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**Physics department**

**College of Education**

**Salahaddin University-Erbil**

**Subject: Electronics**

**Course Book – (Third Year Student)**

**Lecturer's name: Twana Kak Anwer**

**Academic Year: 2023/2024 (1st and 2nd Semesters)**

Course Book

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| **1. Course name** | | Electronics | |
| **2. Lecturer in charge** | | Twana Mohammed Kak Anwer | |
| **3. Department/ College** | | **Physics, Education** | |
| **4. Contact** | | e-mails: [twana.anwar1@su.edu.krd](mailto:twana.anwar1@su.edu.krd) | |
| **5. Time (in hours) per week** | | Theory**: 3 Hours** | |
| **6. Office hours** | | **Sunday: Group A: From**  1.30 To 2.30  **Group B: From**  12.30 To 1.30  **Monday: Group A: From**  12.30 To 2.30  **Group B: From**  8.30 To 10.30 | |
| **7. Course code** | |  | |
| **8. Teacher's academic profile**: I was born in Erbil, Kurdistan Region-Iraq, in 1983. I received the B.Sc. degree (First Class) in Physics from Salahaddin University-Erbil, in 2005, the MSc. degree (First Class) in Laser Optics and from Salahaddin University-Erbil, in 2010, and completed the Ph.D. Course in Communications from the University of Salahaddin, College of Science, in 2016. My MSc. research Parametric Study of the Spherically Symmetric Cavity Laser Resonator, I became an assistant physicist with the physics department, where I worked in the Mechanics Lab, Electricity and Magnetism Lab, General Physics Lab, Advanced Electricity and Magnetism Lab, Electronic Lab, Nuclear Lab, Illustration Lab, Computer Skills Lab, Modern Physics Lab, Electricity and Magnetism, Properties of Matter, Advanced Electricity and Magnetism, Computer Skills, Laser Physics, Electronics, and General Mathematics. Shortly after I joined the physics department, I Started my master and then became the decider of the department. Now, I am a lecturer in physics department and have been teaching Electronics, and Properties of Matter in Education, and Electronics Lab in Education. | | | |
| **9. Keywords** | |  | |
| **10. Course overview:** This course will address the following topics: Charge, electric fields in continuous and non-continuous charge distributions, dielectrics, energy and combinations of capacitors, Semiconductors, N-type silicon, P-type silicon, Water Analogy of Diodes, Open-Circuit Voltage Gain, Voltage Gain, Current Gain, Power Gain, DC Input Power, Conservation of Power, Efficiency, Current Amplifier Model, Diodes (pn junctions; Ideal diodes; diodes with a turn-on voltage; circuits with ideal diodes; rectifiers; limiters; regulators), op amps, Rectification, Amplification, coupling Amplifiers, Oscillation, Transistors(BJT, JFET, and MOSFETS in amplifiers and in digital logic circuits), Bipolar junction transistor, Optoelectronics, Light-Emitting Diodes (LEDs), Photoresistors, Photodiode, Solar cell. | | | |
| **11. Course objective:**   * To help students acquire the knowledge about electronics needed for understanding electronic devices and tools which are embedded our surroundings. * To help students acquire practical experiences which will enable them to develop skills in the use of tools, materials and processes associated with the Electronics area. * To provide students with the fundamentals of the electronic devices and their application. * To provide students with the basic concepts and principles used in the electronic field. * To provide students with knowledge of theory and application of electronic devices and circuits. * To provide students with basic knowledge of electronic and electrical drawings. | | | |
| **12. Student's obligation:**   * Students should attend in class to take notes during explanation with the bringing of (at least) two different colour pens. * Other stationaries during tutorial and exam with a scientific calculator. * Do not knock the door also he/she should come to class quietly during lecture to avoid cut a lecture and disturbing other students. * Should listen carefully and respect other students i.e. do not make noise. * Assignments and report are very important to be pass easy in this course. * Students can ask at any time in the class by rising their hand or can write a note then ask. | | | |
| **13. Forms of teaching:**  Different forms of the teaching will be used to reach the objectives of the course: Power point presentations for the head titles and definitions and summery of conclusions, to make the students more understandable also I will use whiteboard to solving the problems and deriving equations, besides worksheet will be designed to let the chance for participating on several aspects of the subject in the classroom. There will be classroom discussion and the lecturer will give problem homework to be solved, and different issues discussed throughout the academic year.  To get the best of the topic, it is suggested that you attend classes as much as possible, read the required lectures, teacher’s notes regularly as all of them are foundations for the material. Try as much as possible to participate in classroom discussions, preparing the assignments given the course. | | | |
| **14. Assessment scheme:**  Attaining the **requirements** set to succeed in this study subject requires developing a **mathematical** sense, related to this topic, based on emergent analytical and problem-solving skills and memorizing topics cannot secure success.    In this system the **maximum** mark is **(75%)**. The grading system is based on the summation of two categories of **evaluations**:  **First**, **(25%)** of the **mark** is based on the **academic** year effort of the student which includes:   * **20%** for **two** semester examinations, (**10% X 2)** = **20%**, for each semester **10%**. * **3%** for quizzes. * **2%** for solving home works (Question Mark).   **Second**, **(45%)** of the **mark** is based on **final** examination that is comprehensive for the whole of the study material **reviewed** during the academic **year** and it usually occurs during the month of **June**‌    At the **end** of the **evaluation** process, if the students could not **secure** a minimum of **(50%),** they are given a **chance** to **repeat** the **final** exam in **June** and they should be able by then to **equal** or **exceed** the **(50%)** limit otherwise they will have to **repeat** this **subject** during the **next** academic year if it did not **contradict** with the **administrative** regulations. | | | |
| **15. Student learning outcome:** The due dates for submitting the homework assignments are one week from the date of assignment. No late submission will be accepted.  Your problem solutions must include the detailed steps (not just the final answer):  (**a**) A diagram, where appropriate,  (**b**) Symbolic identification of the given and unknown quantities,  (**c**) Identification of the definition, concept, or law used to solve the problem,  (**d**) Algebraic solution of the problem.  Important - correct final answer without the required steps will not be awarded full marks.  Your work must be neat and well organized.  Some organizational tips:  - Write your name in capital letters, so that you will be credited for your    homework  - If you use lined paper, use alternate lines. Otherwise, the work is too    cramped and difficult to read.  - Write on one side of the paper only.  - Start each problem on a new sheet of paper. This allows you to easily    amend your work and to not get stuck with the need to squeeze lots of    material into a small space. Allow for margins at the top, bottom and    sides of the page.  - Number your pages and staple your work together prior to submission.  Working in groups is a valuable way to learn physics, but the work you submit for grading must be your own. | | | |
| **16. Course Reading List and References‌:**  Required book:   * Thomas L. Floyd, Electronic devices, 9th edition, 2012. * Principles of Electronics, V. K. Mehta & Rohit Mehta, Publisher: S. Chand & Co Ltd, Year: 2008, Edition: 11th. * Basic Electronics: Theory and Practice, S. Westcott & J. Riescher Westcott, Publisher: David Pallai, Mercury Learning and Information, Year: 2015. | | | |
| **17. The Topics:** | Twana Kak Anwer | | |
| **Chapter One: Basic Atomic Structure**  **2 Weeks** | 1.1: The Atom  1.2: The Bohr Model  1.3: Atomic Number  1.4: Atomic Mass Number  1.5: Compounds  1.6: Ions  1.7: Atomic and Electron Theories  1.8: Atomic Particles   |  | | --- | | 1.9: Orbital Shells  1.10: Energy Levels  1.11: The Maximum Number of Electrons in Each Shell  1.12: The Valence Shell  1.13: Electron Configuration Table  1.14: Stable and Unstable Atoms  1.15: Energy Band Theory  1.16: Energy Band Diagrams | | | |
| **Chapter Two: Semiconductors**  **3 Weeks** | 2.1: Introduction to Semiconductor  2.2: Pure or Intrinsic Semiconductors  2.3: Impurity or Extrinsic Semiconductors  2.3.1: Donor or n-Type Semiconductor  2.3.2: Acceptor or p-Type Semiconductor  2.4: Drift Velocity, Mobility and Conductivity of Intrinsic Semiconductors  2.4.1: Drift Velocity  2.4.2: Charge Density ()  2.4.3: Current Density ()  2.4.4: Conductivity ()  2.4.5: Conductivity of a Semiconductor ()  2.4.6: Resistance ()  2.4.7: Variation of Conductivity with Temperature  2.5: Carrier Concentration and Fermi Level for Intrinsic Semiconductor  2.5.1: Electron Concentration in The Conduction Band  2.5.2: Hole Concentration in The Valence Band  2.5.3: Fermi Level  2.5.4: Law of Mass Action and Intrinsic Carrier Concentration  2.6: Carrier Concentration, Fermi Level and Conductivity for Extrinsic Semiconductor  2.6.1: N-Type Semiconductor  2.6.2: P-Type Semiconductor  2.6.3: Mixed Semiconductor | | |
| **Chapter Three: P-N Junction**  **3 Weeks** | 3.1: Introduction  3.2: The Diode  3.3: Formation of the Depletion Region  3.4: Barrier Potential  3.5: Energy Diagrams of the PN Junction and Depletion Region  3.6: Diffusion and Drift of Carriers: Einstein Relation  3.7: Biasing a Diode  3.7.1: Forward Bias  3.7.1.1: The Effect of Forward Bias on the Depletion Region  3.7.1.2: The Effect of the Barrier Potential During Forward Bias  3.7.2: Reverse Bias  3.7.2.1: Reverse Current  3.7.2.2: Reverse Breakdown  3.8: Voltage-Current Characteristic of a Diode  3.8.1: V-I Characteristic for Forward Bias  3.8.2: V-I Characteristic for Reverse Bias  3.9: DC and AC Resistance of junction | | |
| **Chapter Four: Diode Application**  **3 Weeks** | 4.1: Introduction (Overview)  4.2: Rectifier  4.2.1: Half Wave Rectifier  Peak Inverse Voltage (PIV):  4.2.2: Full Wave Rectifier  4.2.2.1: The Center-Tapped Full Wave Rectifiers  The Center-Tapped Full Wave Rectifiers Calculation:  Peak Inverse Voltage (PIV):  4.2.2.2: Full Wave Bridge Rectifier  4.3: Filter Circuits  4.3.1: Capacitor Filter Circuits  4.3.2: Inductor Filter Circuits  4.3.3: LC Filter (LC-Section) Circuits  4.3.4: CLC Or Pie Filter Circuits  4.4: Ripple Factor  4.4.1: Ripple Factor of the Half-Wave Rectifier  4.4.2: Ripple Factor of the Full-Wave Rectifier  4.4.3: Ripple Voltage  4.4.4: Ripple Factor with Capacitor Filter  4.4.5: Ripple Factor with Inductor Filter  4.4.6: Ripple Factor with LC Filter  4.4.7: Ripple Factor with Pie Filter  4.5: Regulation  4.5.1: Regulation of the Half-Wave Rectifier  4.5.2: Regulation of the Full-Wave Rectifier  4.6: Diode Limiters (Clipper)  4.7: Biased Limiters  4.8: Diode Clampers (DC Restorers)  Clamper Application:  4.9: Voltage Multipliers  4.9.1: Voltage Doubler  Half-Wave Voltage Doubler:  Full-Wave Voltage Doubler:  4.9.2: Voltage Tripler  4.9.2: Voltage Quadrupler  9.10: Testing a Diode | | |
| **Chapter Five: Special Purpose Diodes**  **3 Weeks** | 5.1: The Zener Diode  5.1.1: Zener Breakdown  5.1.2: Zener Regulation  5.1.3: Zener Equivalent Circuit  5.1.4: Temperature Coefficient ()  5.1.5: Zener Power Dissipation and Derating  5.1.6: Zener Diode Applications  5.2: The Varactor Diode  5.2.1: Varactor Basic Operation  5.2.2: Varactor Diode Applications  Resonant Band-Pass Filter w/ Varactor Diode:  5.3: Optical Diodes  5.3.1: The Light-Emitting Diode (LED)  Typical LEDs:  LED Diode Applications:  Traffic Lights:  5.3.2: Photodiodes  Photodiode Fundamentals:  Spectral Sensitivity:  Photodiode Applications:  5.4: Current Regulator Diode  5.5: The Schottky Diode  5.6: The PIN Diode  5.7: The Tunnel Diode  An application:  5.8: The Laser Diode  An application:  Summary: | | |
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| **Chapter Six: Bipolar Junction Transistor**  **4 Weeks** | 6.1: Introduction  6.2: Transistor Structure  6.3: Basic Transistor Operation  6.3.1: Biasing  6.3.2: Operation  6.3.3: Transistor Currents  6.4: Transistor Characteristics and Parameters  DC Beta () and DC Alpha ():  6.5: Current and Voltage Analysis  6.6: Transistor Configuration and Characteristics  6.6.1: Common Base Static Characteristics  Input or Emitter Characteristics Curve:  Input Resistance:  Output Characteristic Curve:  Output Resistance:  Current Amplification factor ():  Total Collector Current ():  6.6.2: Common Emitter Static Characteristics  Input Characteristics Curve:  Input Resistance:  Output Characteristics Curve:  Output Resistance:  Base Current Amplification Factor (β):  Total Collector Current ():  6.6.3: Common Collector Static Characteristics  Input Characteristics Curve:  Output Characteristics Curve:  Current Amplifier Factor ():  6.7: Collector Characteristic Curves  6.8: Cut off  6.9: Saturation  6.10: DC Load Line  6.11: Maximum Transistor Ratings  6.12: Transistor as Two-Port Network  Application:  6.12.1: Open Circuit Impedance Parameters (z-Parameters)  6.12.2: Short Circuit Admittance Parameters (y-Parameters)  6.12.3: Hybrid Parameters (h-Parameters)  6.12.4: Inverse Hybrid Parameters (-Parameters)  6.12.5: ABCD-Parameters  6.12.6: Scattering Parameters (-Parameters)  6.12.7: Scattering transfer Parameters (-Parameters)  6.13: Determination of h-Parameters  SUMMARY:  KEY TERMS: | | |
| **Chapter Seven:**  **Transistor Biasing**  **2 Weeks** | 7.1: Introduction  7.2: Base Bias (Fixed Bias)  7.3: Collector-Feedback Bias  7.4: Emitter–Feedback Bias  7.5: Voltage-Divider Bias  Voltage Divider with Load:  Loading Effects of Voltage-Divider Bias:  7.6: Thevenin’s Theorem Applied to Voltage-Divider Bias  7.6.1: Voltage-Divider Biased NPN Transistor  7.6.2: Voltage-Divider Biased PNP Transistor  SUMMARY:  KEY TERMS: | | |
| **Chapter Eight:**  **Field Effect Transistor (FET)**  **3 Weeks** | |  | | --- | | 8.1: Introduction  8.2: The JFET  8.2.1: JFET Symbols  8.2.2: Basic Structure  8.2.3: Basic Operation  8.3: JEFT Characteristics and Parameters  8.3.1: Drain Characteristic Curve  8.3.2: Pinch-Off Voltage ()  8.3.3: Breakdown  8.3.4: Controls  8.3.5: Cutoff Voltage ()  8.3.6: Comparison of Pinch-Off Voltage and Cutoff Voltage  8.3.7: JFET Transfer Characteristic  8.3.8: JFET Forward Transconductance ()  8.3.9: Input Resistance and Capacitance  8.3.10: AC Drain-to-Source Resistance  SECTION 8.3 REVIEW:  8.4: JFET Biasing  8.4.1: Self-Bias  Setting the of a Self-Biased JFET:  8.4.2: Voltage-Divider Bias  SECTION 8-3 REVIEW:  8.5: THE MOSFET  8.5.1: Depletion MOSFET (D-MOSFET)  Depletion Mode:  Enhancement Mode:  D-MOSFET Symbols:  8.5.2: Enhancement MOSFET (E-MOSFET)  E-MOSFET Symbols:  8.6: MOSFET Characteristics and Parameters  8.6.1: D-MOSFET Transfer Characteristic  8.6.2: E-MOSFET Transfer Characteristic  8.7: MOSFET Biasing  8.7.1: D-MOSFET Bias  8.7.2: E-MOSFET Bias  KEY TERMS: | | | |
| **Chapter Nine:**  **Power Amplifiers**  **3 Weeks** | 9.1: Introduction  9.2: Class A Power Amplifier  9.2.1: Operation of Class A amplifiers  9.2.2: Heat Dissipation  9.2.3: Centered  9.2.4: Power Gain  9.2.5: DC Quiescent Power  9.2.6: Output Signal Power  9.2.7: Efficiency  9.3: Class B and Class AB Push-Pill Power Amplifiers  9.3.1: Class B Operation  The is at Cutoff:  9.3.2: Class B Push-Pull Operation  9.3.3: Biasing the Push-Pull Amplifier for Class AB Operation  AC Operation:  9.3.4: Single-Supply Push-Pull Amplifier  9.3.5: Class B/AB Power  Maximum Output Power:  DC Input Power:  Efficiency:  Input Resistance:  9.4: Class C Amplifiers  9.4.1: Basic Class C Operation  9.4.2: Power Dissipation  9.4.3: Tuned Operation  9.4.4: Maximum Output Power  9.4.5: Clamper Bias for a Class C Amplifier  KEY TERMS:  SUMMARY: | | |
| **18. Practical Topics (If there is any)** | | |  |
| Introduction of Electronics lab  Silicon diode, Plotting Characteristics Curves  Zener diode, Plotting Characteristic Curves  Half-wave Rectification and Filtering  Centre-point connection for full-wave Rectification  Bridge circuit for Full-wave Rectification and Filtering  Voltage Doubler  Clipping Circuits  Clamping Circuits  Characteristic curves of Transistor using Point-by-Point Method  Common emitter amplifier  Common base amplifier  Common Collector Amplifier  Two-stage amplification using RC connection | | | |
| **19. Examinations:** Different types of questions will be provided to the student as an exercise and also in examinations such as given them in the question banks which contain each of the following ones:   1. Mathematical **derivation** and **explanation** questions for different subjects in calculus are provided. 2. Mathematical **calculation questions** for different algebraic and analytical calculus subjects also given to them. 3. **Multiple** **choices** questions for every subject that are given in calculus topics are also provided to them. 4. Finally, the **true** and **false** questions are also given to them for several mathematical subjects.   Each of these mentioned question types will be seen clearly in the question banks that are given to the quality assurance committee of our physics department. | | | |
| **20. Extra notes:**  Due to a number of **unforeseen** reasons that may lead to the **shifting** of the academic year **program**, it may be subjected to **modifications**. Also, extra **curriculum** hours may be **needed** to cover all the **topics** mentioned above. The students shall be **notified** of the **changes** if and when they may **occur**. | | | |
| **21. Peer review** | | | |