NPTEL ONLINE CERTIFICATION COURSES

Course Name: *Analog Electronic Circuits*

Faculty Name: *Dr. Pradip Mandal*

Department : *Electronics and Electrical Communication Engineering*

Topic:

Introduction to constituent Topics of the course and the Layout

CONCEPTS COVERED

Concepts Covered:

- Tasks performed by analog circuits
- Architectural construction and constituents of analog circuit
- Various topics and sub-topics of the course
- Layout of the course

Emphasis of Analog Electronic Circuits
(*contd… from previous*)

- **Analog building blocks**
  - **Working principles**
  - **Analysis and Design**

- **Integrating different building blocks**
  - **Cascading and Interfacing effects**

- **Practical Analog Modules/Sub-Systems**
  - **Working principles**
  - **Analysis and Design**

Tasks performed by Analog Circuits

- **Signal Amplification**
  - **Gain (*voltage, current, power etc.*)**
  - **Linearity of *Input-Output transfer* characteristic**

Tasks performed by Analog Circuits (*contd…*)

- **Signal Amplification/Rejection based on its frequency**
  - **Frequency response (***Low pass, high pass, band pass etc***.)**

- **Signal Conversion (*out of scope of this course*)**
  - **ADC and DAC**

Architectural construction of Analog Circuits

- **System /Sub-systems (*for specific application*)**
  - **Modules (*performing specific tasks*)**
    - **Building blocks (*having specific characteristics*)**
      - **Components (*devices/circuit elements*)**

- **Top-Down and Bottom-up views**

Flow of Discussion (Bottom-up) - *Components*

- **System /Sub-systems(*for specific application*)**
  - **Modules (*performing specific tasks*)**
    - **Building blocks (*having specific characteristics*)**
      - **Components (*devices/circuit elements*)**

- **Week 1**:
  - **Introduction and objective of this course;**
  - **Revisit to pre-requisite topics (Electrical Theory);**
  - **Starting with simple diode circuit and its analysis.**
  - **Revisiting BJT and MOSFET- operating principles, characteristic equations and equivalent circuits**

Flow of Discussion (Bottom-up) – *Building blocks*

- **System/ Sub-systems (*for specific application*)**
  - **Modules (*performing specific tasks*)**
    - **Building blocks (*having specific characteristics*)**
      - **Components (*devices/circuit elements*)**
- **Week 2:**
  - **Analysis of simple non-linear circuits (each containing one transistor) and introducing the notion of signal amplification.**
  - **Input-output transfer characteristic of a non-linear circuit.**
  - **Linearization of input-output transfer characteristic of a non-linear circuit (w.r.t. an operation point) and, introducing the notion of small signal equivalent circuit.**
  - **Small signal models of transistors.**

Flow of Discussion (Bottom-up)

- **Building blocks (*having specific characteristics*)**

- **Week 3**:
  - **Amplifier models (equivalent circuits):**
    - **voltage amplifier, current amplifier,**
    - **trans-conductance amplifier and trans-resistance amplifier.**
  - **Cascading of multiple amplifiers.**
  - **Common emitter (CE) amplifier**
    - **operating principle, biasing, analysis and design.**
  - **Common source (CS) amplifier**
    - **operating principle, biasing, analysis and design.**

Flow of Discussion (Bottom-up)

- **Building blocks (*having specific characteristics*)**

- **Week 4**:
  - **Frequency response of CE and CS amplifiers,**
  - **High frequency models of BJT and MOSFET, and their usages.**
  - **Limitations of CE/CS amplifiers and hence the need of buffers.**

Flow of Discussion (Bottom-up)

- **Building blocks (*having specific characteristics*)**
- **Week 5**:
  - **Common Collector (CC) and Common Drain (CD) amplifiers**
    - **biasing, operation, analysis and design.**
  - **Common Base (CB) and Common Gate (CG) amplifier**
    - **biasing, operation, analysis and design.**
- **Week 6**:
  - **Multi transistor Amplifiers (operation and analysis):**
    - **CE-CC; CS-CD; CC-CC; Darlington pair etc.**
  - **Cascode amplifiers**
    - **CS-CB and CS-CG**
  - **Amplifier with active load.**

Flow of Discussion (Bottom-up)

- System/Sub-systems (*for specific application*)
  - **Modules (** *performing specific tasks***)**
    - **Building blocks (** *having specific characteristics* **)**
      - Components (*devices/circuit elements*)
- **Week 7**:
  - **Single-ended signaling vs. differential signaling**
  - **Differential amplifier:**
    - **Basic structure and principle of operation,**
    - **analysis for differential mode gain, common mode gain,**
    - **ICMR and output swing**

Flow of Discussion (Bottom-up)

- System /Sub-systems (*for specific application*)
  - **Modules** (*performing specific tasks*)
    - **Building blocks (*having specific characteristics*) - Bias circuits**
      - Components (*devices/circuit elements*)
- **Weak 8:**
  - **Current mirror**
    - **operating principle and analysis,**
  - **Use of current mirror**
    - **as bias circuit and for signal amplification (in CE/CS, CC/CD, CB/CG and**
    - **Differential amplifier).**
  - **Constructing practical circuits using the basic building blocks.**

Flow of Discussion (Bottom-up)

- **System / Sub-systems (*for specific application*)**
  - **Modules (*performing specific tasks*) – *Theory and practical circuit***
    - **Building blocks (*having specific characteristics*)**
      - **Components (*devices/circuit elements*)**

- **Week 9:**
  - **Feedback: Basic feedback theory**
  - **Four different feedback configurations and their characteristics**
  - **Effects of feedback on frequency response of an amplifier**
  - **Application of feedback in practical circuits**

Flow of Discussion (Bottom-up)

- **Sub-System** (*for specific application*) - ***Theory and practical circuit***
  - **Modules** (*performing specific tasks*) - ***Theory and practical circuit***
    - **Building blocks** (*having specific characteristics*)
      - **Components** (***devices/circuit elements***)

- **Week 10**:
  - **Oscillation in feedback system and oscillation criterion**
  - **Stability analysis of a feedback system**
  - **Two-stage differential amplifier and its stability analysis in feedback configuration.**

Flow of Discussion (Bottom-up)

- **Sub-system** (*for specific application*) - ***Theory and practical circuit***
  - **Modules** (*performing specific tasks*)
    - **Building blocks** (*having specific characteristics*)
      - **Components** (*devices/circuit elements*)
- **Week11**:
  - **Comparator and its applications;**
  - **Oscillator: Sinusoidal-Phase-shift and LC;**
  - **Square wave generator**
- **Week12**:
  - **Power efficiency of an amplifier,**
  - **Different modes of operation of amplifiers and their power efficiency:**
  - **Class A, Class B, Class AB and Class C**

Conclusion

Conclusion:

- ❑ Tasks performed by analog circuits
- ❑ Architectural construction and constituents of analog circuit
- ❑ Various topics and sub-topics of the course
- ❑ Layout of the course
- ❑Emphasis of “Analog Electronic Circuits”

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Thank you