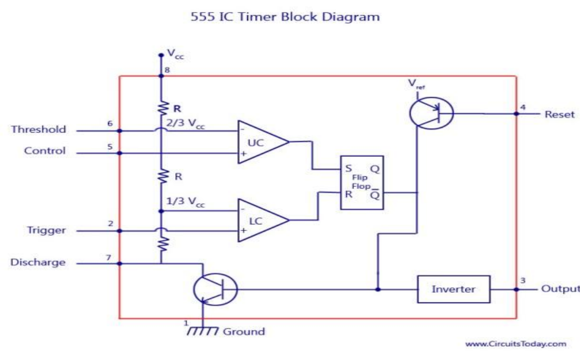
A voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature, and ac line voltage variations.

4.Distinguish the principle of linear regulator and a switched mode power supply.[April/May 2017]

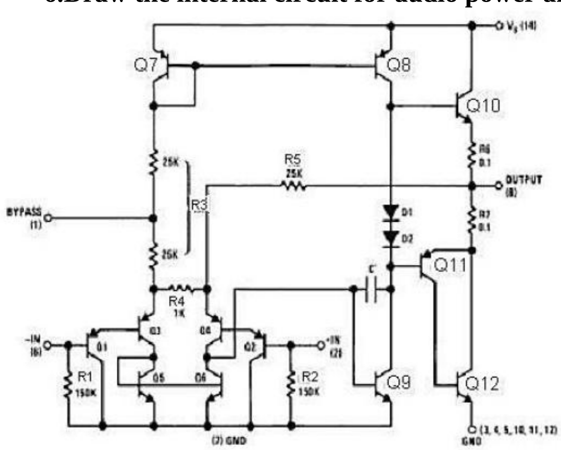
As its name suggests, a linear regulator is one where a linear component (such as a resistive load) is used to regulate the output. It is also sometimes called a series regulator because the control elements are arranged in series between the input and output.

A switching regulator is a voltage regulator that uses a switching element to transform the incoming power supply into a pulsed voltage, which is then smoothed using capacitors, inductors, and other elements.

5.Draw the block schematic of IC 555 timer.[Nov/Dec 2016]



6.Draw the internal circuit for audio power amplifier[April/May 16]



7.What is the function of a voltage regulator? Name few IC voltage regulators. [Nov/Dec 2016]

The function of voltage regulator is to provide a stable dc voltage for powering other electronic circuits. A voltage regulator should be capable of providing substantial output current.

Some IC voltage regulator is 78 XX/79 XX series and 723 general purpose regulators

8.Give the classification of voltage regulators:

- Series / Linear regulators
- Switching regulators.

9.Mention some applications of 555 timer:

- Oscillator
- Pulse generator
- Ramp and square wave generator
- Mono-shot multivibrator

- Burglar alarm
- Traffic light control.

10.List the applications of 555 timer in monostable mode of operation:

- Missing pulse detector
- Linear ramp generator
- Frequency divider
- Pulse width modulation.

11.List the applications of 555 timer in Astable mode of operation:

- FSK generator
- Pulse-position modulator

12.What is a linear voltage regulator?

Series or linear regulator uses a power transistor connected in series between the unregulated dc input and the load and it conducts in the linear region. The output voltage is controlled by the continuous voltage drop taking place across the series pass transistor.

13.What is a switching regulator?

Switching regulators are those which operate the power transistor as a high frequency on/off switch, so that the power transistor does not conduct current continuously. This gives improved efficiency over series regulators.

14.What is the purpose of having input and output capacitors in three terminal IC regulators?

A capacitor connected between the input terminal and ground cancels the inductive effects due to long distribution leads. The output capacitor improves the transient response.

15.Define line regulation.

Line regulation is defined as the percentage change in the output voltage for a change in the input voltage. It is expressed in millivolts or as a percentage of the output voltage.

16.Define load regulation.

Load regulation is defined as the change in output voltage for a change in load current. It is expressed in millivolts or as a percentage of the output voltage.

17.What is meant by current limiting?

Current limiting refers to the ability of a regulator to prevent the load current from increasing above a preset value.

18.Give the drawbacks of linear regulators:

- The input step down transformer is bulky and expensive because of low line frequency.
- Because of low line frequency, large values of filter capacitors are required to decrease the ripple.
- Efficiency is reduced due to the continuous power dissipation by the transistor as it operates in the linear region.

19.What is the advantage of switching regulators?

- Greater efficiency is achieved as the power transistor is made to operate as low impedance switch. Power transmitted across the transistor is in discrete pulses rather than as a steady current flow.
- By using suitable switching loss reduction technique, the switching frequency can be increased so as to reduce the size and weight of the inductors and capacitors.

20.What is an opto-coupler IC? Give examples.

Opto-coupler IC is a combined package of a photo-emitting device and a photo sensing device.

Examples for opto-coupler circuit :LED and a photo diode,
LED and photo transistor,
LED and Darlington.

Examples for opto-coupler IC : MCT 2F , MCT 2E

21.Mention the advantages of opto-couplers:

- Better isolation between the two stages.
- Impedance problem between the stages is eliminated.
- Wide frequency response.
- Easily interfaced with digital circuit.
- Compact and light weight.
- Problems such as noise, transients, contact bounce are eliminated.

22.What is an isolation amplifier?

An isolation amplifier is an amplifier that offers electrical isolation between its input and output terminals.

23.What is the need for a tuned amplifier?

In radio or TV receivers, it is necessary to select a particular channel among all other available channels. Hence some sort of frequency selective circuit is needed thatwill allow us to amplify the frequency band required and reject all the other unwanted signals and this function is provided by a tuned amplifier.

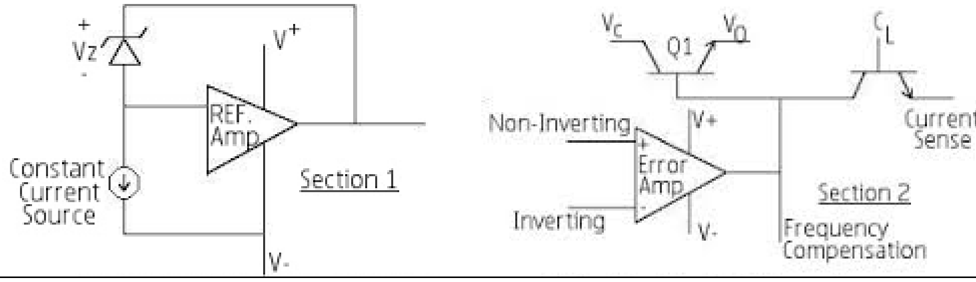
24.Give the classification of tuned amplifier:

(i) Small signal tuned amplifier

- Single tuned
- Double tuned
- Stagger tuned

(ii) Large signal tuned amplifier.

25.Draw the functional block diagram of 723 regulator.



26.Why is the monostable multivibrator circuit called time delay circuit and gating circuit?

Monostable multivibrator circuit called time delay circuit because it generates a fast transition at a predetermined time T after the application of input trigger. It is called as a gating circuit because it generates rectangular waveform at a definite time and could be used as gate parts of a system.

27.Why there is no phase shift provided in the feedback network in Wein-Bridge oscillator?

In Wein-bridge oscillator, the feedback signal is connected to the (+) input terminal so that, the op-amp is working as a non-inverting amplifier, which produces 0 degree or 360 degree phase shift.. Therefore the feedback network need not provide any phase shift.

28.Give the formula for period of oscillations in an op-amp astable circuit.

The formula for period of oscillations in an op-amp astable circuit is $T = 2RC \ln\left[1 + \frac{2R_2}{R_1}\right]$

29.Define duty cycle for a periodic pulse waveform.

The duty cycle of the output pulse waveform is given by

$$d\% = \frac{T_C}{T} * 100 = \frac{R_A + R_B}{R_A + 2R_B} * 100$$

30.What is meant by thermal shutdown applied to voltage regulators?

Due to overheating , the series pass element of regulator may get damaged. To avoid this, thermal shutdown is provided. In this protection scheme, the junction temperature of the series pass element is sensed. By sensing this, its power dissipation is reduced by using certain circuit till its temperature drops to a lower safe value.

31.What are the three waveforms generated by ICL8038?

- Sine wave
- Square wave
- triangular Wave

32.List the characteristics of optocoupler

(i) Current Transfer Ratio:

(ii) Isolation voltage between input & output:

(iii) Response Time:

(iv) Common mode Rejection:

33.Mention two applications of frequency to voltage converter

- Frequency to voltage converter in tachometers.
- Frequency difference measurement.

34.What is the advantage of switching regulators?

Switching regulators are highly efficient and able to step up (boost), step down (buck), and invert voltages with ease

Switching regulators are efficient because the series element is either fully conducting or switched off because it dissipates almost no power. Switching regulators are able to generate output voltages that are higher than the input voltage or of opposite polarity, unlike linear regulators.

PART-B&C

1.i) With neat diagram explain the operation of an astable and monostable multivibrators[Nov/Dec 2017]

[Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 216 &318] **ii)Draw the functional diagram and connection diagram of a low voltage regulator and explain**[Nov/Dec 2017] [Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 241]
2.Answer any two of the following[April/May 2017] **i)Switched capacitor filters** [Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 288] **ii)Audio power amplifier** [Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 322] **iii)Opto coupler** [Ref .Roy Choudhry, ShailB.Jain, “Linear Integrated Circuits (Fourth Edition)”, Page 322]
2.With neat diagram explain IC723 general purpose voltage regulator[May/June 14] [April/May 16] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 272]
3.Explain Sawtooth waveform generator and LM 380Audio amplifier in detail [April/May 16] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 247]
4.Describe the working of a astable multivibrator using 555 timer[Nov/Dec 11] [April/May 16] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 345]
5.Explain in detail Voltage to frequency and frequency to voltage converter[May/June 14] [Ref. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition page 520
6.i)Design a phase shift oscillate at 100Hz (May/June 15) [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 250] **ii) Describe monostable multivibrator with necessary diagrams and derive for ON time and recovery time**[May/June 15] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 337]
7.i)Briefly describe about monolithic switching regulators[April/May 15] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 280] ii)**Draw the schematic of ICL 8038 function generator and discuss its** features (8) [April/May 15] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 225]
8.Describe the working of a Astable multivibrator using op-amp [Nov/Dec 14] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 241]
9.Describe the working of a monostable multivibrator using 555 timer[Nov/Dec 13] [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 337]
10.Explain Video amplifier and opto-couplers [Ref .Roy Choudhry, Shail B.Jain, “Linear Integrated Circuits (Second Edition)”, Page 380]

COURSE DELIVERY PLAN-THEORY

Faculty Name : G C JAGAN	**Programme/Branch:B.E/ECE**
Academic Year:201-2018	**Year/Semester/Batch:II/IV/2016-2020**
Subject Code/Subject Name: EC6040/Linear Integrated Circuits	**Regulation:2013**

A. Details of the relevant POs & PSOs supported by the course	
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and electronics engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO I	Competence in using modern electronic tools in hardware and software co-design for networking and communication applications.
PSO II	Promote excellence in professional career and higher education by gaining knowledge in the field of Electronics and Communication Engineering
PSO III	Understand social needs and environmental concerns with ethical responsibility to become a successful professional.

B. Details of COs Mapping with PO/PSOs identified for the course

Course Outcome	Course Description	Program Outcomes/Program Specific Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C215.1	**Describe** the basics of operational amplifiers.	3	3	3	2	1	-	-	-	-	-	-	-	2	2	-
C215.2	**Design** linear and non-linear applications of operational amplifiers.	3	3	3	3	2	-	-	-	-	-	1	1	3	3	-
C215.3	**Develop** applications using analog multiplier and PLL.	3	3	3	2	2	-	-	-	-	-	1	1	3	3	-
C215.4	**Construct** ADC and DAC using operational amplifiers.	3	3	3	2	2	-	-	-	-	-	1	1	3	2	-
C215.5	**Generate** waveforms using operational amplifiers and Construct circuits using special function IC's.	3	3	3	3	2	-	-	-	-	-	1	1	3	2	-

C. Syllabus of the course

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R-2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC..

D. Content Beyond Syllabus:

1. Dry EDM
2.Application of Cryogenic cooling in Machining
3.

F. Delivery Resources:

Text Book(s):

T1:D.RoyChoudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000..

T2: Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition, Tata McGraw-Hill, 2007

Reference Book(s):

R1: Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Edu, 2001..
R2: Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
R3:B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001
R4: Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.
R5: Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.
R6: William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004.
R7: S.Salivahanan& V.S. KanchanaBhaskaran, “Linear Integrated Circuits”, TMH, 2008.

On line learning materials (and Others if any):

1. nptel.ac.in/courses/112105126/39
2.

UNIT I BASICS OF OPERATIONAL AMPLIFIERS				
Topic to be Covered	Delivery Resources			Delivery Method
	Text Book with Pg.No	Reference Book (if any with Pg.No)	Online Resource (Web Link of the Specific Topic)	
Current mirror and current sources	T1: Pg no:65			
Current sources as active loads	T1: Pg no:77			
Voltage sources		R7: Pg no:57		
Voltage References	T2: Pgno:506			
BJT Differential amplifier with active loads	T1: Pg no:78			
Basic information about op-amps	T1: Pg no:37			
Ideal Operational Amplifier	T1: Pg no:41			
General operational amplifier stages	T1: Pg no:53			
Internal circuit diagrams of IC 741	T1: Pg no:82			
DC and AC performance characteristics	T1: Pg no:104&111			
slew rate	T1: Pg no:123			
Open and closed loop configurations.		R7: Pg no:139		
Course Outcome: C215.1: **Describe** the basics of operational amplifiers.				
No of hours in the syllabus : 9				
No of hours planned : 9				
No of hours taught : 9				

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS				
Topic to be Covered	Delivery Resources			Delivery Method
	Text Book with Pg.No	Reference Book (if any with Pg.No)	Online Resource (Web Link of the Specific Topic)	
Sign Changer		R7: Pg no:183		
Scale Changer	T1: Pgno:135	R7: Pg no:183		
Phase Shift Circuits		R7: Pg no:184		
Voltage Follower	T1: Pg no:49			
V-to-I and I-to-V converters	T1: Pgno:146			
adder, subtractor	T1: Pgno:136			
Instrumentation amplifier	T1: Pgno:141			
Integrator,	T1: Pgno:168			
Differentiator	T1: Pgno:164			
Logarithmic amplifier,	T1: Pgno:155			
Antilogarithmic amplifier,	T1: Pgno:157			

Comparators	T1: Pgno:207			
Schmitt trigger	T1: Pgno:212			
Precision rectifier	T1: Pgno:148			
peak detector	T1: Pgno:151			
clipper and clamper	T1: Pgno:151			
Low-pass, high-pass and band-pass Butterworth filters	T1: Pgno:262			
Course Outcome: C215.2 Design linear and non-linear applications of operational amplifiers.				
No of hours in the syllabus : 9				
No of hours planned : 9				
No of hours taught : 9				

UNIT III ANALOG MULTIPLIER AND PLL				
Topic to be Covered	Delivery Resources			Delivery Method
	Text Book with Pg.No	Reference Book (if any with Pg.No)	Online Resource (Web Link of the Specific Topic)	
Analog Multiplier using Emitter Coupled Transistor Pair		R7: Pg no:394		
Gilbert Multiplier cell		R7: Pg no:398		
Variable transconductance technique		R7: Pg no:404		
analog multiplier ICs and their applications		R7: Pg no:406		
Operation of the basic PLL	T1: Pg no:327			
Closed loop analysis	T1: Pg no:328			
Voltage controlled oscillator	T1: Pg no:334			
Monolithic PLL IC 565	T1: Pg no:337			
application of PLL for AM detection	T1: Pg no:342			
FM detection	T1: Pg no:			
FSK modulation and demodulation	T1: Pg no:344			
Frequency synthesizing	T1: Pg no:343			
Course Outcome: C215.3Develop applications using analog multiplier and PLL.				
No of hours in the syllabus : 9				
No of hours planned : 9				
No of hours taught : 9				

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS				
Topic to be Covered	Delivery Resources			Delivery Method
	Text Book with Pg.No	Reference Book (if any with Pg.No)	Online Resource (Web Link of the Specific Topic)	
Analog and Digital Data Conversions	T1: Pg no:348			
D/A converter – specifications	T1: Pg no:349			
weighted resistor type	T1: Pg no:349			
R-2R Ladder type, Voltage Mode	T1: Pg no:352			
Current-Mode R-2R Ladder types	T1: Pgno:353			
switches for D/A converters	T1: Pg no:351			

high speed sample-and-hold circuits	T1: Pg no:153	R7: Pg no:479		
A/D Converters – specifications	T1: Pg no:357			
Flash type	T1: Pg no:358			
Successive Approximation type	T1: Pg no:361			
Single Slope type		R7: Pg no:398		
Dual Slope type	T1: Pg no:363			
A/D Converter using Voltage-to-Time Conversion		R7: Pg no:498		
Over-sampling A/D Converters		R7: Pg no:503		
Course Outcome: C215.4 ConstructADC and DAC using operational amplifiers.				
No of hours in the syllabus : 9				
No of hours planned : 9				
No of hours taught : 9				

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS				
Topic to be Covered	Delivery Resources			Delivery Method
	Text Book with Pg.No	Reference Book (if any with Pg.No)	Online Resource (Web Link of the Specific Topic)	
Sine-wave generators	T1: Pg no:222			
Multivibrators	T1: Pg no:216			
Triangular wave generator	T1: Pg no:220			
Saw-tooth wave generator	T2: Pg no:476			
ICL8038 function generator		R7: Pg no:336		
Timer IC 555	T1: Pg no:311			
IC Voltage regulators	T1: Pg no:240			
Three terminal fixed and adjustable voltage regulators	T1: Pg no:240			
IC 723 general purpose regulator	T1: Pg no:248			
Monolithic switching regulator	T1: Pg no:255			
Switched capacitor filter IC MF10	T1: Pg no:228			
Frequency to Voltage and Voltage to Frequency converters	T2: Pg no:486			
Audio Power amplifier		R7: Pg no:530		
Video Amplifier		R7: Pg no:538		
Isolation Amplifier		R7: Pg no:547		
Opto-couplers and fibre optic IC.		R7: Pg no:542		
Course Outcome: C215.2 Design linear and non-linear applications of operational amplifiers.				
No of hours in the syllabus : 9				
No of hours planned : 9				
No of hours taught : 9				