



MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.



MUST KNOW CONCEPTS

MKC

BME

2021-22

Course Code & Course Name : 19MDC04 & LOGIC CIRCUITS FOR CLINICAL ENGINEERS

Year/Sem/Sec : II/IV/-

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
Unit-I : IC Fabrication and Operational Amplifier				
1.	IC	-	Active and passive components fabricated together on a single crystal of silicon.	-
2.	Sheet resistance	-	Sheet resistance is defined as the resistance in ohms /square offered by the diffused area.	-
3.	virtual ground of OP-Amp	-	It is a point that is at the fixed ground potential (0v), though it is not practically connected to the actual ground or common terminal of the circuit.	-
4.	slew rate	-	The maximum rate of change of output Voltage caused by a step input voltage	-
5.	input offset voltage	-	.A small voltage applied to the input terminals to make the output voltage as zero when the two input terminals are grounded.	-
6.	Sensitivity	-	The percentage or fractional change in output current per percentage or fractional change in power-supply voltage.	-
7.	CMRR	-	The relative sensitivity of an op-amp to a difference signal as compared to a common - mode signal.	-
8.	Ion implantation	-	Ion implantation is the introduction of ionized particles atoms into targets with enough energy to penetrate beyond surface regions.	-
9.	differential amplifier	-	A differential amplifier is one which amplifies the difference between its two input signals. The gain with which it amplifies the difference is called its differential.	-
10.	current mirror	-	The circuit in which the output current is forced to equal the input current	-

11.	voltage reference circuit	-	A voltage reference circuit is a constant d.c. voltage source which acts as a reference or standard for other circuits.	-
12.	operational amplifier	-	An operational amplifier is a direct coupled high gain amplifier usually consisting of one or more differential amplifiers.	-
13.	Widlar current source	-	It is a modification of the basic two-transistor current mirror that incorporates an emitter degeneration resistor for only the output transistor.	-
14.	Wilson current mirror	-	A Wilson current mirror or Wilson current source is a circuit configuration designed to provide a constant current source or sink	-
15.	surface passivation	-	The process of creating the protective SiO ₂ layer on the wafer surface is known as surface passivation.	-
16.	metallization	-	After devices have been fabricated in the silicon substrate, interconnections must be made to link all the components on the chip.	-
17.	input offset voltage	-	It is defined as the voltage that must be applied between the input terminals of an op-amp to nullify the output	-
18.	input bias current	-	It is defined as the average of the current entering into the input terminals of an op-amp.	-
19.	Why integrators are preferred over differentiators?	-	Integrators are more linear than the differentiators and the integrators reduce the power consumption than the high pass filter.	-
20.	Inverting Amplifier	-	The output is given as feedback to the inverted terminal of input by means of a feedback resistor.	-
21.	PSRR	-	Power Supply Rejection Ratio (PSRR) is defined as the change in op-amp's input offset voltage due to variations in supply voltage.	-
22.	Tail current	-	Tail current is defined as the current which is flowing through the common emitter resistor of the differential amplifier.	-
23.	Thermal drift	-	Thermal drift is defined as the change in offset current and offset voltage due to temperature.	-
24.	Different types of op-amp	-	Different types of op-amp: 1. Bipolar op-amp 2. FET op-amp 3. MOSFET op-amp	-
25.	Full power response	-	the maximum frequency of a large amplitude sine wave with which op-amp can have undistorted output.	-

Unit-II : Characteristics of Op Amp and Applications

26.	AC characteristics of Op Amp	-	<ul style="list-style-type: none"> • Frequency Response • Slew rate 	-
27.	DC characteristics of op Amp	-	<ul style="list-style-type: none"> • Input resistance, • Output resistance, • Input bias current, • Input offset current, • Input offset voltage, • Total offset voltage, • Thermal drift, • Power supply rejection ratio. 	-
28.	Instrumentation amplifier	-	Instrumentation amplifier is a kind of differential amplifier with additional input buffer stages.	-
29.	Current to voltage converter	-	Special case of inverting amplifier in which input current is converted into a proportional output voltage.	-
30.	Voltage to current converter	-	Op Amp circuit that converts input voltage into a proportional output current.	-
31.	Differentiator	-	Op Amp circuit that provides an output signal which is proportional to the differentiation of the input signal	-
32.	Integrator	-	Op Amp circuit that provides an output signal which is proportional to the integration of the input signal.	-
33.	Application of differentiator	-	<ul style="list-style-type: none"> • Used in wave shaping circuits • Used as a rate of change detector in FM demodulator 	-
34.	Application of Integrator	-	Used in ADCs, ramp generator, analog computers and signal wave shaping circuits.	-
35.	Differential amplifier	-	Differential Amplifier is a device which is used to amplify the difference between the <u>voltages</u> applied at its inputs.	-
36.	Subtractor	-	An op Amp circuit that provides difference between two signals	-
37.	Summing amplifier	-	An op Amp circuit that provides output signal which is proportional to the sum of the input signal.	-
38.	Voltage follower	-	Voltage follower is an <u>Op-amp</u> circuit whose output <u>voltage</u> straight away follows the input voltage.	-
39.	Application of voltage follower	-	<ul style="list-style-type: none"> • Buffers for logic circuits. • In Sample and hold circuits. • In Active filters. • In Bridge circuits via transducer 	-
40.	Sign changer	-	Inverting amplifier circuit with unity gain.	-
41.	Scale changer	-	Inverting amplifier circuit with a gain of scale factor 'K'	-

42.	Frequency compensation techniques	-	<ul style="list-style-type: none"> External frequency compensation Internal frequency compensation 	-
43.	External frequency compensation techniques	-	<ul style="list-style-type: none"> Dominant pole compensation Pole zero compensation 	-
44.	Slew rate	-	Defined as the maximum rate of change of output voltage of an op amp with respect to time.	-
45.	Input bias current	-	Average of two input bias current flowing into the non-inverting and inverting input of an op amp.	-
46.	Gain of inverting amplifier	-	$A_V = - \frac{R_f}{R_i}$	-
47.	Gain of non-inverting amplifier	-	$A_V = 1 + \frac{R_f}{R_i}$	-
48.	Input offset voltage	-	Voltage that must be applied between the input terminals of an op amp to nullify the output.	-
49.	Use of R _{comp} resistor	-	To overcome the errors due to the bias current	-
50.	Precision rectifier	-	Rectifier circuit with op amp that can rectify input voltage of a very small amplitude even less than forward voltage drop of diode.	-

Unit-III : Comparator and Waveform Generators

51.	Comparator	-	An op amp circuit that compares a input voltage with a known reference voltage.	-
52.	Application of comparator	-	Zero crossing detector, window detector, Time marker generator, pulse meter.	-
53.	Zero crossing detector	-	A zero-crossing detector or ZCD is one type of voltage comparator, used to detect a sine waveform transition from positive and negative that coincides when i/p crosses the zero voltage condition.	-
54.	Window detector	-	A window detector circuit is used to determine whether an unknown input is between two precise reference <u>threshold voltages</u> . It employs two <u>comparators</u> to detect over-voltage or under-voltage	-
55.	Schmitt trigger	-	A Schmitt trigger is a regenerative comparator circuit that makes use of positive feedback to implement hysteresis and is used to remove noise from an analog signal while converting it to a digital one.	-
56.	Identify op amp configuration in comparator and Schmitt	-	Comparator – Open loop configuration Schmitt trigger – Closed loop configuration with positive feedback.	-

	trigger			
57.	Hysteresis voltage	-	Difference between the upper and lower threshold voltage	-
58.	Condition for oscillation	-	Barkausen criterion must be satisfied. $ A\beta = 1$ and angle $(A\beta) = 0$ degrees.	-
59.	RC phase shift oscillator	-	An oscillator circuit in which the required phase-shift of 360° is offered collectively by the RC phase-shift networks and the <u>Op-Amp</u> working in inverted configuration.	-
60.	Wein bridge oscillator	-	An audio frequency oscillator. It involves both positive and negative feedback.	-
61.	Multivibrator	-	A wave shaping circuit which gives symmetric or asymmetric square wave output.	-
62.	Types of multivibrator	-	<ul style="list-style-type: none"> • Astable multivibrator • Monostable multivibrator • Bistable multivibrator 	-
63.	Astable multivibrator	-	Free running symmetric multivibrator that has no stable states. [has two quasi-stable state]	-
64.	Monostable multivibrator	-	One shot multivibrator that has one stable state and one quasi-stable state.	-
65.	Bistable multivibrator	-	Bistable multivibrator, in which the circuit is stable in either state. It can be flipped from one state to the other by an external trigger pulse. This circuit is also known as a <u>flip-flop</u>	-
66.	Frequency of oscillation of RC phase oscillator	-	$f_o = \frac{1}{2\pi(\sqrt{6})CR}$	-
67.	Frequency of oscillation of Wein bridge oscillator	-	$f_r = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}}$ <p>if $R_1 = R_2 = R$ and $C_1 = C_2 = C$</p> <p>then $f_r = \frac{1}{2\pi RC}$</p>	-
68.	Application of wein bridge oscillator	-	<ul style="list-style-type: none"> • Used to measure the audio frequency. • Can be designed for the long range of frequencies. • It produces sine wave. 	-
69.	Multiplier	-	An analog multiplier is a circuit with an output that is proportional to the product of two inputs	-
70.	Schmitt trigger application	-	<ul style="list-style-type: none"> • Pulse shaping • Square wave generation 	-
71.	Disadvantage of wein bridge oscillator	-	Very high frequencies cannot be generated.	-
72.	Other names of	-	Mono shot, one shot, single shot, gating	-

	monostable multivibrator		circuit, delay circuit.	
73.	Feedback network used in RC phase shift oscillator	-	Three RC sections	-
74.	Feedback network used in Wein bridge oscillator	-	A lead-lag network	-
75.	Other names of window detector	-	Window comparator circuit or dual edge limit detector circuits	-
Unit-IV : Phase Locked Loop and Data Converters				
76.	Blocks of PLL	-	a. Phase detector/comparator b. Low pass filter c. Error amplifier d. Voltage controlled oscillator	-
77.	Capture range	-	The range of frequencies over which the PLL can acquire lock with an input signal is called the capture range	-
78.	Lock range	-	The range of frequencies over which the PLL can maintain lock with the incoming signal is called the lock-in range or tracking range	-
79.	Expression of capture range	-	Lock in range $\Delta f_L = \pm 7.8 f_o / V$	-
80.	Expression of lock range	-	Capture range = $\pm = [\Delta f_L / (2 * [R * C])]$ 1/2	-
81.	Applications of PLL	-	a. Frequency multiplication/division b. Frequency translation c. AM detection d. FM demodulation e. FSK demodulation	-
82.	Disadvantages of flash type ADC	-	number of comparators needed almost doubles for each added bit	-
83.	Advantages of R-2R ladder DAC	-	a) Easier to build accurately as only two precision metal films are required. b) Number of bits can be expanded by adding more sections of same R/2R values.	-
84.	Disadvantages of R-2R ladder DAC	-	In this type of DAC, when there is a change in the input, changes the current flow in the resistor which causes more power dissipation which creates non-linearity in DAC	-
85.	Start of Conversion in ADC	-	This is the control signal for start of conversion which initiates A/D conversion process	-
86.	End of Conversion in ADC	-	This is the control signal which is activated when the conversion is completed	-
87.	Types of ADC	-	1. Flash (comparator) type converter 2. Counter type converter 3. Tracking or servo converter 4. Successive approximation type converter	-

88.	Types of DAC	-	1. Weighted resistor DAC 2. R-2R Ladder 3. Inverted R-2R Ladder	-
89.	Absolute accuracy	-	It is the maximum deviation between the actual converter output & the ideal converter output	-
90.	Relative accuracy	-	It is the maximum deviation after gain & offset errors have been removed	-
91.	Monotonicity	-	A monotonic DAC is one whose analog output increases for an increase in digital input	-
92.	Conversion time	-	total time required to convert an analog signal into its digital output	-
93.	Stages of PLL operates	-	1. Free running 2. Capture 3. Locked/ tracking	-
94.	Settling time of D/A converter	-	Time taken for the output to settle within specified band + ½ LSB of its final value	-
95.	Fastest ADC	-	Flash type ADC is the fastest ADC as the conversion takes place simultaneously rather than sequentially	-
96.	Specifications of data convertors	-	conversion time settling time accuracy linearity monotonic	-
97.	Sample period	-	The time during which the voltage across the capacitor in sample and hold circuit is equal to the input voltage	-
98.	Hold period	-	The time period during which the voltage across the capacitor is held constant	-
99.	Sample and hold circuit	-	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	-
100.	Essentials parts of a DAC	-	Analog input signal, D/A converter circuit, Switches for DAC	-

Unit-V : Specialized IC Applications

101.	Applications of 555 Timer	-	<ul style="list-style-type: none"> • Astable Multivibrator • Monostable Multivibrator • Missing pulse detector • Linear ramp generator • Frequency divider • Pulse width modulation • FSK generator • Pulse position modulator • Schmitt trigger 	-
102.	Applications of 555 timer in monostable mode	-	<ul style="list-style-type: none"> • Linear ramp generator • Frequency divider 	-

			<ul style="list-style-type: none"> • Pulse width modulation. 	
103.	Applications of 555 timer in Astable mode	-	<ul style="list-style-type: none"> • FSK generator • Pulse-position modulator 	-
104.	555 IC	-	The 555 timer is an integrated circuit specifically designed to perform signal generation and timing functions	-
105.	Basic blocks of IC 555	-	<ul style="list-style-type: none"> • A relaxation oscillator • RS flip flop • Two comparator • Discharge transistor. 	-
106.	Features of 555 Timer	-	<ul style="list-style-type: none"> • It has two basic operating modes: monostable and astble • It is available in three packages. 8 pin metal can , 8 pin dip, 14 pin dip. • It has very high temperature stability. 	-
107.	Voltage Regulator	-	A voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature, and ac line voltage variations	-
108.	Classification Of Voltage Regulators	-	<ul style="list-style-type: none"> • Series / Linear regulators • Switching regulators. 	-
109.	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	-
110.	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.	-
111.	Advantages of IC voltage regulators	-	<ul style="list-style-type: none"> • low cost • high reliability • reduction in size • excellent performance 	-
112.	Multivibrators	-	Multivibrators are regenerative circuits, which are mainly used in timing applications	-
113.	Classification of multivibrators	-	<ul style="list-style-type: none"> • AstableMultivibrators • MonostableMultivibrators • BistableMultivibrators 	-
114.	AstableMultivibrators	-	The astableMultivibrators toggles between one state and the other without the influence of any other external control signal	-
115.	MonostableMultivibrators	-	The monostablemultivibrator or one – shot requires an external signal called a trigger to force the circuit into a quasi-stable state for a particular time or delay	-
116.	AstableMultivibrators	-	The astableMultivibrators toggles	-

			between one state and the other without the influence of any other external control signal	
117.	Pin 1	GND	Ground reference voltage, low level (0 V)	-
118.	Pin 2	TRIG	The OUT pin goes high and a timing interval starts when this input falls below 1/2 of CTRL voltage	-
119.	Pin 3	OUT	This output is driven to approximately 1.7 V below +V _{cc} , or to GND	-
120.	Pin 4	RESET	A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts	-
121.	Pin 5	CTRL	Provides "control" access to the internal voltage divider	-
122.	Pin 6	THR	The timing (OUT high) interval ends when the voltage at threshold is greater than that at CTRL	-
123.	Pin 7	DIS	Open collector output which may discharge a capacitor between intervals	-
124.	Pin 8	V _{cc}	Positive supply voltage, which is usually between 3 and 15 V depending on the variation	-
125.	Applications of frequency to voltage converter	-	1. Frequency to voltage converter in tachometers. 2. Frequency difference measurement.	-
Placement Questions				
126.	Hohmann Transfer Orbit	-	This is an intermediate orbit having a highly elliptical shape.	-
127.	Attitude & orbit control system (AOCS)	-	It consists of rocket motors that are used to move the satellite back to the correct orbit when an external force causes it to drift.	-
128.	Satellite Antennas	-	<ul style="list-style-type: none"> • Wire antennas: monopoles and dipoles • Horn antennas • Reflector antennas • Array antennas 	-
129.	Passive Satellites	-	A satellite that only reflects signals from one Earth station to another or from several Earth stations to several others.	-
130.	Active Satellites	-	In active satellites, it amplifies or modifies and retransmits the signal received from the earth.	-
131.	Satellite orbits in terms of the orbital height	-	<ul style="list-style-type: none"> • GEO • MEO • LEO 	-
132.	MEO satellites	-	The GPS constellation calls for 24 satellites to be distributed equally among six circular orbital planes	-

133.	Frequencies allocated to the satellites:	-	<ul style="list-style-type: none"> • VHF: 01-0.3 --- Mobile & Navigational Satellite Services • L-band: 1.0-2.0 --- Mobile & Navigational Satellite Services • C-band: 4.0-8.0 --- Fixed Satellite Service • Ku-band: 12.0-18.0 --- Direct Broadcast Satellite Services 	-
134.	Statistical multiplexing	-	Allocate bandwidth to arriving packets on demand.	-
135.	Digital Video Broadcasting (DVB)	-	Digital Video Broadcasting (DVB) has become the synonym for digital television and for data broadcasting world-wide.	-
136.	High Power Amplifier	-	Amplifier may work with signals of all level, depending on where they are in the signal chain	-
137.	Proposed Broadband Satellite systems	-	<ul style="list-style-type: none"> • Teledesic • SkyBridge • Spaceway 	-
138.	Non Geostationary Orbits (NGSO)	-	<ul style="list-style-type: none"> • Polar Orbit • Equatorial Orbit • Inclined Orbit 	-
139.	Problems of Geosynchronous Satellite Communications Systems	-	<ul style="list-style-type: none"> • No coverage of polar region. • Long time delay. • Echo. • Eclipse due to the earth and the sun. • Sun Transit outage 	-
140.	Satellite Bus subsystems	-	<ul style="list-style-type: none"> • Mechanical structure • Attitude and orbit control system • Propulsion System • Electrical Power System • Tracking Telemetry and Command System • Thermal Control System 	-
141.	Simplification	-	$39.912 \% \text{ of } 79.908 + \sqrt{3969.12 * 4.897} - 12.190 * 7.198 = ?$ Ans: 263	-
142.	Profit and Percentage	-	<p>A Shopkeeper makes 30% profit when he gives 12% discount while selling an article. At the end of the day he gives a customer 6% additional discount so that the remaining articles are sold. What will be his new approximate profit percentage?</p> Ans: 21%	-
143.	Number Series	-	<p>Find the wrong term in the following number series?</p> 4, 12, 60, 360, 2520, 20160	-

			Ans: 4	
144.	Number Series	-	What value should come in the place of question mark in the given series? 2209, 1849, 1681, 1369, 961, 841, ? Ans: 529	-
145.	Relation ship	-	Eight persons B, E, J, K, M, S, T and V are in a family with three different generations. J is the son of B. E is the daughter of K and sister of S. M is the mother of E. V is the sister-in-law of S, who has only two siblings. S is the aunt of J. T is the niece of B. E does not has any child. How is K related to T? Ans: Grandfather	-
146.	Computer Awareness	-	The command to access the memory or the input/output device is carried by the _____ Ans: Control bus	-
147.	Directions	-	A man started walking from his place. He goes 5m south. He turns 90 degree anticlockwise and walks for 7m. Now he turns left and goes 3m. After turning right, he walks for 4m, again he walks for 3m after turning left. Now he turns towards west and walks for 5m. He again walks for 5m before he stops. What is the direction of his starting point with respect to his ending point? Ans: South	-
148.	Speed and Time	-	A train travelling at 72 km/hr crosses another train of length equivalent to five-sixth of its own length travelling in opposite direction at 60 km/hr in 9 seconds. Find the length of the second train? Ans: 150 m	-
149.	Profit and Loss	-	A, B and C entered into a partnership by investing Rs. 18000, Rs. 24000 and Rs. 30000 respectively. After 4 months, A withdraws one-third of the amount and B invested Rs. 16000 more. And after 3 months, C withdraw three-fifth of the amount. Find the total profit at the end of the year, if the share of B is Rs. 52000?	-

			Ans: 106750	
150.	Time and Work	-	35 men can complete a piece of work in 18 days. After 8 days from the start of the work, some men left. If the remaining work was completed by the remaining men in 14 days, then find the men left after 8 days from the start of the work? Ans: 10 men	-

Faculty Prepared

Signature

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