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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 |
| **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.
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| **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.
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| **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.
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| **17. The Topics:** | Twana Kak Anwer |
| **Chapter One: Basic Atomic Structure****2 Weeks**  | 1.1: The Atom1.2: The Bohr Model1.3: Atomic Number1.4: Atomic Mass Number1.5: Compounds 1.6: Ions1.7: Atomic and Electron Theories1.8: Atomic Particles

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| 1.9: Orbital Shells1.10: Energy Levels1.11: The Maximum Number of Electrons in Each Shell1.12: The Valence Shell1.13: Electron Configuration Table1.14: Stable and Unstable Atoms1.15: Energy Band Theory1.16: Energy Band Diagrams |

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| **Chapter Two: Semiconductors****3 Weeks**  | 2.1: Introduction to Semiconductor2.2: 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 Semiconductor2.4: Drift Velocity, Mobility and Conductivity of Intrinsic Semiconductors 2.4.1: Drift Velocity2.4.2: Charge Density ($ρ$) 2.4.3: Current Density ($\rightharpoonaccent{J}$)2.4.4: Conductivity ($σ$)2.4.5: Conductivity of a Semiconductor ($σ$)2.4.6: Resistance ($R$)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 Level2.5.4: Law of Mass Action and Intrinsic Carrier Concentration 2.6: Carrier Concentration, Fermi Level and Conductivity for Extrinsic Semiconductor 2.6.1: N-Type Semiconductor2.6.2: P-Type Semiconductor2.6.3: Mixed Semiconductor |
| **Chapter Three: P-N Junction** **3 Weeks**  | 3.1: Introduction3.2: The Diode3.3: Formation of the Depletion Region3.4: Barrier Potential3.5: Energy Diagrams of the PN Junction and Depletion Region3.6: Diffusion and Drift of Carriers: Einstein Relation3.7: Biasing a Diode3.7.1: Forward Bias3.7.1.1: 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 Bias3.7.2.1: Reverse Current3.7.2.2: Reverse Breakdown3.8: Voltage-Current Characteristic of a Diode3.8.1: V-I Characteristic for Forward Bias3.8.2: V-I Characteristic for Reverse Bias3.9: DC and AC Resistance of $p-n$ junction |
| **Chapter Four: Diode Application****3 Weeks**  | 4.1: Introduction (Overview)4.2: Rectifier4.2.1: Half Wave RectifierPeak Inverse Voltage (PIV):4.2.2: Full Wave Rectifier4.2.2.1: The Center-Tapped Full Wave RectifiersThe Center-Tapped Full Wave Rectifiers Calculation:Peak Inverse Voltage (PIV):4.2.2.2: Full Wave Bridge Rectifier4.3: Filter Circuits4.3.1: Capacitor Filter Circuits4.3.2: Inductor Filter Circuits4.3.3: LC Filter (LC-Section) Circuits 4.3.4: CLC Or Pie Filter Circuits4.4: Ripple Factor4.4.1: Ripple Factor of the Half-Wave Rectifier4.4.2: Ripple Factor of the Full-Wave Rectifier4.4.3: Ripple Voltage4.4.4: Ripple Factor with Capacitor Filter4.4.5: Ripple Factor with Inductor Filter4.4.6: Ripple Factor with LC Filter4.4.7: Ripple Factor with Pie Filter4.5: Regulation 4.5.1: Regulation of the Half-Wave Rectifier 4.5.2: Regulation of the Full-Wave Rectifier4.6: Diode Limiters (Clipper)4.7: Biased Limiters4.8: Diode Clampers (DC Restorers)Clamper Application: 4.9: Voltage Multipliers4.9.1: Voltage DoublerHalf-Wave Voltage Doubler: Full-Wave Voltage Doubler: 4.9.2: Voltage Tripler4.9.2: Voltage Quadrupler9.10: Testing a Diode |
| **Chapter Five: Special Purpose Diodes** **3 Weeks**  | 5.1: The Zener Diode5.1.1: Zener Breakdown 5.1.2: Zener Regulation5.1.3: Zener Equivalent Circuit 5.1.4: Temperature Coefficient ($TC$)5.1.5: Zener Power Dissipation and Derating5.1.6: Zener Diode Applications5.2: The Varactor Diode5.2.1: Varactor Basic Operation5.2.2: Varactor Diode ApplicationsResonant Band-Pass Filter w/ Varactor Diode:5.3: Optical Diodes5.3.1: The Light-Emitting Diode (LED)Typical LEDs:LED Diode Applications:Traffic Lights:5.3.2: PhotodiodesPhotodiode Fundamentals:Spectral Sensitivity:Photodiode Applications:5.4: Current Regulator Diode5.5: The Schottky Diode5.6: The PIN Diode5.7: The Tunnel DiodeAn application:5.8: The Laser DiodeAn application:Summary: |
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| **Chapter Six: Bipolar Junction Transistor** **4 Weeks**  | 6.1: Introduction6.2: Transistor Structure6.3: Basic Transistor Operation 6.3.1: Biasing6.3.2: Operation6.3.3: Transistor Currents 6.4: Transistor Characteristics and Parameters DC Beta ($β\_{DC}$) and DC Alpha ($α\_{DC}$):6.5: Current and Voltage Analysis 6.6: Transistor Configuration and Characteristics6.6.1: Common Base Static Characteristics Input or Emitter Characteristics Curve: Input Resistance: Output Characteristic Curve: Output Resistance:Current Amplification factor ($α$):Total Collector Current ($I\_{C}$):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 ($I\_{C}$):6.6.3: Common Collector Static Characteristics Input Characteristics Curve: Output Characteristics Curve: Current Amplifier Factor ($γ$):6.7: Collector Characteristic Curves6.8: Cut off6.9: Saturation6.10: DC Load Line 6.11: Maximum Transistor Ratings 6.12: Transistor as Two-Port NetworkApplication: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 ($g$-Parameters)6.12.5: ABCD-Parameters6.12.6: Scattering Parameters ($S$-Parameters)6.12.7: Scattering transfer Parameters ($T$-Parameters)6.13: Determination of h-ParametersSUMMARY: KEY TERMS: |
| **Chapter Seven:** **Transistor Biasing****2 Weeks**  | 7.1: Introduction7.2: Base Bias (Fixed Bias)7.3: Collector-Feedback Bias 7.4: Emitter–Feedback Bias 7.5: Voltage-Divider BiasVoltage Divider with Load: Loading Effects of Voltage-Divider Bias:7.6: Thevenin’s Theorem Applied to Voltage-Divider Bias7.6.1: Voltage-Divider Biased NPN Transistor7.6.2: Voltage-Divider Biased PNP TransistorSUMMARY: KEY TERMS: |
| **Chapter Eight:** **Field Effect Transistor (FET)****3 Weeks** |

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| 8.1: Introduction8.2: The JFET8.2.1: JFET Symbols8.2.2: Basic Structure8.2.3: Basic Operation8.3: JEFT Characteristics and Parameters8.3.1: Drain Characteristic Curve8.3.2: Pinch-Off Voltage ($V\_{P}$)8.3.3: Breakdown8.3.4: $V\_{GS}$ Controls $I\_{D}$8.3.5: Cutoff Voltage ($V\_{GS (off)}$)8.3.6: Comparison of Pinch-Off Voltage and Cutoff Voltage8.3.7: JFET Transfer Characteristic8.3.8: JFET Forward Transconductance ($g\_{m}$)8.3.9: Input Resistance and Capacitance8.3.10: AC Drain-to-Source ResistanceSECTION 8.3 REVIEW: 8.4: JFET Biasing8.4.1: Self-Bias Setting the $Q-Point$ of a Self-Biased JFET:8.4.2: Voltage-Divider BiasSECTION 8-3 REVIEW:8.5: THE MOSFET8.5.1: 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 Parameters8.6.1: D-MOSFET Transfer Characteristic8.6.2: E-MOSFET Transfer Characteristic8.7: MOSFET Biasing8.7.1: D-MOSFET Bias8.7.2: E-MOSFET BiasKEY TERMS: |

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| **Chapter Nine:** **Power Amplifiers****3 Weeks**  | 9.1: Introduction9.2: Class A Power Amplifier 9.2.1: Operation of Class A amplifiers9.2.2: Heat Dissipation9.2.3: Centered $Q-Point$9.2.4: Power Gain9.2.5: DC Quiescent Power9.2.6: Output Signal Power9.2.7: Efficiency9.3: Class B and Class AB Push-Pill Power Amplifiers 9.3.1: Class B Operation The $Q-Point$ is at Cutoff:9.3.2: Class B Push-Pull Operation9.3.3: Biasing the Push-Pull Amplifier for Class AB OperationAC Operation: 9.3.4: Single-Supply Push-Pull Amplifier9.3.5: Class B/AB PowerMaximum Output Power:DC Input Power:Efficiency:Input Resistance:9.4: Class C Amplifiers 9.4.1: Basic Class C Operation9.4.2: Power Dissipation9.4.3: Tuned Operation9.4.4: Maximum Output Power9.4.5: Clamper Bias for a Class C AmplifierKEY TERMS:SUMMARY: |
| **18. Practical Topics (If there is any)** |  |
| Introduction of Electronics labSilicon diode, Plotting Characteristics CurvesZener diode, Plotting Characteristic CurvesHalf-wave Rectification and FilteringCentre-point connection for full-wave RectificationBridge circuit for Full-wave Rectification and FilteringVoltage DoublerClipping CircuitsClamping CircuitsCharacteristic curves of Transistor using Point-by-Point MethodCommon emitter amplifierCommon base amplifierCommon Collector AmplifierTwo-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**  |