Pokhara University
Faculty of Science and Technology

Course No.: xxx xxx	Full marks: 100
Course title: Electronics Device and Circuits (3-1-2)	Pass marks: 45
Nature of the course: Theory & Practical	Time per period: 1 hour
Level: Undergraduate	Total Periods: 45
	Program: BE

1. Course Description

This course covers an introduction to active electronic components and a study of circuits containing such components. This is designed to teach the students about theory, concepts and principles of operation of various electronics devices related to their use and working in electronic systems and applications. It also aims to introduce students the analysis and design techniques of circuits involving these discrete devices as well as the integrated circuits.

2. General Objectives

The general objective of the course are:

- To equip the students with in-depth concepts and the principles of operation, construction and characteristics of semiconductor devices, and their utilization in basic electronics building blocks (or modules) and their performances.
- To provide the students with the techniques of analysis and design of basic building blocks of modern technology using devices.
- To acquaint the students with diode as a rectifier, feedback and design feedback amplifier, and oscillators & power amplifiers using transistor.

3. Methods of Instruction

Lecture, discussion, Tutorials, Assignments, Lab works, Project works, Presentation

4. Course in Detail

Specific Objectives	Contents
• explain the basic function of diodes in electrical circuits and describe the characteristics of an ideal diode; • describe the electrical characteristics of conductors, insulators and semiconductors; • discuss the doping of semiconductor materials and the construction of semiconductor diodes; • describe the characteristics of a typical diode and sketch its current-voltage characteristics;	**Unit I: Semiconductor diode (6 hrs)** 1.1 Review of insulator and semiconductor and conductors 1.2 Conduction in semiconductors 1.3 Theory of p-n junction 1.4 Forward and reverse biasing of diode 1.5 Diode as a nonlinear device 1.6 Ideal and piecewise linear model of diode 1.7 The effects of temperature in V-I characteristic curves 1.8 Junction capacitances and its effects 1.9 Diode switching times 1.10Junction breakdown

• outline the use of several forms of special-purpose semiconductor devices, including Zener, tunnel and varactor diodes; • Design a range of circuits that exploit the characteristics of semiconductor diodes.	1.11Construction, characteristics and applications of Zener diode, Schottky diode
• explain the importance of bipolar transistors in modern electronic circuits; • describe the construction, operation and characteristics of bipolar transistors; • analyze simple amplifier circuits based on transistors and determine their operating conditions and voltage gain; • discuss the importance of negative feedback in overcoming variability in such circuits; • describe the low-frequency behavior of amplifiers that use coupling capacitors; • List a range of applications of bipolar transistors in addition to their uses in amplifiers.	**Unit II: Bi-polar Junction Transistor (6 hrs)** 2.1 Introduction of bipolar junction transistor 2.2 Current flow mechanism in PNP and NPN transistors 2.3 Input and output characteristics of CE and CB transistor amplifiers 2.4 Reach through and punch through effects 2.5 Active and cut off and saturation modes of operations of BJT and BJT switching times 2.6 The transistor as an amplifier and switch 2.7 Comparison of CB, CE and CC configurations 2.8 BJT biasing, dc load line, ac load line and Q point 2.9 Stability factor
• Explain and analyze the operation of both half and full wave rectifiers • Explain and analyze filters and regulators and their characteristics • Explain and analyze the operation of diode limiting and clamping circuits	**Unit III: DC Power supply (5 hrs)** 3.1 Half wave and full wave rectifiers 3.2 Average value, RMS value ripple factor of half and full wave rectifiers 3.3 Filtering process, Shunt capacitor and LC filter and pi filter 3.4 Series Shunt and biased clipper circuits 3.5 Clamping circuits 3.6 Regulated and unregulated power supplies 3.7 Transistor series and transistor shunt regulators
• list the various major forms of field-effect transistor (FET); • describe the characteristics common to all forms of FET and explain how these characteristics make them suitable for use in amplifiers; • describe the physical operation of both MOSFETs and JFETs and explain how this influences the characteristics of these devices; • outline the behavior of FETs;	**Unit IV: The Field Effect Transistor (FET) (5 hrs)** 4.1 Comparison between FET and BJT 4.2 Construction and working principle of JFET 4.3 Biasing and load line 4.4 Drain and transfer characteristics of JFET and JFET parameters 4.5 Construction and working principles of DMOSFET and EMOSFET

• Develop the small signal models of transistor that are used in analysis of linear amplifier. • Small signal hybrid model- measurement and analysis using h-parameter • Low frequency r_e model and analysis using r_e model	**Unit V: The Small Signal Low Frequency Analysis Model of BJT (5 hrs)** 5.1 Low frequency hybrid model 5.2 Transistor configurations and their hybrid model- Measurement of h-parameters and analysis of a transistor amplifier circuit using h-parameters 5.3 Low frequency re model, amplifier configuration and their expression for voltage gain, current gain, input impedance and output impedance using re model 5.4 Analysis of transistor amplifier circuit using re model 5.5 Emitter follower
• Describe methods for inter-stage coupling in multi-stage amplifiers: • Direct Coupling • Capacitor coupling. • Transformer Coupling	**Unit VI: Multistage Amplifiers (4 hrs)** 6.1 Multistage amplifier and Gain calculation of n-stages cascaded amplifiers 6.2 Methods of coupling 6.3 Expression of voltage gains, Current gains, input and output impedance for two stages RC coupled amplifier using re model 6.4 Choice of configuration in a cascade 6.5 Darlington-pair amplifier and its effective beta
• Different classes of operation of Amplifiers • Power conversion capabilities and applications • Merits and demerits • Problems with distortion in Amplifiers and remedies • Push-Pull power Amplifiers • Advanced Power Amplifiers	**Unit VII: Large Signal Amplifiers (4 hrs)** 7.1 Analysis of large signal model 7.2 Class A, B, AB and Class C amplifiers 7.3 Push-pull amplifiers 7.4 Cross over distortion 7.5 Transformer coupled push-pull stages 7.6 Amplifier efficiency, power dissipation and heat sinks
• Principle of Feedback Amplifiers • Advantages of Negative feedback • Gain stability • Increased bandwidth	**Unit VIII: Feedback Amplifiers (3 hrs)** 8.1 Negative feedback amplifiers and advantages of negative feedback 8.2 Gain stability, extension of bandwidth 8.3 Importance of positive feedback on oscillation
• Familiarity with operational amplifiers (op-amps) and basic op-amp circuits: • Inverting, non-inverting, and summing amplifiers.	**Unit IX: Operational Amplifier and Oscillator (7 hrs)** 9.1 Basic Model 9.2 Ideal and non-ideal properties 9.3 Virtual ground concept, offset voltage, input bias current, slew rate and CMRR

• Input and output impedances of op-amp circuits.	9.4 Inverting and non-inverting amplifier 9.5 Integrator, differentiator and summing amplifier and their applications 9.6 Astable and monostable multivibrators 9.7 Barkhausen criteria for oscillation 9.8 RC phase shift and Wein bridge oscillator using Op-amp

5. Laboratory Work

1. Study of V-I characteristics of PN diode and Zener diode.
2. Study of half wave and full wave rectifiers.
3. Study of input and output characteristics of CE and CB transistor amplifier.
4. Measurement of gain in single stage and multistage amplifiers.
5. Frequency response of CE amplifier
6. Frequency response of CC amplifier
7. Measurement of efficiency of class A and Class B push pull power amplifiers.
8. Design of RC phase shift and Wein Bridge oscillator.
9. Measurement of Regulation in series regulator against change in input voltage and load resistance.
10. Study of drain characteristics of JFET.

6. List of Tutorials

The various tutorial activities that suits your course should cover all the content of the course to give students a space to engage more actively with the course content in the presence of Instructor/professor. The following tutorial activities of 15 hrs. should be conducted to cover the content of this course:

1. Discussion-based Tutorials: (2 hrs)
2. Numerical and analysis based numerical of diode, Zener diode, and transistor. (5 Hrs)
3. Discussion and designing of biasing circuit (2 Hrs)
4. Analysis and numerical solution of small and large frequency signal amplifier. (3Hrs)
5. Numerical problems for operational and feedback amplifier. (3Hrs)

7. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and projects etc. The tabular presentation of the internal evaluation is as follows:

External Evaluation	**Marks**	**Internal Evaluation**	**Weight**	**Marks**
Semester-End examination	50	**Theory**		30
		Attendance & Class Participation	10%	
		Assignments	20%	
		Presentations/Quizzes	10%	
		Term exam	60%	
		Practical		20

		Attendance & Class Participation	10%	
		Project Report	10%	
		Viva	20%	
		Exam	60%	
		Total Internal		50
Full Marks: 50 + 50 = 100				

Student Responsibilities

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books

1. Jacob Millman & Christors C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill, India.
2. Theodore F. Bogart, Electronic Devices and Circuits, Univesal Book Stall, Indial.

References

1. Roberst Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall, India.
2. Allen Mottershead, Electronic Devices and Circuits, Prenticre- Hall, India
3. Albert Paul Malvino, Electronic Principles, Tata Mc Graw Hill, India.
4. S. Sedra and K.C. Smith, Microelectronic Circuits, Holt, Rinehart and Inc., New York.