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Lecture Plan -1

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: IDEAL AND PRACTICAL OPERATIONAL AMPLIFIER , INVERTING AND NON-INVERTING AMPLIFIER	Time Allotted
1.	**Introduction** The operational amplifier (abbreviated as op-amp) is a direct coupled high gain amplifier to which feedback is added to control its overall response characteristics. It is used to perform a wide variety of linear functions and also some non-linear operations and is often referred to as the basic linear integrated ckt or more accurately analog integrated ckt.	10 min
2	**Division of the Topic** ➢ Ideal operational amplifier ➢ Practical operational amplifier ➢ Inverting operational amplifier ➢ Non-inverting operational amplifier.	30 min
3.	**Conclusion** The integrated op-amp has gained wide acceptance as a versatile, predictable and economic system building block. It offers all the advantages of monolithic integrated ckts: small size, high reliability, reduced cost, temperature tracking and low offset voltage and current.	5-min
4	**Question / Answer** **Ques. What is the input impedance of ideal op-amp?** **Ans.** Infinity. **Ques. What is the bandwidth of ideal op-amp?** **Ans.** infinity	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan -2

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: DIFFERENTIAL AMPLIFIER	Time Allotted
1.	**Introduction** The function of the differential amplifier is to amplify the difference between the two. The need for differential amplifier arises in many physical measurements where response from dc to many MHz is required. It is also the basic building block of the integrated operational amplifier with differential input.	10 min
2	**Division of the Topic** ❖ Differential amplifier ❖ Different differential amplifier configurations: • Dual input, balanced output differential amplifier • Dual input, unbalanced output differential amplifier • Single input, balanced output differential amplifier • Single input, unbalanced output differential amplifier	30 min
3.	**Conclusion** The differential amplifier consists of two symmetrical common emitter sections and is capable of amplifying the difference between the two input signals. It can amplify the dc as well as the ac signals because it employs the direct coupling.	5-min
4	**Question / Answer** **Ques. Which parameters are used for the analysis of differential amplifier?** **Ans.** h-parameters **Ques. what is the input resistance of the differential amplifier?** **Ans.** $2\beta_{ac}r_e$	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-3

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: **DIFFERENTIAL AMPLIFIER WITH SWAMPING RESISTOR AND CONSTANT CURRENT BIAS**	Time Allotted
1.	**Introduction** The differential amplifier can be biased by using emitter biased, constant current bias or the current mirror technique. In the differential amplifier the combination of emitter resistance and the supply is used to set-up the dc emitter current. The constant current bias is better than the previous because it set-up the dc emitter current and also provides the current stabilization. And hence ensures a stable operating point.	10 min
2	**Division of the Topic** ➢ Differential amplifier with swamping resistance ➢ Constant current bias ➢ Dual input, balanced output differential amplifier using constant current bias ➢ Methods to increase the thermal stability.	30 min
3.	**Conclusion** The zener diode is useful for maintaining the contant base voltage and in turns the constant emitter current in a constant current bias ckt.	5-min
4	**Question / Answer** **Ques. what is the function of the swamping resistance?** **Ans. T**he dependence of the voltage gain of he differential amplifier on variations in r_e can be reduced. **Ques. What is the value of V_{be} of the transistor in saturation?** **Ans.** 0.715	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-4

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: TRANSFER CHARACTERISTICS OF THE DIFFERENTIAL AMPLIFIER	Time Allotted
1.	**Introduction** It is important to examine the transfer characteristic (Ic versus V_{b1}- V_{b2}) of the differential amplifier to understand its advantages and limitations. The automatic gain control is possible with the differential amplifier.	10 min
2	**Division of the Topic** ➢ Transfer characteristics of the basic differential amplifier ckt ➢ Curve between the normalized differential input voltage and normalized collector current. ➢ Conclusions drawn from the transfer curve.	30 min
3.	**Conclusion** The transfer characteristics are linear in a small region around the operating point where the input varies approximately Vt (26 mv at room temperature). It is possible to increase the region of linearity by inserting two equal resistors in series with the emitter leads of the two transistors of the differential amplifier**.**	5-min
4	**Question / Answer** **Ques. what is the value of the threshold voltage at the room temperature?** **Ans.** 26 mv **Ques. what is the reasonable value of the resistor that should be added in series with the emitters of the differential amplifier?** **Ans.** 50-100Ω	5-min

Assignment to be given:-NIL

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan-5

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: OFFSET ERRORS VOLTAGES AND CURRENT	Time Allotted
1.	**Introduction** The ideal operational amplifier is perfectly balanced, that is Vo is 0 when V1 is equal to V2. a real operational amplifier exhibit an unbalance caused by the mismatch of the input transistors. This mismatch results in unequal bias currents flowing through the input terminals. And also requires that an input offset voltage be applied between the two input terminals to balance the amplifier output.	10 min
2	**Division of the Topic** ➢ Input bias current ➢ input offset current ➢ Input offset current drift ➢ Input offset voltage ➢ Input offset voltage drift ➢ Output offset voltage ➢ Power supply rejection ratio ➢ Slew rate. ➢ Common mode rejection ratio(CMRR)	30 min 5-min
3.	**Conclusion** Dc error voltages and dc error currents that can be measured at the input and at the output terminals come under the heading of dc offset errors voltage and current. When we use the operational amplifier, it is often necessary to balance the offset voltage. This means that we have to apply a small dc voltage in the input so as to cause the dc output voltage to become zero.	5-min
4	**Question / Answer** **Ques. what is the typical value of open loop gain?** **Ans.** 50000. **Ques. what is the typical value of the slew rate?** **Ans.** 1V/μs.	

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-6

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: **-SCALE CHANGER, PHASE SHIFTER, ADDER, AVERAGE AMPLIFIER**	**Time Allotted:-**
1.	**Introduction** In linear ckt the output ckt is of the same nature as the input and vary in accordance with the input with the limits set by the saturation levels and slew rate. These amplifiers are used inverting and non-inverting amplifier.	10 min
2	**Division of the Topic** ➢ Scale changer ➢ Voltage gain ➢ Phase shifter ➢ Adder ➢ Summing amplifier ➢ Average amplifier	30 min
3.	**Conclusion** In linear applications op-amp is used to perform the mathematical operations and is used in digital computers..	5 min
4	**Question /Answer** **Q.Which configuration is used in peaking amplifier?** **Ans.** Inverting **Q. which configuration is used in the subtractor?** **Ans.** Differential	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-7

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: -**VOLTAGE TO CURRENT CONVERTOR AND CURRENT TO VOLTAGE CONVERTOR**	**Time Allotted:-**
1.	**Introduction** In certain systems typically drive for the deflection coil in the tv picture tube we require to convert a voltage signal to a proportional current signal. In current to voltage converter , photodiodes and photo multipliers tubes provide output current which depends only on the incident light flux but is independent of the load impedance.	10 min
2	**Division of the Topic** **Voltage to current converter** ➢ Operation ➢ Application **Current to voltage converter** ➢ Operation ➢ application	30 min
3.	**Conclusion** In the ckt the lower limit on current measurement is set by the biased current of the inverting input. Often a capacitor is put in shunt with the feedback resistor in order to reduce the high frequency noise.	5 min
4	**Question /Answer** **Q. Which converter is used in low voltage ac and dc voltmeter?** **ans.** voltage to current converter with floating load **Q. what is he meaning of floating load?** **Ans.** when the load resistance is not connected to ground**.**	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milkman Halkies,TMH
2) Operational Amplifier: Gayakwad
3) Electronic Devices and Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-8

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: **DC VOLTAGE FOLLOWER, BRIDGE AMPLIFIER, AC COUPLED AMPLIFIER, AC VOLTAGE FOLLOWER.**	**Time Allotted:-**
1.	**Introduction** Voltage follower is that in which the output follows the input. In A bridge amplifier an op-amp is used to amplify the output from a transducer bridge. An ac voltage follower is used to provide impedance buffering.	10 min
2	**Division of the Topic** **Dc voltage follower:** ➢ operation ➢ Application **Bridge amplifier** Fractional change of resistance and output voltage **Ac coupled amplifier** Operation and amplifier **Ac voltage follower**.	30 min
3.	**Conclusion** The voltage gain of this entire amplifier provides the characteristics of op-amp. AC voltage follower is used as an impedance matching to connect a signal source with high internal impedance to a load of low impedance.	5 min
4	**Question /Answer** **Q Which configuration is used in the bridge amplifier?** **Ans** differential **Q.What is the function of the bootstrapping capacitor?** Ans. To increase the input resistance	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan-9

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: - **INTEGRATOR**	**Time Allotted:-**
1.	**Introduction** An analog integrator is used in many applications which require the generation or the processing of an analog signal. integrator is used in digital computers ,in ADC	10 min
2	**Division of the Topic** ➢ Operation ➢ Frequency response characteristics ➢ Applications	30 min
3.	**Conclusion** An integrator makes an excellent sweep ckt for a CRT oscillioscope and is called the miller integrator or miller sweep generator.	5 min
4	**Question /Answer** **Q. What will be the output of the integrator when the input is triangular?** **Ans.** Square wave **Q. what is the effect of feedback resistance?** **Ans.** To reduce the error voltage**.**	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan-10

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	Topic: - **DIFFERENTIATOR**	Time Allotted:-
1.	**Introduction** As the name implies the differentiator differentiates the input signal. It means the output signal is the derivative of the input waveform. The differentiator may be constructed from the inverting amplifier.	10 min
2	**Division of the Topic** ➢ Basic differentiator ckt ➢ Frequency response ➢ Practical differentiator ➢ Sine wave input and cosine output ➢ Square input and its output	30 min
3.	**Conclusion** the input signal will be differentiated if certain conditions will be satisfied i. e. if the time period of the input signal is larger than or equal to the product of feedback resistance and the input capacitor. .	5 min
4	**Question /Answer** **Q. what is the output of the square wave input?** **Ans.** Spikes **Q. what is the use of differentiator?** **Ans.** In the wave shaping circuits to detect the high frequency components in an input signal**.**	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan -11

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic :-**Comparators, regenerative comparators (Schmitt Trigger**)**	**Time Allotted:-**
1.	**Introduction** A **:-**Comparators is circuit which compares an input signal $V_i(t)$ with a reference voltage VR, when input Vi exceeds the VR, the comparator output V0 takes on a value which is different from the magnitude of V0 when Vi is smaller than V_R.The reference voltage may be any voltage, provided that it does not exceed the maximum common mode range	10 min
2	Division of the Topic ➢ basic operation ➢ use of clamp diode ➢ transfer characteristics ➢ comparator as a zero crossing detector ➢ comparator as a pulse time modulator ➢ zero crossing detector as phase meter ➢ zero crossing detector as time marker generator using a sine wave ➢ comparator characteristics ➢ Limitations ➢ Applications	30 min
3.	Conclusion . A comparator compares a signal voltage on input of an op. amp with a known voltage called the reference voltage on the other It is used in circuit such as a digital interfacing, Schmitt trigger, discriminators, voltage level detectors, and oscillators	5 min
4.	Question / Answer **Q1 What is comparator characteristics**? Ans. A comparator compares a signal voltage on input of an op. amp. with a known voltage called the reference voltage on the other input Q2 **What is Schmitt Trigger?** Ans. It is an inverting comparator with positive feedback. Input may be sinusoidal or any irregular shaped voltage. Then the changes the state of the output v0 every time vi magnitude exceeds certain upper threshold voltage Vut or lower threshold voltage. The output exhibits hysteresis	5 min

Assignment to be given:-NIL

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan-12

Faculty**:-** Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: - **SAMPLE AND HOLD CKT AND LOGRITHMIC AMPLIFIER AND ANTILOGRITHMIC AMPLIFIER**	**Time Allotted:-**
1.	**Introduction** A data acquisition system, in general, rECE-IIves signals from a no. of different sources. A multiplexers selects each signal in sequence and subsequently a so called sample and hold ckt converts the analog information into a constant voltage over the gating time interval.	10 min
2	**Division of the Topic** ➢ Sample and hold ckt ➢ Operation and application of the sample and hold ckt ➢ Logarithmic amplifier ➢ Operation of logarithmic amplifier ➢ Antilogarithmic amplifier	30 min
3.	**Conclusion** The sample and hold ckt are used in digital interfacing and communication such as analog to digital and pulse modulation system. Logarithmic and antilogarithmic amplifiers are used in the calculators and in computers.	5 min
4	**Question /Answer** **Q. what is a sample and hold ckt?** Ans. This ckt samples the input signal and holds onto its sampled value until the input is sampled again. **Q. what is logarithmic amplifier?** **Ans.** It is the device in which the output voltage is proportional to the logarithm of the input voltage.	5 min

Assignment to be given:-nil

Reference Readings1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan-13

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: **LOGARITHMIC MULTIPLIER , WAVEFORM GENERATOR**	**Time Allotted:-**
1.	**Introduction** Logarithmic multiplier is the combination of the log and antilog amplifier to give the result in multiplication or division to analog signals. The waveform generators are the electronic generators which are used to generate different types of waveforms like square wave, pulse and triangular wave.	10 min
2	**Division of the Topic** ➢ Logarithmic multiplier ➢ Operation and application ➢ Waveform generator:… • Square wave • Pulse wave • triangular wave	30 min
3.	**Conclusion** Square wave generator is also called the astable multivibrator because it has no stable state. Pulse generator is also called the monostable multivibrator. Triangular wave generator uses an op-amp integrator to supply constant current resulting in linear output voltage.	5 min
4	**Question /Answer** **Q. what is astable multivibrator?** **Ans.** Square wave generator is also called the astable mutivibrator. **Q. what is the function of integrator in triangular wave generator?** **Ans.** To supply constant current to capacitor.	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan-14

Faculty:- Semester:-V Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-D

S. No.	**Topic**: - **ADC, MULTIVIBRATOR, MILLER AND BOOTSTRAP SWEEP GENERATOR.**	**Time Allotted:-**
1.	**Introduction** Digital systems are used in many applications. Digital systems such as microprocessor use a binary system of one and zero and therefore the input has to be converted to the digital form from the analog form and this work is done by the use of analog to digital converters (ADC).	10 min
2	**Division of the Topic** ➢ Introduction to ADC ➢ Successive approximation ADC ➢ Monolithic / hybrid ADC	30 min
3.	**Conclusion** Typical applications of ADC include microprocessor interfacing, data printing and recording, digital voltmeter, control of LED or LCD display. Specifications such as resolution and the non-linearity are very important in ADC. Conversion time is also an important parameter.	5 min
4	**Question /Answer** **Q .what is the function of SAR?** **ANS.** The SAR adjusts the digital output of DAC until it is equivalent to the analog input. **Q. What is conversion time?** **Ans.** The time required to convert the analog input to its corresponding digital output.	5 min

Assignment to be given:-nil

Reference Readings:- 1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan -15

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: CLASSIFICATION OF THE AMPLIFIERS AND THE DISTORTION IN AMPLIFIERS	Time Allotted
1.	**Introduction** The need is to amplify the signal without in. distortion. For this the active devices involved must operate linearly. The first step in this analysis is the replacement of the actual ckt by a linear model. Amplifiers are described in many ways, according to their frequency range, the method of operation, the use , the type of load, the method of interstage coupling.	10 min
2	**Division of the Topic** ➢ Classification Of The Amplifiers On The Basis Of Frequency ➢ Division Of Amplifiers On The Basis Of Position Of Quiescent Point**:** • class-A • class-B • class-AB • class-C ➢ Classification On The Basis Of Application ➢ Distortion In Amplifiers	30 min
3.	**Conclusion** The application of the sinusoidal signal to the input of an ideal class-A amplifier will result in a sinusoidal output wave. Generally, the output waveform is not an exact replica of the input-signal waveform because of various types of distortion that may arise either from the inherent non-linearity in the characteristics of the transistor or due to associated circuit.	5-min
4	**Question / Answer** **Ques. What is the reason of non-linear distortion?** **Ans**. It is due to the production of harmonics due to non-linear dynamic curve in the characteristics**.** **Ques. In which field class-C operation is used?** **Ans.** In tuned radio frequency amplifiers	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan -16

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: STEP RESPONSE OF AN AMPLIFIER	Time Allotted
1.	**Introduction** One of the criteria of amplifier fidelity is the response of the amplifier to a particular input waveform. The most generally useful is the step voltage. In terms of the ckt response to the step input, the response to an arbitrary waveform may be written in the form of the superposition integral.	10 min
2	**Division of the Topic** Step voltage response of the low pass RC ckt Rise time pulse response of the low-pas RC ckt Tilt or sag Square wave testing	30 min
3.	**Conclusion** The short step (excellent pulse) and a repeated step (square wave) are available commercially and therefore these are recommended for the analysis. Further more the step voltage is the voltage which permits small distortion to stand out	5-min
4	**Question / Answer** **Ques. What is the important feature of the step voltage?** **Ans**. It is a combination of the most abrupt voltage change possible and the slowest possible voltage variation. **Ques. What is square wave?** **Ans.** It is repeated step.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan -17

Faculty: Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: PASS-BAND OF CASCADED STAGES	Time Allotted
1.	**Introduction** if in a cascade of stages the input impedance of one stage is low enough to act as an appreciable shunt on the output impedance of the preceding stage, then it is no longer possible to isolate the stages. Under these conditions individual 3-db frequency can't be defined. Therefore the pass-band of the cascaded system is different from that of the single stage.	10 min
2	**Division of the Topic** ➢ Dominant pole ➢ Lower 3-db frequency in the non-interacting stages ➢ Interacting stages ➢ Step response	30 min
3.	**Conclusion** If the amplitude response of the single stage is plotted on log-log paper , the resulting graph will approach a straight line whose slope is 6-db per octave both at the lower and the high frequencies. For an n-stage amplifier , it follows that the amplitude response falls 6n db per octave.	5-min
4	**Question / Answer** **Ques. What is high 3-db frequency for n-cascaded stage?** **Ans.** It equals the frequency for which the overall voltage gain falls 3-db or 0.707 of its midband value **Ques. 6db per octave is equivalent to what?** **Ans.** 20 db per decade**.**	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan -18

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: MULTISTAGE TRANSISTOR AMPLIFIER AND R-C COUPLED AMPLIFIER	Time Allotted
1.	**Introduction** When the voltage amplification or power gain of a single stage amplifier is insufficient to meet the requirements , then multistage transistor amplifier is used. In multistage amplifier ,the output of the first stage is combined to the next stage through a coupling device. The process is known as cascading.	10 min
2	**Division of the Topic** ➢ Multistage transistor amplifier ➢ Four basic methods of coupling: resistance-capacitance coupling o Impedance coupling o Transformer coupling o Direct coupling ➢ R –C coupled transistor amplifier: operation ▪ Simplified equivalent ckt of RC coupled amplifier	30 min
3.	**Conclusion** To achieve the max. voltage gain common emitter type transistors are used. The voltage gain of a common collector type transistor is less than unity so it can't be used for intermediate stages. The voltage gain of common base amplifiers using cascaded is also less than unity. Hence it can't be used. The voltage gain of common emitter amplifier is greater than unity so it is possible to increase the gain by cascading a number of stages.	5-min
4	**Question / Answer** **Ques. R-C coupling is used for which type of amplification?** **Ans.** Voltage **Ques. What is the need of coupling amplifiers?** **Ans**. Amplifiers are coupled to increase the gain either voltage or power**.**	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -19

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: FREQUENCY RESPONSE OF R-C COUPLED AMPLIFIER	Time Allotted
1.	**Introduction** For the purpose of analysis we divide the entire frequency range into the following three frequency ranges. The RC coupled amplifier is used for the middle frequency range ,low frequency range and then the high frequency range. The bandwidth is the difference between the upper cut-off frequency and the lower cut-off frequency.	10 min
2	**Division of the Topic** ➢ R-C coupled amplifier in • middle frequency range • Lower frequency range • Higher frequency range ➢ Lower cut-off frequency ➢ Higher cut-off frequency ➢ Frequency response curve ➢ Bandwidth	30 min
3.	**Conclusion** At mid frequency, the impedance offered by coupling capacitor C is so small as to be an effective short circuit. Hence at mid-frequency the effect of coupling capacitor C can be neglected. At low frequency the impedance offered by the coupling capacitor is comparable to the load resistance. Hence it largely effects the current amplification. In the high frequency the reactance offered by the coupling capacitor C is very small and it can be considered as the short ckt.	5-min
4	**Question / Answer** **Ques. What is lower cut-off frequency?** **Ans.** It is defined as the frequency at which the magnitude of the voltage gain in the low frequency range falls to 0.707 of the magnitude of the gain in mid-frequency range. **Ques. What is wiring capacitor?** **Ans.** The connecting wires are separated by air which serves as the dielectric**.**	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan -20

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: EFFECT OF EMITTER BYPASS CAPACITOR ON LOW FREQUENCY RESPONSE.	Time Allotted
1.	**Introduction** The bypass capacitor is approximately 100μF. This provides a low reactance path to the amplified ac signal. In the absence of this capacitor the voltage developed across the resistance will feed back to the input side thereby reducing the output voltage. Thus in presence of bypass capacitor amplified ac will pass through it. But at low frequency the impedance offered by this becomes considerable and hence creates a problem.	10 min
2	**Division of the Topic** ➢ Circuit of a common emitter with resistance and capacitor ➢ Common emitter equivalent circuit ➢ Graph between frequency and the voltage gain ➢ Lower 3 db frequency	30 min
3.	**Conclusion** The effect of bypass capacitor is negligible at the mid- and high frequency but at the lower frequency the effect of this can't be neglected. At the lower frequency the impedance of the by-pass capacitor becomes considerable and hence its effect on the voltage gain is very important and a new term that is 3-db frequency is added.	5-min
4	**Question / Answer** **Ques. What is 3-db frequency?** **Ans.** It is the frequency at which the voltage ratio drops to 0.707 of its max value**.** **Ques. On which factors the choice of bypass capacitor depends?** **Ans.** Transistor parameters and source resistance.	5-min

Assignment to be given:-

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan -21

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: INTRODUCTION TO THE AMPLIFIER AND AMPLIFIER TYPES	Time Allotted
1.	**Introduction** An amplifier means a signal from some pick-up transducer or other input source and provides a large version of the signal to some output device or to other amplifier stage. an input transducer signal is generally small (a few millivolts from a cassette or a cd input, or a few micro volts from an antenna) and needs to be amplified sufficiently to operate an output device.	10 min
2	**Division of the Topic** Introduction to amplifier ➢ Types of amplifier: class-A amplifier • class-B amplifier • Class-C amplifier ➢ Amplifier efficiency	30 min
3.	**Conclusion** Power amplifier or the large signal amplifier primarily provides sufficient power to an output load to drive a speaker or other power device, typically a few watts to tens of watts. Amplifier classes represent the amount the output signal varies over one cycle of operation for a full cycle of input signal.	5-min
4	**Question / Answer** Q. the output signal varies by which angle for a class-A amplifier? Ans. By $360^{0.}$ Q. in which fields the Class-C amplifier used? Ans in the tuned ckt in radio and communication	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
Revision :00

Lecture Plan -22

Faculty: - Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: CLASS –A LARGE SIGNAL AMPLIFIER	Time Allotted
1.	**Introduction** The only difference between the small signal amplifier and the large signal amplifier is that the signal handled by the large signal ckt are in the range of volts and the transistor used is a power transistor that is capable of operating in the range of a few tens of watts.	10 min
2	**Division of the Topic** ➢ Introduction to the large signal class-A amplifier ➢ D-C bias operation ➢ A-C operation ➢ Power considerations ➢ Output power ➢ Max efficiency	30 min
3.	**Conclusion** The max efficiency of a class-A series fed amplifier is seen to be 25% .since this maximum efficiency will occur only for the ideal conditions of both voltage swing and the current swing , most series- fed ckt will provide efficiencies of much less than 25%.	5-min
4	**Question / Answer** **Q.** How will you define the efficiency of the amplifier? Ans. The efficiency of an amplifier represents the amount of ac power delivered from the dc source. Q. What is the special feature of the power amplifier? Ans. They are capable of handling large power or the current.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -23

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: TRANSFORMER COUPLED CLASS-A AMPLIFIER	Time Allotted
1.	**Introduction** A form of class-A amplifier having maximum efficiency of 50% uses a transformer to couple the output signal to the load. A transformer can increase or decrease voltage or current levels according to the turns ratio. The transformer can step-up or step-down a voltage applied to one side directly as the as the ratio of the turns on each side .	10 min
2	**Division of the Topic** ➢ Transformer coupled audio power amplifier ➢ Transformer action ➢ Voltage transformation ➢ Current transformation ➢ Impedance Transformation ➢ operation of amplifier stage dc load line ➢ AC load line ➢ Power calculations ➢ efficiency	30 min
3.	**Conclusion** When the input signal is small .with very little ac power delivered to the load , the max power is dissipated by the transistor. When the input signal is larger and the power delivered to the load is larger, less power is dissipated by the by transistor. In other words the transistor of a class –An amplifier has to work hard when the load is disconnected from the amplifier and the transistor dissipates least power when the load is drawing the max power from the ckt.	5-min
4	**Question / Answer** Q. What is the theoretical efficiency of the transformer coupled class-A power amplifier? Ans. 50 % Q. what is the relation between the voltage transformation and the current transformation? Ans. Voltage transformation=1/current transformation	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
Revision :00

Lecture Plan -24

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: CLASS-B AMPLIFIER OPERATION	Time Allotted
1.	**Introduction** Class B operation is provided when the dc bias leaves the transistor biased just off, the transistor turning on when the ac signal is applied. This is essentially no-bias and the transistor is conducting for only half cycle of the input signal. To obtain output for the full cycle of the signal, it is necessary to use two transistors and have each conduct on opposite half cycle; the combined operation provides a full cycle of output signal.	10 min
2	❖ **Division of the Topic** ❖ Block representation of push pull operation ❖ Input (dc)power ❖ Output(ac) power ❖ Efficiency ❖ Power dissipated by the output transistor ❖ Max power consideration	30 min
3.	**Conclusion** The power dissipated by the output power transistor is the difference between the input power delivered by the supplies and the output power delivered to the load. The maximum efficiency of a class-B amplifier can go up to 78.5 %. For class-B operation the max power dissipated by the output transistors does not occur at the max power input or output conditions.	5-min
4	**Question / Answer** Q. what is the condition for the max power dissipation? Ans. Voltage across load=$0.636V_{CC}$ Q. What is the max value of transistor power dissipation? Ans. Max power dissipation=$2V_{CC}^2/\pi^2R_L$	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -25

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	**Topic: CLASS-B AMPLIFIER CKT, TRANSFORMER COUPLED CLASS-A, CLASS-B PUSH PULL AMPLIFIER.**	**Time Allotted**
1.	**Introduction** The push –pull ckt uses a center-tapped input transformer to produce opposite polarity signals to the two transistor inputs and an output transformer to drive the load in a push pull mode.	10 min
2	**Division of the Topic** ❖ Class –B amplifier ckts ❖ Phase splitter ckts ❖ Transformer coupled push pull ckts	30 min
3.	**Conclusion** In the push pull operation, for the first half cycle of the operation, transistor Q1 is driven to the conduction. Whereas the transistor Q2 is driven off. The current I_1 through the transformer results in the first half cycle of the signal to the load. During the second half cycle of the input signal, Q2 conducts, whereas Q1 stays off., the current I_2 through the transformer resulting in he second half cycle to the load.	5-min
4	**Question / Answer** Q. what is the class-B amplifier? Ans. A class B ckt provides an output signal varying over one half the input signal cycle . Q. how many transformers are used in the push –pull ckts? Ans. Two. One at the input and the other at the output.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -26

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-C

S. No.	Topic: AMPLIFIER HARMONIC DISTORTION, CLASS-C POWER AMPLIFIER	Time Allotted
1.	**Introduction** An ideal amplifier is capable of amplifying a pure sinusoidal signal to provide a large version , the resulting waveform being a pure single frequency sinusoidal signal. When distortion occurs the output will not be an exact duplicate (except for magnitude) of the input signal.	10 min
2	**Division of the Topic** ❖ Amplifier distortion ❖ Harmonics ❖ Harmonic distortion ❖ Total harmonic distortion ❖ Second harmonic distortion ❖ Power of signal having distortion ❖ Class –C power amplifier	30 min
3.	**Conclusion** An instrument such as the spectrum analyzer would allow the measurement of the harmonics present in the signal by providing a display of the fundamental component of a signal and a number of its harmonics on a display screen. .similarly a wave analyzer instrument allows more precise measurement of the harmonic components of the distorted signal.	5-min
4	**Question / Answer** Q. How will you define the total harmonic distortion Ans. When an output signal has a number of individual harmonic distortion components , the signal can be seen to have a total harmonic distortion based upon the individual elements as combined by the relation: $\sqrt{(D_1^2+D_2^2+D_3^2+\ldots.)}*100$ Q. What is the frequency of harmonics? Ans. Integral multiple of the fundamental frequency.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan 27

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: INTRODUCTION TO FEEDBACK CONCEPT	Time Allotted
1.	**Introduction** When a part or the fraction of the output is combined to the input ,there is feedback. This process of combining a fraction of he output energy back to the input is known as feedback. If the net effect of the feedback is to reduce the magnitude of the input signal , it is called the negative, inverse or degenerative feedback. It reduces the gain of the amplifier but has the advantages of stabilization of the gain, reduction in distortion and noise and many more.	10 min
2	**Division of the Topic** ➢ Feedback concept ➢ General theory of feedback ➢ Negative feedback ckt ➢ Advantages of negative feedback	30 min
3.	**Conclusion** The gain of the amplifier may change due to the change in the parameters of the transistor or the supply voltage variation. Negative feedback stabilizes the gain of the amplifier. It increases the input impedance and reduces the output impedance. The negative feedback also increases the bandwidth of the amplifier. It reduces the distortion and noise.	5-min
4	**Question / Answer** **Ques. The negative feedback increases or reduces the gain?** **Ans** it reduces the gain. **Ques. What is the effect of negative feedback on the lower cut-off frequency?** **Ans.** Lowers the lower cut-off frequency**.**	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan 28

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: GENERAL CHARACTERISTICS OF THE NEGATIVE FEEDBACK AMPLIFIER	Time Allotted
1.	**Introduction** Since negative feedback reduces the transfer gain, why is it used? The answer is that many desirable characteristics are obtained for the price of gain reduction. The main advantage is desensitivity. The variations due to aging, temperature, replacement, etc., of the ckt components and transistor is reflected in a corresponding lack of stability of the amplifier transfer gain.	10 min
2	**Division of the Topic** ➢ Desensitivity of transfer amplification ➢ Frequency distortion ➢ Non-linear distortion ➢ Reduction of noise	30 min
3.	**Conclusion** If the feedback network doesn't contain reactive elements, the overall gain is not a function of frequency. With the negative feedback ckt a large amplitude signal can be applied safely to the amplifier for which the operation was earlier slightly distorted because of being beyond its linear range.	5-min
4	**Question / Answer** **Ques. How does the negative feedback affect the bandwidth?** **Ans.** It increases the bandwidth **Ques. What is not affected by the feedback?** **Ans.** Gain- bandwidth product.	5-min

Assignment to be given:-

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

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Lecture Plan 29

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: CHANGE IN INPUT IMPEDENCE	Time Allotted
1.	**Introduction** Due to the application of the negative feedback, the input impedance increases. High input impedance is desirable in an amplifier because it will not load the input voltage source.	10 min
2	**Division of the Topic** **Change in input impedance:** o voltage series feedback o Current shunt feedback o Voltage shunt feedback o Current series feedback	30 min
3.	**Conclusion** In the voltage series feedback input impedance is increased by the factor (1+AB). The case is same in the current shunt feedback system and other but in the voltage –shunt feedback the input impedance is reduced.	5-min
4	**Question / Answer** **Ques. What is the effect of negative feedback on the gain?** **Ans.** It reduces the gain. **Ques. The negative feedback widens the 3-db frequency. True or False?** **Ans.** True	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan 30

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-A

S. No.	Topic: CHANGE IN OUTPUT IMPEDENCE	Time Allotted
1.	**Introduction** Due to the application of the negative feedback, the output impedance decreases. Low output impedance is desirable in an amplifier because it is capable of delivering the power to the load without much loss.	10 min
2	**Division of the Topic** **Change in input impedance:** o voltage series feedback o Current shunt feedback o Voltage shunt feedback o Current series feedback ckt	30 min
3.	**Conclusion** In the in the voltage series feedback the output impedance is reduced but in the case of current shunt feedback, the current series feedback and the voltage shunt feedback the output impedance is increased.	5-min
4	**Question / Answer** **Ques. In which cases the positive feedback is used?** **Ans.** In the oscillators **Ques. With the negative feedback, what is the affect on the input impedance?** **Ans.** It is increased.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

Doc. No.: DCE/0/15
Revision :00

Lecture Plan -31

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-B

S. No.	Topic: INTRODUCTION TO SINUSOIDAL OSCILLATOR AND BARKHAUSEN CRITERIA.	Time Allotted
1.	Introduction An oscillator is a device which generates an alternating voltage. This may also be defined as the circuit which generates an a.c. output signal without requiring any externally applied input signal. The oscillator converts dc energy into ac energy at a very high frequency. So the function of the oscillator is opposite to that of the rectifier which converts ac power into dc power.	10 min
2	Division of the Topic ➢ Introduction to the oscillator ➢ Types of oscillator ➢ According to generated waveform ➢ According to the frequency of the generated signal ➢ The oscillatory circuit ➢ Essential of transistor oscillator i. e. barkhausen criteria	30 min
3.	Conclusion Tank ckt, transistor amplifier and the feedback ckt are the three essential parts of the transistor amplifier. The function of the feed back ckt is to provide a part of the output energy to LC ckt in proper phase. When the feedback is positive, the overall gain of the amplifier is written as $A_f = A/(1-AB)$ where AB is loop gain.	5-min
4	Question / Answer Q. what is barkhausen criteria of oscillator? Ans. AB=1 Q. what is a tank ckt? Ans. A tank ckt consist of an inductor L in parallel with a capacitor C.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -32

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-B

S. No.	Topic: R-C PHASE SHIFT OSCILLATOR	Time Allotted
1.	Introduction The oscillator containing the L-C tuned ckt is good for generating the high frequency oscillations. For low frequencies (audio frequencies) the R-C oscillators are more suitable. Tuned ckt is not an essential requirement for oscillations. The essential requirement is that there must be a 180^0 phase shift around the feedback network and the loop gain should be greater than unity.	10 min
2	➢ Division of the Topic ➢ Principle of phase shift oscillator ➢ Circuit arrangement ➢ Circuit action ➢ Frequency of oscillations ➢ Calculation of the current gain for h_{fe} of the transistor	30 min
3.	Conclusion When a sinusoidal voltage of frequency f is applied to a ckt consisting of resistor R and capacitor C in series, then the alternating current leads the applied voltage by certain angle, known as the phase angle. The value of R and C is selected in such a way that for the frequency f, the phase angle is 60^0 so using a ladder network of three R-C sections, desired 180^0 phase shift can be produced.	5-min
4	Question / Answer Q. for the sustained oscillations what is the value of h_{fe} of the transistor? Ans. 56 Q. what is the frequency of oscillations in phase shift oscillator for $R=R_L$? Ans. $1/(2\sqrt{10}\,\pi RC)$	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky

Doc. No.: DCE/0/15
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Lecture Plan -33

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-B

S. No.	Topic: WEIN BRIDGE OSCILLATOR	Time Allotted
1.	**Introduction** This is also the audio frequency R-C oscillator. The advantage of this oscillator is that the frequency may be varied in the range of 10 kHz to 1 MHz whereas in R-C oscillators, the frequency can't be varied. The oscillator consists of two stages of R-C coupled amplifier and a feedback network.	10 min
2	**Division of the Topic** ➢ Introduction to wein-bridge oscillator ➢ Frequency of the oscillator ➢ Advantages of wein bridge oscillator over others ➢ Disadvantages of wein-bridge oscillator	30 min
3.	**Conclusion** Although it requires two transistors and a large number of components, it gives good frequency stability and moreover frequency can be changed. But it has some limitations also such as it can't generate very high frequency.	5-min
4	**Question / Answer** Q. What is the frequency of wein bridge oscillator? Ans. F=1/2Πcr Q. How can you change the range of frequency? Ans. By using different values of R.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices and Ckt Theory: Boylestad and Nashelsky

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Lecture Plan -34

Semester: -**V** Class: -**ECE** Subject Code:-**EE-305-F**

Subject: - **ANALOG ELECTRONICS CKT** Section:-B

S. No.	Topic: CRYSTAL OSCILLATOR	Time Allotted
1.	**Introduction** In case of LC and RC oscillators the frequency of operation doesn't remain strictly constant . the reason is that the values of resistors and inductors , which are frequency determining factors , change with temperature. For high degree of frequency stability , crystal oscillators are used. Quartz crystals are generally used in crystal oscillators. The principle of crystal oscillator depends upon the piezoelectric effect.	10 min
2	**Division of the Topic** ➢ Introduction to the piezoelectric effect ➢ Working of quartz crystal ➢ Crystal oscillator ckt ➢ Working of crystal oscillator	30 min
3.	**Conclusion** In order to use the crystal in electronic ckts, it is placed between two metal plates. The arrangement is equivalent to a capacitor with crystal as dielectric. When an alternating voltage is applied crystal starts vibrating with a velocity with the frequency of the applied voltage. And if the frequency of the applied voltage is made equal to the natural frequency of the crystal, resonance takes place and the crystal vibrates with maximum amplitude.	5-min
4	**Question / Answer** **Q.** What is piezoelectric effect? Ans. The crystal exhibit the property that when a mechanical stress is applied across the faces of the crystal, a potential difference is developed across the opposite faces. Converse is also true that application of potential difference produces the stress. **Q.** How does the change in power supply effects the change in frequency? Ans. Variation in supply means variations in Vcc.	5-min

Assignment to be given:-NIL

Reference Readings:-1) Integrated Electronics: Milliman Halkies,TMH
2) Operational Amplifier: Gaikwad
3) Electronic Devices And Ckt Theory: Boylestad And Nashelsky