KADI SARVA VISHWAVIDYALAYA

B.E. Semester: V
Electronics & Communication Engineering
Subject Name: Integrated Circuits and Applications
Subject Code: EC-505 **W.E.F 2014-15**

A. Course Objective:

The educational objectives of this course are

- To present a problem oriented introductory knowledge of Integrated Circuits.
- To address the underlying concepts and methods behind Integrated Circuits.

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EC-505	**Integrated Circuits and Applications**	**4**	**0**	**2**	**6**	**5**	**3**	**70**	**30**	**20**	**30**	**150**

C. Detailed Syllabus:

1. **Introduction to Operational Amplifiers:**
   Introduction, Block diagram representation of a typical op-amp, its equivalent circuit, types of ICs, Manufacturers' designations and package types for ICs, Power supplies for ICs.

2. **Interpretation of Data Sheets and Characteristics of an op-amp:**
   Interpreting datasheet, Ideal op-amp, Equivalent circuit of an op-amp, Ideal voltage transfer curve, Open-loop op-amp configurations.
3. **An Op-amp with Negative Feedback:**
   Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Differential amplifier.
4. **The Practical op-amp:**
   Introduction, Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Effect of variation in power supply voltage on offset voltage, Change in input offset voltage, input offset current with time, Other parameters which changes with temperature and supply voltage change, noise, Common-mode configuration and common-mode rejection ratio, Slew rate and it equations, Effect of slew rate in applications, Difference between bandwidth, Transient response and slew rate.
5. **General Linear Applications:**
   DC and AC amplifiers, AC amplifiers with single supply voltage, Peaking amplifier, Summing, Scaling and Averaging amplifier, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-to-current converter with floating load and its applications, Current-to-voltage converter, Very high-input impedance circuit, Integrator, Differentiator.
6. **Comparators and Converters**:
   Comparator, Zero Crossing Detector, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifier, Half/Full Wave, Square, Triangular.& Sawtooth Wave, Log/Antilog Amplifier.

7. Active Filters:

Classification of filters, Magnitude and frequency scaling, Magnitude and attenuation characteristics of ideal and practical filters, Design parameter Q & _0, Biquad (Universal) filter design, Butter worth Low pass and High pass filters - 1st and 2nd order circuits design, Butterworth pole location, Sallen & Key circuit, Butterworth Band pass Filters- Frequency Transformation, Deliyannis- Friend circuit , Chebyshev filter characteristics, Band reject filters.

8. Specialized IC Applications:

a. 555 Timer and its Applications:

Block Diagram, Monostable and Astable Multivibrator, Applications as Frequency Divider, Square Wave Generator.

b. Free-Running Ramp Generator

c. Phase Locked Loop and Its Applications:

Block Diagram and Operation, Applications as Frequency Multiplier, Frequency Shift Keying.

d. Design of Power Supply:

Simple OP-AMP Voltage regulator, Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics.

e. Power Amplifiers:

Monolithic Power Amplifiers (LM380).

f. Function Generator:

IC XR 2206

9. Operational Trans-conductance Amplifier:

Introduction, Internal diagram, Analysis, Active Filter.

D. <u>Lesson Planning:</u>

SR. No.	Lectures (Hours)	% Weight-age in Exam	Topics
1	04	05	**Introduction to Operational Amplifiers:** Introduction, Block diagram representation of a typical op-amp, its equivalent circuit, types of ICs, Manufacturers' designations and package types for ICs, Power supplies for ICs.
2	03	05	**Interpretation of Data Sheets and Characteristics of an op-amp:** Interpreting datasheet, Ideal op-amp, Equivalent circuit of an op-amp, Ideal voltage transfer curve, Open-loop op-amp configurations.
3	08	15	**An Op-amp with Negative Feedback:** Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Differential amplifier.
4	05	10	**The Practical op-amp:** Introduction, Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Effect of variation in power supply voltage on offset voltage, Change in input offset voltage, input offset current with time, Other parameters which changes with temperature and supply voltage change, noise, Common-mode configuration and common-mode rejection ratio, Slew rate and it equations, Effect of slew rate in applications, Difference between bandwidth, Transient response and slew rate.

5	**10**	**15**	**General Linear Applications:** DC and AC amplifiers, AC amplifiers with single supply voltage, Peaking amplifier, Summing, Scaling and Averaging amplifier, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-to-current converter with floating load and its applications, Current-to-voltage converter, Very high-input impedance circuit, Integrator, Differentiator.
6	**10**	**15**	**Comparators and Converters**: Comparator, Zero Crossing Detector, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifier, Half/Full Wave, Square, Triangular and Saw tooth Wave Generator, Log/ Antilog Amplifier.
7	**10**	**15**	**Active Filters:** Classification of filters, Magnitude and frequency scaling, Magnitude and attenuation characteristics of ideal and practical filters, Design parameter Q & _0, Biquad (Universal) filter design, Butter worth Low pass and High pass filters - 1st and 2nd order circuits design, Butterworth pole location, Sallen & Key circuit, Butterworth Band pass Filters-Frequency Transformation, Deliyannis- Friend circuit , Chebyshev filter characteristics, Band reject filters.
8	**08**	**15**	**Specialized IC Applications:** **a. 555 Timer and its Applications:** Block Diagram, Monostable and Astable Multivibrator, Applications as Frequency Divider, Square Wave Generator. **b.** Free-Running Ramp Generator **c. Phase Locked Loop and Its Applications:** Block Diagram and Operation, Applications as Frequency Multiplier, Frequency Shift Keying. **d. Design of Power Supply:** Simple OP-AMP Voltage regulator, Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics. **e. Power Amplifiers:** Monolithic Power Amplifiers (LM380). **f. Function Generator:** IC XR 2206
9	**02**	**05**	**Operational Trans-conductance Amplifier:** Introduction, Internal diagram, Analysis, Active Filter.
TOTAL	**60**	**100**	

E. <u>Instructional Method And Pedagogy</u> (ANNEXURE-I)

F. Suggested List Of Experiments:

1 To configure op-amp in Inverting amplifier mode and measure gain.

2 To configure op-amp in Non-Inverting amplifier mode and measure gain.

3 To configure op-amp IC 741 as a summing amplifier.

4 To configure op-amp IC 741 as an integrating amplifier.

5 To configure Operational amplifier as a Differentiator.

6 To configure op-amp IC 741 as an Instrumentation amplifier.

7 To configure op-amp IC 741 as a low pass filter and plot its frequency response.

8 To configure op-amp IC 741 as a High pass filter and plot its frequency response.

9 To configure op-amp IC 741 as a Schmitt Trigger.

10 To configure op-amp IC 741 as a Half wave Rectifier.

11 To configure op-amp IC 741 as a Full wave Rectifier.

12 Configure IC 555 as an Astable (free running) multivibrator.

13 Configure IC 555 as Monostable multivibrator.

14 Find slew rate of op-amp IC 741.

15 Configure op-amp IC 741 as a waveform generator.

G. Students Learning Outcomes

On successful completion of the course

- The student can identify different areas of Integrated Circuits. Can find the applications of all the areas in day to day life. Can identify the operations, working, construction, material etc. Aspects of Integrated Circuits, Rectifiers, Filters, Multivibrators, Signal Generators etc.

H. Recommended Study Materials

TEXT & REFERENCE BOOKS:

1) Op-amps and Linear Integrated Circuits, by Ramakant A. Gayakwad.
2) Design with Operational Amplifiers and Analog Integrated Circuits, by Sergio Franco, Tata McGraw-hill 2009 Edition.
3) Design of Analog Filers, by R. Schaumann, and Mac E. Van Valkenburg.
4) Integrated Circuit, by K.R.Botkar Khanna Publication.