ELX 213.3 Electronic Devices (3-1-2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

The purpose of the course is to provide knowledge of principles of electronic devices and circuits. Moreover, it provides a method for analysis of semiconductor devices.

Course Contents:

1. **Semiconductor diode** **(8 hrs)**
   - 1.1 Review of conduction in semiconductors
   - 1.2 Theory of p-n junction
   - 1.3 Band structure of p-n junction
   - 1.4 The p-n junction as a diode
   - 1.5 The effects of temperature in V-I characteristics
   - 1.6 Space- charge of transition region capacitance and its effects
   - 1.7 Diffusion capacitance and its effects
   - 1.8 Diode switching times
   - 1.9 Zener diode
   - 1.10 Tunnel diode
   - 1.11 Construction
   - 1.12 Characteristics and Applications of Schottky diode
   - 1.13 Varactor diode and Metal Oxide Varister
2. **Non-Linear Model** **(2 hrs)**
   - 2.1 Basic properties of non-linear elements
   - 2.2 Non-linear circuit analysis (Graphical/ Algebraic analysis methods)
   - 2.3 Piecewise linear modeling
   - 2.4 Use and application of SPICE in analysis
3. **Bi-polar Junction Transistor (BJT)** **(7 hrs)**
   - 3.1 Construction of a BJT
   - 3.2 Working principal of BJT
   - 3.3 Modes of operation Transistor Configuration
   - 3.4 Analytical expression for transistor characteristics
   - 3.5 Input-output characteristics of CB, CE and CC transistor configurations

3.6 α,β,γ and their relationship
3.7 Avalanche effect
3.8 Early Effect
3.9 Reach – through
3.10 The EBERS-Moll equations
3.11 BJT switching time
3.12 Maximum voltage rating

4. **BJT biasing and Thermal Stabilization (6 hrs)**
   4.1 Biasing and its needs
   4.2 Types of biasing (fixed bias, collector to bias, Voltage divider or self bias)
   4.3 DC/AC load line, Quiescent or Qpoint
   4.4 Stability and stability factor of biasing circuit
   4.5 Design of biasing circuit
   4.6 Bias compensation (diode compensation for V_{BE} and I_{CO})
   4.7 Thermal runway and stability.

5. **The Small Signal Low Frequency Analysis Model of BJT (7 hrs)**
   5.5 Low frequency hybrid model
   5.6 Measurement of h parameter
   5.7 Transistor configurations and their hybrid model
   5.8 Expression for Current gain, Voltage gain, input impedance and output impedance of two port BJT network
   5.9 Analysis of a transistor amplifier circuit using h-parameters
   5.10 Expression for voltage gain, current gain, input impedance and output impedance of CE,CB and CC configurations using h-model
   5.11 Comparison of characteristics of CB, CE and CC, Transistor as an amplifier

6. **The Junction Field Effect Transistor (JFET) (6 hrs)**
   6.8 Comparison between BJT and JFET
   6.9 Construction and types of JFET, Working Principal of JFET
   6.10 The pinch-off voltage and its importance
   6.11 Drain and transfer characteristics
   6.12 Trans-conductance, Biasing and load line
   6.13 V-I characteristics
   6.14 Configuration of JFET (CS,CD,CG), small signal model and analysis of CS, CD, CG, generalized FET Amplifier
   6.15 Uni-Junction transistor

7. **The Metal Oxide Semiconductor (3 hrs)**
   7.5 Construction and Working Principles of DMOSFET ,EMOSFET ,and CMOS load line

biasing

7.6 V-I characteristics

7.7 Small signal analysis Model of MOSFET

8. **Clippers, Champers and Rectifiers (6 hrs)**

8.5 Rectifier, Half Wave and Full Wave (Center tapped and Bridge) rectifier

8.6 Average Value RMS value

8.7 Ripple factor, Rectification efficiency , Form factor of half wave and full wave rectifier

8.8 Diode clipper and Clamper harmonic components

8.9 Filters: inductor and capacitor filters- L section and P-I section filters

Laboratory:

1. Familiarization with equipment
2. Measurement of characteristics of PN Diode and Zener diode
3. Study of half wave and full wave rectifier circuits
4. Study of full wave rectifier (Center tap and Bridge) rectifier circuits
5. Study of Clipper Circuits
6. Measurement of input and output characteristics of CB, CE configurations
7. Measurement of input and output characteristics of JFET
8. Measurement of input and output characteristics of NMOS
9. Measurement of input and output characteristics of PMOS
10. Measurement of input and output characteristics of CMOS

Text Books:

1. S. Sedra and KC. Smith, *"Microelectronics Circuits"* Holt Rinebart and Winston, New York.
2. J Milliman and Halkias, *"Electronics Devices and Circuits"* Mc Graw Hill
3. T.F Bogart "*Electronic Devices and Circuits*" PHI
4.

References:

1. V.K Mehta, " *principles of Electronics* " S Chand & Co. Fifth edition
2. MN. Horenstein," *Microelectronic Circuits and Devices*" second edition, Prentice Hall of india
3. Dhruba Banjade, Electronic Devices, Sukunda Prakashan, Kathmandu, Nepal