**SRM UNIVERSITY**
**FACULTY OF ENGINEERING AND TECHNOLOGY**

***SCHOOL OF ELECTRONICS AND ELECTRICAL ENGINEERING***
***DEPARTMENT OF ECE***
**COURSE PLAN**

**Course Code** : EC0206
**Course Title** : Linear Integrated Circuits
**Semester** : IV
**Course Time** : January to May 2012
**Location** : S.R.M. University.

**Faculty Details**

| Sec. | Name | Office | Office hour | Mail id |
|---|---|---|---|---|
| A | Mrs.S.Kayalvizhi | TP903A | Day 2-6th hr, day 3-1st & 2nd, Day 4- 7th hr. | kayalvizhi.s@ktr.srmuniv.ac.in |
| B | Mrs. V.K. Daliya | TP903A | Day 2-1st, 7th hr, Day 5-5th & 6th hr. | Daliya.vk@ktr.srmuniv.ac.in |
| C | Mrs. K. Vadivukarasi | TP1203A | Day 2- 6th & 7th hr, day 5- 2nd &4th hr. | vadivukarasi.k@ktr.srmuniv.ac.in |
| D | Ms. M.K. Srilekha | TP1006A | Day 2- 1st &3rd hr, Day 3-4th &5th hr. | srilekha.m@ktr.srmuniv.ac.in |
| E | Mr. A. Joshua Jafferson | TP1206A | Day 3- 5th hr, day 4-5th hr, Day 5- 1st & 2nd hr. | Joshua.j@ktr.srmuniv.ac.in |
| F | Mrs. A. Vinnarasi | TP1003A | Day 1-7th hr, Day 2-3rd hr, day 3- 5th hr, Day 4- 1st hr. | Vinnarasi.a@ktr.srmuniv.ac.in |

**TEXT BOOKS**

1. Roy Choudhury and Shail Jain, " *Linear Integrated Circuits*", Wiley Eastern Ltd,1995
2. Ramakant A.Gayakwad, "*Op-Amps and Linear Integrated Circuits*", 4th edition, Pearson education.

## References

1. Coughlin & Driscoll, "*Operational-Amplifiers and Linear Integrated Circuits*", 6th edition, Pearson education.
2. Sergio Franco, "Design with operational amplifier and analog integrated circuits", McGraw Hill, 1997.

**Prerequisite** : ECO203 – ELECTRON DEVICES

1. **INSTRUCTIONAL OBJECTIVES**

1. To design simple circuits like amplifiers using op-amps.
2. To design waveform generating circuits
3. To design simple filters circuits for particular application.
4. To gain knowledge in designing a stable voltage regulators.

**Assessment Details**

| | | |
|---|---|---|
| Cycle Test – I | : | 10 Marks |
| Surprise Test | : | 5 Marks |
| Cycle Test – II | : | 10 Marks |
| Mdel Exam | : | 20 Marks |
| Attendance | : | 5 marks |

**Test Schedule**

| S.No. | DATE | TEST | PORTIONS | DURATION |
|---|---|---|---|---|
| 1 | 30.01.2012(tentative) | Cycle Test-1 | Session 1 to 12 | 2 Periods |
| 2 | 05.03.2012(tentative) | Cycle Test-2 | Session 13 to 24 | 2 Periods |
| 3 | 09.04.2012(tentative) | Model Exam | Session 1 to 45 | 3 Hrs |

**Outcomes**

Students who have successfully completed this course

| Instruction Objective | Program outcome |
|---|---|
| 1. To design simple circuits like amplifiers using op-amps.<br>2. To design waveform generating circuits<br>3. To design simple filters circuits for particular application.<br>4. To gain knowledge in designing a stable voltage regulators. | b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems |
| | c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data. |
| | d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications |

**Detailed Session Plan**

| | | | | |
|---|---|---|---|---|
| **Introduction to operational amplifier**: Op-amp symbol, terminals, packages and specifications-Block diagram Representation of op-amp-Op-amp input modes-Op-amp Data sheets and interpretation-Ideal op-amp and practical op-amp-Open loop and closed loop configurations of op-amp **Practical Limitations of op-amp circuits**:-Bias and offset currents / offset voltage-Frequency compensation and stability-Gain bandwidth product-Slew Rate-Drift-CMRR and PSRR **Basic op-amp circuits**: Inverting and Non-inverting voltage amplifiers-Voltage follower-Summing , scaling and averaging amplifiers-Differential amplifiers-AC amplifiers. **Internal Schematic of 741 op-amps.** | | | | |
| **Session No.** | **Topics to be covered** | **Text book** | **Instruction Objective** | **Program Outcome** |
| 1 | **Introduction to operational amplifier:** op-amp fundamentals | Roy Choudhury and Shail Jain, "*Linear Integrated Circuits*", Wiley Eastern Ltd,1995 Chapter (s) - 2, 3,4 | 1. To design simple circuits like amplifiers using op-amps. | b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems<br><br>c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.<br><br>d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications |
| 2 | block diagram representation of op-amp Representation of op-amp-Op-amp input modes-Op-amp Data sheets and interpretation | | | |
| 3 | ideal op-amp and its characteristics .practical op-amp and its characteristics | | | |
| 4 | Open loop and closed loop configurations of op-amp | | | |
| 5 | Bias and offset currents / offset voltage(Problems as in Ex 3.1 to 3.3) | | | |
| 6 | Frequency compensation and stability-Gain bandwidth product | | | |
| 7 | Slew Rate-Drift-CMRR and PSRR | | | |
| 8 | **Basic op-amp circuits:** inverting amplifier, non-inverting amplifier(Problems as in Ex .2.1 to 2.4) | | | |
| 9 | voltage follower Summing Amplifier (Problems as in Ex. 4.1,4.2) | | | |
| 10 | scaling, averaging and differential amplifiers. (Problems as in Ex. 2.5) | | | |
| 11 | AC amplifiers. **Internal Schematic of 741 op-amps.** | | | |

**OP - AMP APPLICATIONS**

**Linear Applications**: Instrumentation Amplifiers-V-to-I and I-to-V converters-Differentiators and Integrators.

**Non-linear Applications**: Precision Rectifiers-Wave Shaping Circuits (Clipper and Clampers)-Log and Antilog Amplifiers-Analog voltage multiplier circuit and its applications-Operational Trans conductance amplifier (OTA)-Comparators and its applications-Sample and Hold circuit.

| Session No. | Topics to be covered | Text book | Instruction Objective | Program Outcome |
|---|---|---|---|---|
| 12 | Instrumentation Amplifiers-V-to-I and I-to-V converters | Roy Choudhury and Shail Jain, "*Linear Integrated Circuits*", Wiley Eastern Ltd,1995 Chapter (s) 4 ,5 | To design waveform generating circuits | b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems<br><br>c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.<br><br>d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications |
| 13 | Differentiators and Integrators. | | | |
| 14 | Precision Rectifiers | | | |
| 15 | Wave Shaping Circuits (Clipper and Clampers) | | | |
| 16 | Log and Antilog Amplifiers | | | |
| 17 | Analog voltage multiplier circuit and its applications | | | |
| 18 | Operational Trans conductance amplifier (OTA) | | | |
| 19 | Comparators and its applications-Sample and Hold circuit | | | |

**OSCILLATORS AND FREQUENCY GENERATORS**

**Op-amp oscillators**: Positive feedback and the Barkhausan criterion-Wien Bridge and phase shift oscillators- Square / Triangle / Ramp function generators.

**Single Chip oscillators and Frequency generators**: Voltage controlled oscillator-555 Timer-555 Monostable operation and its applications-555 Astable operation and its applications-Phase Locked Loop-Operation of 565 PLL-Closed loop analysis of PLL-PLL applications.

| Session No. | Topics to be covered | Text book | Instruction Objective | Program Outcome |
|---|---|---|---|---|
| 20 | **op-amp oscillators:** +ve feedback and Barkhausen criterion | Roy Choudhury and Shail Jain, "*Linear Integrated Circuits*", Wiley Eastern Ltd,1995 Chapter (s) – 5,8 & 9 | To design simple filters circuits for particular application<br><br>. | b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems<br><br>d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications |
| 21 | Phase shift and Wein bridge oscillator. (Problems as in Ex. 5.4) | | | |
| 22 | Square wave, traingular wave and saw-tooth wave generator. | | | |
| 23 | **Single Chip oscillators and Frequency generators:** VCO and its applications | | | |

| | | | | |
|---|---|---|---|---|
| 24 | 555 Timer | | | |
| 25 | Monostable ,Astable operation and its applications. (Problems as in Ex. 8.1, 8.2) | | | |
| 26 | Phase Locked Loop-Operation of 565 PLL | | | |
| 27,28 | Closed loop analysis of PLL-PLL applications. | | | |

**ACTIVE FILTERS AND VOLTAGE REGULATOR**

**Filter Fundamentals**: Filter types-Filter order and poles-Filter class or alignment (Butterworth, Bessel, Chebyshev and Elliptic or Cauer) **Realizing Practical Filters**: Sallen-Key LPF and HPF Realizations-BPF Realization-Notch Filter (Band Reject) Realization-State Variable Filters-All Pass Filters **Switched Capacitor Filters, Voltage Regulators**-Need for Regulation-Linear Regulators-Monolithic IC Regulators (78xx,79xx,LM 317,LM 337,723)-Switching Regulators.

| Session No. | Topics to be covered | Text book | Instruction Objective | Program Outcome |
|---|---|---|---|---|
| 29 | **Active filters:** Basic filters and their characteristics | Roy Choudhury and Shail Jain, " *Linear Integrated Circuits*", Wiley Eastern Ltd,1995 Chapter (s) – 6 &7 | . To gain knowledge in designing a stable voltage regulators. | b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems<br><br>c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.<br><br>d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications |
| 30 | Differences among a Butterworth, a Chebyshev and a Cauer filter | | | |
| 31 | I order active LPF and HPF. Sallenkey LPF and HPF Realizations.(Problems as in EX.7.1 to 7.4) | | | |
| 32 | Wide band pass and narrow band pass filter.(Problems as in EX.7.6 ) | | | |
| 33 | Wide band reject and narrow band reject filters .(Problems as in EX.7.7 and 7.8) | | | |
| 34 | State Variable Filters, All-pass filter | | | |
| 35 | Switched Capacitor Filters | | | |
| 36 | **Voltage Regulators:** Linear Regulators-Monolithic IC Regulators (78xx,79xx,LM 317,LM 337,723) | | | |
| 37 | Switching Regulators | | | |

**DATA CONVERSION DEVICES**

Advantages and disadvantages of working in the digital domain, **Digital to Analog Conversion**: DAC Specifications-DAC circuits-Weighted Resistor DAC-R-2R Ladder DAC-Inverted R-2R Ladder DAC Monolithic DAC, **Analog to Digital conversion**: ADC specifications-ADC circuits-Ramp Type ADC Successive Approximation ADC-Dual Slope ADC-Flash Type ADC-Tracking ADC-Monolithic ADC

| Session No. | Topics to be covered | Text book | Instruction Objective | Program Outcome |
|---|---|---|---|---|
| 38 | **D/A converter:** Characteristics & specifications | Roy Choudhury and Shail Jain, " *Linear Integrated Circuits*", Wiley Eastern Ltd,1995<br>Chapter (s) – 10 | .<br>To design simple circuits like amplifiers using op-amps. | b) Graduates will demonstrate the ability to identify, formulate and solve<br>engineering problems<br><br>c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.<br><br>d) Graduates will demonstrate the ability to design a<br>system, component or process as per needs and specifications |
| 39 | **D/A types:** Weighted resistor DAC, R-2R Ladder DAC, | | | |
| 40 | Inverted R-2R Ladder DAC,Monolithic DAC | | | |
| 41 | **A/D converter:** Characteristics & specifications | | | |
| 42 | **A/D types:** Flash type ADC, Ramp type ADC | | | |
| 43 | Counter type ADC | | | |
| 44 | Successive Approximation type ADC | | | |
| 45 | Dual Slope ADC, Tracking type ADC Monolithic ADC | | | |