



Ministry of Higher Education and  
Scientific Research - Iraq  
University of Baghdad  
College of Engineering  
Department of Computer Engineering



## MODULE DESCRIPTOR FORM

### نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	SEMICONDUCTOR PHYSICS		Module Delivery
Module Type	SUPPORT		Class Lecture + Lab
Module Code	COE 110		
ECTS Credits	6		
SWL (hr/sem)	150		
Module Level	1	Semester of Delivery	
Administering Department	Computer Engineering	College	Engineering
Module Leader	Hussien Joma Abbas	e-mail	hussain.joma@alnaji-uni.edu.iq
Module Leader's Acad. Title	Professor	Module Leader's Qualification	Ph.D.
Module Tutor		e-mail	
Peer Reviewer Name		e-mail	
Review Committee Approval		Version Number	1.0

Relation With Other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	Semester	
Co-requisites module	None	Semester	

## Module Aims, Learning Outcomes and Indicative Contents

### أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

<p><b>Module Aims</b> أهداف المادة الدراسية</p>	<p>The aim of this module is to provide students with a comprehensive understanding of the fundamental principles and practical applications of semiconductor physics and electronic devices. This includes an in-depth study of the physics of semiconductors, diode and transistor characteristics, and their various applications in electronic circuits. The course combines theoretical knowledge with hands-on laboratory experiments to equip students with the skills necessary to analyze and design electronic circuits.</p>
<p><b>Module Learning Outcomes</b> مخرجات التعلم للمادة الدراسية</p>	<p>By the end of this module, students will be able to:</p> <ol style="list-style-type: none"><li><b>1. Understand the Physics of Semiconductors</b><ul style="list-style-type: none"><li>○ Explain the atomic structure and electronic states of semiconductors.</li><li>○ Describe the formation and characteristics of PN junctions.</li></ul></li><li><b>2. Analyze Diode Characteristics and Operations</b><ul style="list-style-type: none"><li>○ Understand the forward and reverse biased conditions of PN junctions.</li><li>○ Interpret the VI characteristics of semiconductor diodes, including Zener diodes.</li><li>○ Assess the impact of temperature and other factors on diode performance.</li></ul></li><li><b>3. Apply Diode Functions in Circuits</b><ul style="list-style-type: none"><li>○ Perform load-line analysis for diodes in series and parallel configurations.</li><li>○ Design and analyze rectifier circuits (half-wave and full-wave).</li><li>○ Understand the application of diodes in clippers and clampers.</li></ul></li><li><b>4. Understand Bipolar Junction Transistors (BJTs)</b><ul style="list-style-type: none"><li>○ Explain the construction and operation of BJTs.</li><li>○ Understand the different states of BJT operation and their significance.</li><li>○ Analyze DC biasing techniques and load line analysis for BJTs.</li></ul></li><li><b>5. Use BJTs as Switches and Amplifiers</b><ul style="list-style-type: none"><li>○ Design circuits using BJTs as switches.</li><li>○ Analyze the operation of BJTs as amplifiers and understand their role in amplification.</li></ul></li><li><b>6. Develop Problem-Solving Skills in Electronic Circuit Design</b><ul style="list-style-type: none"><li>○ Apply theoretical knowledge to solve practical problems in electronic circuit design.</li><li>○ Use analytical and simulation tools to design and test semiconductor-based circuits.</li></ul></li></ol> <p>This module equips students with both the theoretical background and practical skills necessary for understanding and applying semiconductor devices in computer engineering.</p>

## Indicative Contents

المحتويات الإرشادية

### Week 1: Physics of Semiconductors

- **Topics:** Atomic Structure, Electronic State.

### Week 2: PN Junction

- **Topics:** Formation of Depletion Layer, Junction Potential, Forward Biased PN Junction.

### Week 3: PN Junction Characteristics

- **Topics:** Forward Biased VI Characteristics, Reverse Biased PN Junction, Reverse Biased VI Characteristics.

### Week 4: Semiconductor Diodes

- **Topics:** Diode Operating Conditions, Actual Diode Characteristics, Zener Region.

### Week 5: Semiconductor Diodes

- **Topics:** Forward Bias Voltage, Temperature Effects, Diode Specification, and Max Ratings.

### Week 6: Diode Applications

- **Topics:** Load-Line Analysis, Series Diode Configurations, Parallel Configurations.

### Week 7: Diode Applications

- **Topics:** Half-Wave Rectification, Full-Wave Rectification, Peak Reverse Voltage.

### Week 8: Diode Applications

- **Topics:** Diode Clippers, Biased Clippers, Parallel Clippers.

### Week 9: Diode Applications

- **Topics:** Clampers, Biased Clamper Circuits.

### Week 10: Diode Applications

- **Topics:** Zener Diodes.

### Week 11: Bipolar Junction Transistor (BJT)

	<ul style="list-style-type: none"> <li>• <b>Topics:</b> Construction and Operation.</li> </ul> <p><b>Week 12: Bipolar Junction Transistor (BJT)</b></p> <ul style="list-style-type: none"> <li>• <b>Topics:</b> Construction and Operation (continued).</li> </ul> <p><b>Week 13: DC Biasing of BJTs</b></p> <ul style="list-style-type: none"> <li>• <b>Topics:</b> Biasing and the Three States of Operation.</li> </ul> <p><b>Week 14: DC Biasing of BJTs</b></p> <ul style="list-style-type: none"> <li>• <b>Topics:</b> Transistor Saturation Level, Load Line Analysis.</li> </ul> <p><b>Week 15: BJT Applications</b></p> <ul style="list-style-type: none"> <li>• <b>Topics:</b> The BJT as a Switch and Amplifier.</li> </ul> <p><b>Laboratory Experiments</b></p> <ol style="list-style-type: none"> <li>1. <b>EXP 1: Diode Rectifier and Smoothing Filters</b> <ul style="list-style-type: none"> <li>○ Design and analyze rectifier circuits and smoothing filters.</li> </ul> </li> <li>2. <b>EXP 2: Non-linear Wave Shaping: Clipper and Clamper Circuits</b> <ul style="list-style-type: none"> <li>○ Implement and analyze clipper and clamper circuits.</li> </ul> </li> <li>3. <b>EXP 3: Zener Diode</b> <ul style="list-style-type: none"> <li>○ Explore the characteristics and applications of Zener diodes.</li> </ul> </li> <li>4. <b>EXP 4: BJT Characteristics and Parameters</b> <ul style="list-style-type: none"> <li>○ Analyze the characteristics and parameters of BJTs.</li> </ul> </li> <li>5. <b>EXP 5: Transistor as a Switch</b> <ul style="list-style-type: none"> <li>○ Implement and analyze transistors in switching applications.</li> </ul> </li> </ol> <p>This structure ensures that students receive a balanced education with both theoretical knowledge and practical skills, preparing them for advanced studies or professional work in electronic engineering and related fields.</p>
<p><b>Learning and Teaching Strategies</b> استراتيجيات التعلم والتعليم</p>	
<p><b>Strategies</b></p>	<ul style="list-style-type: none"> <li>- Lectures.</li> <li>- Homework and Assignments.</li> <li>- Tests and Exams.</li> <li>- In-Class Questions and Discussions.</li> <li>- Extracurricular Activities.</li> <li>- Individual / Group Projects</li> <li>- In- and Out-Class oral conversations.</li> </ul>

## Student Workload (SWL)

### الحمل الدراسي للطالب

<b>Structured SWL (h/sem)</b> الحمل الدراسي المنتظم للطالب خلال الفصل	79	<b>Structured SWL (h/w)</b> الحمل الدراسي المنتظم للطالب أسبوعياً	5.267
<b>Unstructured SWL (h/sem)</b> الحمل الدراسي غير المنتظم للطالب خلال الفصل	71	<b>Unstructured SWL (h/w)</b> الحمل الدراسي غير المنتظم للطالب أسبوعياً	4.733
<b>Total SWL (h/sem)</b> الحمل الدراسي الكلي للطالب خلال الفصل	150		

## Module Evaluation

### تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
<b>Formative assessment</b>	<b>Quizzes</b>	3	10% (10)	3, 7, 11	LO #1-4
	<b>Assignments</b>	2	5% (5)	3, 9	LO # 1,2,3
	<b>Lab.</b>	6	20% (20)	1 -15	LO # 1-6
<b>Summative assessment</b>	<b>Project</b>	1	5% (5)	12	LO #1-4
	<b>Mid Exam</b>	1	10% (10)	15	LO # 3,4,5
	<b>Final Exam</b>	3 hr	50% (50)	16	LO # 1-6
<b>Total assessment</b>			100% (100 Marks)		

## Delivery Plan (Weekly Syllabus)

### المنهاج الاسبوعي النظري

Material Covered	
<b>Week 1</b>	Physics of Semiconductors: Atomic Structure, Electronic State
<b>Week 2</b>	PN Junction: Formation of Depletion layer, Junction Potential, Forward Biased PN junction
<b>Week 3</b>	PN Junction: Forward Biased VI Characteristics, Reverse biased PN junction, Reverse biased VI Characteristics
<b>Week 4</b>	Semiconductor Diodes: Diode Operating Conditions, Actual Diode Characteristics, Zener Region
<b>Week 5</b>	Semiconductor Diodes: Forward Bias Voltage, Temperature Effects, Diode Specification and Max Ratings
<b>Week 6</b>	Diode Applications: Load-Line Analysis, Series Diode Configurations, Parallel Configurations

<b>Week 7</b>	Diode Applications: Half-Wave Rectification, Full-Wave Rectification, Peak reverse voltage
<b>Week 8</b>	Diode Applications: Diode Clippers, Biased Clippers, Parallel Clippers
<b>Week 9</b>	Diode Applications: Clampers, Biased Clamper Circuits
<b>Week 10</b>	Diode Applications: Zener Diodes
<b>Week 11</b>	Bipolar Junction Transistor (BJT) Construction and Operation
<b>Week 12</b>	Bipolar Junction Transistor (BJT) Construction and Operation
<b>Week 13</b>	DC Biasing of BJTs: Biasing and the Three States of Operation
<b>Week 14</b>	DC Biasing of BJTs: Transistor Saturation Level, Load Line Analysis
<b>Week 15</b>	The BJT as a Switch and Amplifier
<b>Week 16</b>	<b>Final Exam</b>

### Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	<b>Material Covered</b>
<b>Week 1, 2, 3</b>	EXP 1: Diode Rectifier and Smoothing Filters
<b>Week 4, 5, 6, 7</b>	EXP 2: Non-linear Wave Shaping: Clipper and Clamper circuits
<b>Week 8, 9</b>	EXP 3: Zener Diode
<b>Week 10,11 ,12</b>	EXP 5: BJT characteristics and parameters
<b>Week 13, 14</b>	EXP 6: Transistor as a Switch

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, 10th Edition, 2009.	Yes
Recommended Texts	<ul style="list-style-type: none"> <li>• Microelectronic Circuits, Sedra, Smith, Fourth edition or Fifth edition, Oxford University Press, 1998-2003.</li> <li>• Semiconductor Physics and Devices, Donald A. Neamen, 3rd edition, 2003</li> <li>• Electronics a Systems Approach, Neil Storey, Pearson.</li> <li>• The Art of Electronics, Paul Horowitz and Winfield Hill, Cambridge University Press</li> </ul>	Yes
Websites	Multisim Live ( <a href="http://www.multisim.com/live/">www.multisim.com/live/</a> )	

#### APPENDIX:

GRADING SCHEME مخطط الدرجات				
Group	Grade	التقدير	Marks (%)	Definition
Success Group (50 - 100)	A – Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
Note:				
<p>NB Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.</p>				

