#### COURSE OBJECTIVES:

1. To know the idealized and practical equivalent circuits of op amp.

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- 2. To know design of filters using op amps and static op amp limitations.
- 3. To know the dynamic op amp limitations and stability of op amp circuits.
- 4. To know the operation of nonlinear circuits and signal generators using op amps.
- 5. To know the A-D and D-A conversion techniques.

### COURSE OUTCOMES:

#### After successful completion of the course, the students are able to

- 1. demonstrate knowledge in (i)V to I and I to V convertors, (ii)Active filters, (iii)Stability of Op amp, (iv)Comparators, (v)Signal generators, (vi)A-D and D-A conversion techniques.
- 2. elucidate and design the basic op-amp circuits such as linear and non-linear circuits, Active filters, signal generators, and data converters.
- 3. infer the DC and AC characteristics of operational amplifiers its effect on output, and their compensation techniques.
- demonstrate the applications of linear and Nonlinear Amplifiers.
- 5. examine the working of D-A, A-D Converters, Schmitt trigger, precision rectifiers, peak detectors, and sample & hold circuit.

### UNIT I

Operational Amplifier Fundamentals: amplifier fundamentals, the operational amplifier, basic op amp configurations, ideal op amp circuit analysis, feedback in op amp circuits, op amp powering.

Circuits with Resistive Feedback: current to voltage converters, voltage to current converters, current amplifiers, difference amplifiers, instrumentation amplifiers.

### UNIT II

Active Filters: common frequency responses, the transfer function, first order active filters, standard second order responses, filter approximations cascade design direct design.

Static Op-Amp Limitations: simplified op amp circuit diagram, input bias and offset currents, input offset voltage, input offset error compensation, maximum ratings.

### UNIT III

Dynamic Op-Amp Limitations: open loop response, closed loop response, transient response, effect of finite gbp on integrator circuits, effect of finite gbp on filters.

Stability: the stability problem, stability in constant-gbp op amp circuits, internal frequency compensation, external frequency compensation.

### **UNIT IV**

**Nonlinear Circuits:** voltage comparators, comparator applications, schmitt trigger, precision rectifiers, peak detectors, sample and hold amplifiers

Signal Generators: sine wave generators, multivibrators, monolithic timers, triangular wave generators, saw tooth wave generators, monolithic waveform generators.

#### UNIT V

D-A and A-D Converters: performance specifications, d-a conversion techniques, a-d conversion techniques.

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## LEARNING RESOURCES:

# TEXT BOOK(s):

Sergio Franco - Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Edition, TMH, 2002

# **REFERENCE BOOK(s):**

- 1. RamaKant A. Gayakwad Op-Amps and Linear Integrated Circuits, 4th Edition, PHI, Pearson Education, 2003.
- 2. D.Roy and Choudhury Shail B.Jain, Linear Integrated Circuits, 2nd Edition, New Age International, 2003.

# WEB RESOURCES:

- 1. http://nptel.ac.in/courses/117108038/
- 2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-01sc-introduction-to-electri cal-engineering-and-computer-science-i-spring-2011/unit-3-circuits/op-amps/