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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**School of Computer Science**

**COURSE PLAN**

Programme : B. Tech. (CIT Branches)

Course : Basic Electronics Engineering

Subject Code : PHYS-1003

No. of credits : 3

Semester : I/II

Session : 2018-19

Batch : 2018-22

Prepared by :

Email :

**Approved By**

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| --- | --- | --- | --- | --- | --- |
| **PHYS 1003** | Basic Electronics Engineering | L | T | P | C |
| **Version 1.0** |  | 3 | 0 | 0 | 3 |
| **Pre-requisites/Exposure** | 12th level Physics | | | | |
| **Co-requisites** | 12th level Mathematics | | | | |

**Course objectives:**

1. To demonstrate the basics of semiconductor and its type with the energy level diagram and formation of PN junction diode, its characteristics and breakdown during reverse biasing.
2. To familiarize the students about the applications of diode in Voltage regulators, Rectifiers, Filters, Clippers and Clampers.
3. To develop an understanding about Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), MOSFET and there configurations.
4. To familiarize with the analysis of basic transistor amplifier circuits, feedback amplifiers transistor as an Amplifier and their classification. To develop the knowledge of Operational Amplifier and its application as Summer, Integrator and Differentiator.
5. To enhance the knowledge related to communication system and to equip the students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.

**Course Outcomes**

On completion of this course, the students will be able to

CO1: To define the transport phenomena in semiconductors and basics of transistors, operational amplifier & communication system.

CO2: To compare different types of: breakdown mechanism in diodes, rectifiers, transistor configurations, and modulation mechanisms.

CO3: To apply the knowledge of working of diode, transistor & op-amp in various electronics problems.

CO4: To analyze the different types of diode, transistor & op-amp based circuits for determining the output waveform.

**Catalog Description:**

The aim of the course is to introduce the basic concepts of semiconductor devices within the context of engineering especially computer Science students.  The objective of this course is to equip the students with the required mathematical tools/formulas necessary to understand and analyze basic analog electronic components and circuits such as diodes, transistors etc. Emphasis is on analysis and application of electronic circuits utilizing semiconductor diodes, operational amplifiers, and transistors. During the delivery of the course, the students will be provided with examples of day-to-day devices to cover and demonstrate the fundamentals of basic electronic circuits. A student who completes the course successfully will be able to demonstrate the basic electronic components, their device structure, principle of operations and analysis, circuit representations etc. and understand the analog electronics and their corresponding circuit analysis. This course provides a platform to understand basic electronics which may provide the students good career options as electronics professional.

**Course Content**

**Unit I: 7 lecture hours**

Introduction to Semiconductors- Intrinsic & Extrinsic semiconductors, Energy level diagram, concept of fermi level, Transport Phenomena in semiconductor{Conductivity, temperature dependence of conductivity(Qualitative), mobility, drift current, diffusion current}, P-N Junction diode : Formation of depletion layer, Biasing and Working of Diode, Diode equation, diode characteristics, Breakdown in a diode: Zener and Avalanche breakdown.

**Unit II: 8 lecture hours**

Diode Applications- Zener diode and its application as a voltage stabilizer, Rectifiers: Half wave and Full wave rectifiers: Centre tap type and Bridge type. Expression for form factor, ripple factor and efficiency, Filters: capacitor filter, L and pi filters, Clipping (series and parallel) and Clamping Circuits

**Unit III: 6 lecture hours**

Fundamental of Transistors- Bipolar junction transistors (BJTs); C-B,C-E and C-C configuration, input and output characterizations, load line and operating point, Field effect Transistors (FET) : comparison with BJT, construction and characteristic of JFET and MOSFET (Depletion and Enhancement Type).

**Unit IV: 10 lecture hours**

Transistor Amplifiers- Introduction to Amplifiers, Classification of Amplifier: based on Q point and Load line, Class A, Class B, Class C & Class AB, Concept of Feedback Amplifiers, comparison of positive and negative feedback, Introduction to Operational Amplifiers, Operational Amplifiers parameters, Gain in Operational Amplifiers: Non-inverting and Inverting amplifier, Applications of Operational Amplifiers as Summer (inverting configuration only), Integrator, Differentiator**.**

**Unit V: 8 lecture hours**

Communication System- Basics of Communication system, Concept of Antenna and Bandwidth, Techniques of Amplitude and Frequency modulation, Comparison between Am and FM, Radio Receivers : FM radio receiver and Superhetrodyne receiver, Noise Classifications, Signal to Noise ratio, Applications of Modulation and Demodulation.

**Text Books**

1. Boylestad R.B., Nashelsky L. (2009) Electronic Device and Circuit Theory. Dorling Kindersley (India) Pvt. Ltd. ISBN: 97881317031703144

2. Kennedy G., Davis B. (2008) Electronic Communication Systems. Tata Mcgraw-Hill Pvt. Ltd. ISBN: 10007463682

**Reference Books**

1. Millman J., Halkias C.C. (1972) Integrated Electronics: Analog & Digital Circuit System- Tata Mcgraw-Hill Pvt. Ltd. ISBN: 9780070423152

2. Mottershead. A (1979) Electronic Devices and Circuits-, Prentice Hall India Learning Pvt. Ltd. ISBN: 9788120301245

**Video Resources:** Available with Department of Physics.

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Components** | **Common Class Test** | **Assignment** | **MSE** | **ESE** |
| **Weightage (%)** | **18** | **12** | **20** | **50** |

**Internal Assessment: Weightage – 30%**

**Common Class Tests (ccts):** Three CCTs – Multiple choice questions will be held online through Blackboard platform; Those who do not appear in test examinations shall lose their marks.

**Assignments:** After completion of each unit or in the mid of the unit, there will be home assignments based on theory and numerical problems. Those who fail to submit the assignments by the due date shall lose their marks.

**Mid Term Examination: Weightage – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination ofShort and Long theory/numerical Questions.

**End Term Examination: Weightage – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**Relationship between the Course Outcomes (COs) and Program Outcomes (POs)**

|  |  |  |
| --- | --- | --- |
| **Mapping between COs and POs** | | |
|  | **Course Outcomes (COs)** | **Mapped Programme Outcomes** |
| **CO1** | To define the transport phenomena in semiconductors and basics of transistors, operational amplifier & communication system. | **PO1, PO2** |
| **CO2** | To compare different types of: breakdown mechanism in diodes, rectifiers, transistor configurations, and modulation mechanisms. | **PO1, PO2** |
| **CO3** | To apply the knowledge of working of diode, transistor & op-amp in various electronics problems. | **PO1, PO2, PO12** |
| **CO4** | To analyze the different types of diode, transistor & op-amp based circuits for determining the output waveform. | **PO1, PO2, PO12** |

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|  |  | Engineering Knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual or team work | Communication | Project management and finance | Life-long Learning |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PHY 1003 | Basic Electronics Engineering | 3 | 2 |  |  |  |  |  |  |  |  |  | 1 |

1=weakly mapped

2= moderately mapped

3=strongly mapped

**Model Question Paper**

**Note: In the model question paper, the mapping of COs is done with the syllabus of even semester of 2016-17 (not with the current one).**

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| --- | --- | --- | --- | --- | --- | --- |
| **Name:**  **Enrolment No:** | |  | | | | |
| Course: PHY1003– Basic Electronics Engineering **Programme: B.Tech.(CIT:CS-BAO, CS-IFM, BFSI, ECRA)) Semester: EVEN-2016-17**  **Time: 03 hrs. Max. Marks:100**  **Instructions:**  Attempt all **four questions** from **Section A** (each carrying 5 marks); **Four Questions** from **Section B** (each carrying 10 marks)**. Two questions from Section C** (each carrying 20 marks)**.** | | | | | | |
| **Section A**  **(All questions are compulsory)** | | | | | | |
| 1. | What do you mean by Avalanche and Zener Breakdown voltages? Discuss the major differences between them | | **[5]** | **CO1** | |
| 2. | Draw neat and clean circuit diagrams of half and full wave (center-tapped) rectifiers along with their output waveforms. | | **[5]** | **CO1** |
| ­­­ 3. | Write the different categories of amplifiers on the basis of operating point. Which amplifier has maximum efficiency and conduction angle? | | **[5]** | **CO2** |
| 4. | Convert [1110110101]2 into Hexadecimal and Octal system | | **[5]** | **CO4** |
|  | **SECTION B**  **(Attempt either part ‘a’ or ‘b’ in question no. 8**.**)** | |  | |
| 5. | Draw and discuss the input and output characteristics of a n-p-n transistor in common-base configuration with the help of a circuit diagram | | **[10]** | **CO2** |
| 6. | a). Discuss XOR and NAND logic gates with their symbols and truth tables.  (b): Implement the OR Gate by using NOR gate.  (c): Find the output Y of logic circuits given below by using Boolean algebra | | **[10]** | **CO4** |
| 7 | Discuss different types of modulations and why modulation is required in communication system? What is modulation index? Calculate the modulation index if a carrier wave of 100 V & 1200 kHz is modulated by 50 V & 1000 Hz sine wave signal. | | **[10]** | **CO3** |
| 8 | (a): What do you mean by a Clamper circuit? Discuss and write the steps for determining the output waveform of unbiased positive Clampers? Sketch the output waveform for the given circuit    **OR**  (b): Discuss the effect of biasing on the width of depletion layer of PN junction diode. A germanium diode has a saturation current of 10 μA at room temperature (300 K). Find the saturation current at 400 K. | | **[10]** | **CO1** |
|  | **SECTION C**  **(Attempt either part ‘a’ or ‘b’ in question no. 10**.**)** | |  | |
| 9 | (a)(i)What do you mean by an operational amplifier ? Write the characteristics of an ideal operational Amplifier.  (ii) The amplifier shown in figure has Rf =10 kΩ, R1=10 kΩ, R2=2.2 kΩ and R3= 3.3 kΩ. If V1= 6 V, V2 = -3 V, V3=-0.75 V. Find Vout    (b)(i) A center-tapped full wave rectifier has the load resistance RL= 2000 ohm. The forward resistance RF of each diode is 20 ohm. The voltage across half of the secondary winding is given by the equation V = 400sin14t. Calculate the Maximum current, Direct current and ripple factor.  (ii) Draw the circuit diagram of a differentiator using Op-Amp. Derive the expression for output of a differentiator circuits. | | **[10]**  **[10]** | **CO2**  **CO1** |
| 10 | (a)(i) What are Encoders? Describe the decimal to BCD Encoder with clear functional block diagram, truth table and its implication with gates.  (ii) Write the difference between the combinational and sequential circuit? Describe full Subtractor with functional block diagram and truth table.  **OR**  (b)(i) What are De-Multiplexers ? Describe the 1:4 De-multiplexer with clear functional block diagram, truth table and its implication with gates.  (ii) What do you mean by Flip Flop? Discuss Clocked RS Flip Flop and draw its logical diagram & symbol. Explain its operation with the help of truth table. | | **[20]** | **CO4** |

**Sample format for Indirect Assessment of Course outcomes**

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| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes of Basic Electronics Engineering.

Use the scale 1-4\*

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| --- | --- | --- | --- | --- | --- |
| Sl. No. |  | 1 | 2 | 3 | 4 |
| CO1 | To define the transport phenomena in semiconductors and basics of transistors, operational amplifier & communication system. |  |  |  |  |
| CO2 | To compare different types of: breakdown mechanism in diodes, rectifiers, transistor configurations, and modulation mechanisms. |  |  |  |  |
| CO3 | To apply the knowledge of working of diode, transistor & op-amp in various electronics problems. |  |  |  |  |
| CO4 | To analyze the different types of diode, transistor & op-amp based circuits for determining the output waveform. |  |  |  |  |

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3

Below Average

Good

1

Very Good

Average

4

2

**Lecture wise Plan**

**UNIT 1: Introduction to Semiconductors**

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| --- | --- | --- |
| **Le No.** | **Topic** | **Elaborated** |
| L-1 | Introduction to semiconductors (Intrinsic & Extrinsic semiconductors) Energy level diagram | Introduction to semiconductors, Intrinsic and Extrinsic Semconductors. Differentiation of semiconductors based on type of doping, energy level diagram, |
| L-2 | Concept of fermi level, Transport Phenomena in semiconductors {Conductivity, temperature dependence of conductivity (Qualitative)} | Concept of fermi level, dependence of conductivity on temperature, |
| L-3 | Mobility, drift current, diffusion current | Concept and expression for mobility, drift current and diffusion current along with their expression. |
| L-4 | P-N Junction diode : Formation of depletion layer | PN junction diode and the formation of depletion layer |
| L-5 | Biasing and Working of Diode | Concept of Forward and Reverse Biasing and working of P-N junctionDiode |
| L-6 | Diode equation, diode characteristics | P-N junction diode equation and its characteristics |
| L-7 | Breakdown in a diode: Zener and Avalanche breakdown | Breakdown mechanism in a p-n junction diode, Zener and Avalanche breakdown along with difference between the two types of breakdown |

**UNIT -2: Diode Applications**

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| --- | --- | --- |
| L-8,9 | Zener diode and its application as a voltage stabilizer | Working and properties ofZener diode and its application as a voltage stabilizer |
| L-10 | Rectifiers: Half wave and Full wave rectifiers: Centre tap type | Working of Half wave and Full wave rectifiers: Centre tap type and expression for form factor, ripple factor and efficiency |
| L-11 | Bridge type, Expression for form factor, ripple factor and efficiency | Working of Bridge rectifier, Expression for form factor, ripple factor and efficiency |
| L-12 | Filters: capacitor filter, L and pi filters | Concept of filter circuits, Working of capacitor filter, L and pi filters |
| L-13 | Clipping (series) | Introduction to clipping, Some examples of series Clipping circuits |
| L-14 | Clipping (parallel) | Clipping (parallel) and some examples of parallel clipper circuits |
| L-15 | Clamping Circuits | Introduction to clamping, Rules to solve clamping circuits, example of clamping circuit |

**UNIT – 3: Fundamentals of Transistors**

|  |  |  |
| --- | --- | --- |
| L-16, 17 | Bipolar junction transistors (BJTs); C-B,C-E and C-C configuration, input and output characteristics | Introduction to Bipolar junction transistors (BJTs); Working of transistor in C-B,C-E and C-C configuration, input and output characteristics in each configuration |
| L-18 | Load line and operating point | Concept of Load line and operating point: Q point |
| L-19 | Field effect Transistors (FET) : comparison with BJT, | Introduction to Field effect Transistors (FET), Comparison of FET with BJT, |
| L-20,21 | Construction and characteristic of JFET and MOSFET (Depletion and Enhancement Type). | Construction and characteristics of JFET and MOSFET (Depletion and Enhancement Type). |

**Unit -4 Transistor Amplifiers**

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| --- | --- | --- |
| L-22,23 | Introduction of Amplifiers, Classification of Amplifier: based on Q point and load line, Class A, Class B , Class C and Class AB | Introduction of Amplifiers, Classification of Amplifier on the basis of Q point and load line as Class A, Class B , Class C and Class AB |
| L-24 | Concept of Feedback Amplifiers, comparison of positive and negative feedback, | Concept of Feedback Amplifiers, comparison of positive and negative feedback along with expressions |
| L-25 | Introduction to Operational Amplifiers, | Introduction to Operational Amplifiers, Concept of Virtual ground |
| L-26 | Operational Amplifiers parameters, | Operational Amplifiers parameters: Definitions of CMRR, PSRR, SLEW RATE,INPUT/OUTPUT OFFSET CURRENT/VOLTAGES |
| L-27,28 | Gain in Operational Amplifiers: Non-inverting and Inverting amplifier | Derivation of the expression for Gain in Operational Amplifiers: Non-inverting and Inverting amplifier |
| L-29 | Applications of Operational Amplifiers as Summer (inverting configuration only) | Applications of Operational Amplifiers as Summer ( Derivation for inverting configuration only), |
| L-30 | Integrator | Circuit of Op-amp as Integrator along with the derivation of the expressioncircuits |
| L-31 | Differentiator. | Circuit of Op-amp as Differentiator along with the derivation of the expressioncircuits. |

**Unit -5 Communication System**

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| L-32 | Basics of Communication system, | Basics of Communication system, |
| L-33 | Concept of Antenna and Bandwidth, | Concept of Antenna and Bandwidth, |
| L-34 | Techniques of Amplitude and Frequency modulation | Definitions of Amplitude and Frequency modulation along with the working Principle |
| L-35 | Comparison between AM and FM, | Comparison between Amplitude Modulation and Frequency Modulation, |
| L-36,37 | Radio Receivers : FM radio receiver and superhetrodyne receiver, | Concept of FM radio receiver and superhetrodyne receiver, |
| L-38 | Noise Classifications, Signal to Noise ratio, | Classification of Noises, Signal to Noise ratio, |
| L-39 | Applications of Modulation and Demodulation | Applications of Modulation and Demodulation in various field of life |