Kingdom of Saudi Arabia Ministry of Higher Education **Qassim University** College of Engineering	Qassim University جامعة القصيم	**المملكة العربية السعودية** وزارة التعليم العالي **جامعة القصيم** **كليه الهندسه**

Advanced Experimental Methods in Electronics

College:	**College of Engineering**
Department:	**Electrical Engineering Dept.**

First: Course Definition

1- Course Code: 616

2- Units	**3**
3 – Semester	**First semester of MSC program**
4 -Prerequisite	**-----**
5- Co-requisite	**-----**

6- Location (if not on main Campus):

Second: Course Objectives

- The purpose of this course is to provide incoming post graduate students with the required knowledge of equipment and techniques to help them succeed in their experimental research work.
- In the first part they will learn how to make electronic devices by advance fabrication technique which will be followed by the theoretical teaching of the experimental techniques to characterize these devices based on their electrical and magnetic properties.
- In the next module they will learn how to use sophisticated scanning probe characterization techniques to investigate the local properties of new area micro and nano devices.
- Emphasis will also be placed on the correct approach to take handle the data acquired in their research work and to put them in presentable format, to make them distinguished researchers.

Third: Course Specifications

1- Topics to be covered

Subject	No of Weeks	Units
1. **Device Fabrication:** Introduction, Fabrication Process (Patterning, Etching and deposition), Fabrication process Examples (Schotkey diode fabrication, SOI Hall Effect sensors, MOSFET)	2	6
2. **Electrical Characterization Techniques:** Characterization of Electrical properties (Conductivity Measurement, Hall Effect in Semiconductors, Deep-Level Transient Spectroscopy, Capacitance-Voltage (C-V) Characterization of Semiconductors, Example Characterization of pn Junctions, Electrical Measurements on Superconductors)	3	9
3. **Electrical Characterization Techniques** Characterization of Magnetic properties (Generation and Measurement of Magnetic Fields, Magnetic Moment and Magnetization, Vibrating Sample Magnetometer, Thermo magnetic Analysis, Techniques to Measure Magnetic Domain Structures)	3	9
4. **Scanning Probe Characterization techniques for micro and nano electronics:** Optical Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Scanning electron microscopy, Transmission Electron Microscopy, XRD	4	12
5. **Data Accusation and Handling:** Introduction, Data Accusation and device control using Lab view, Data Handling: formatting, report writing and presentation techniques	2	6

2- Course components (Total hrs in the Semester) : 42

Lecture	Exercise	(Visits to characterization labs)
42	7	------

c

3- Intended Learning Outcomes of the Course (ILO's)

a. *Knowledge*

i) Description of the knowledge to be acquired-:

- To gain the fundamental knowledge of monolithgoraphic techniques for device fabrication by knowing the different fabrication techniques
- To comprehensively understand the principles of characterization of electronics devices by different electrical techniques for different parameters and be able to correlate the data.
- To understand and learn methods to characterize the devices and material based on their magnetic characterization.
- Learn the principles of SPM techniques and its use for the characterization of nano devices.
- Learn how to process acquired scientific data and convert it to presentable form.

ii) Teaching strategies to be used to develop that knowledge

- Lectures

- Assignments, at home
- Discussions in the Class
- Case study Report (data collection, internet search, and reporting)

iii) Methods of assessment of knowledge acquired

- **Quizzes:** to assess understanding of the course knowledge.
- **Assignment reports:** to assess ability to answer some comprehensive questions.
- **Midterm Exams:** to assess understanding of the course knowledge.
- **Final Exam:** to assess understanding of the course knowledge.

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- The ability to analyze, and determine the micro Fabrication.
- The ability to select the suitable technology,
- The ability to control the synchronous machines.

ii) Teaching strategies to be used to develop these cognitive skills

- Lectures
- Assignments, at home
- Discussions in the Class
- Literature Survey Report (data collection, internet search, and reporting)

iii) Methods of assessment of student's cognitive skills

- **Quizzes:** to assess understanding of the course knowledge.
- **Assignment reports:** to assess ability to answer some comprehensive questions.
- **Midterm Exams:** to assess understanding of the course knowledge.
- **Final Exam:** to assess understanding of the course knowledge.

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- Team work
- Ideas development and sharing with others

ii) Teaching strategies to be used to develop these skills

- Assignments, at home
- Discussions in the Class
- Case study Report (data collection, Internet search, and reporting)

iii) Methods of assessment of student's interpersonal skills and capacity to carry responsibility

Unified reports and Seminars: to assess the integration done by the student in a - unified report and presentations.

Oral Group Exams: to assess interactive and communication abilities.-

d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

- Use of the internet search
- Technical report writing

ii) Teaching strategies to be used to develop these skills

- Assignments, at home
- Assignment Reports (data collection, Internet search, and reporting)

iii) Methods of assessment of students numerical and communication skills

- Assignment Reports: to assess technical report writing abilities.

Discussion Groups: to assess interactive and communication abilities.-

e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

Not Applicable

ii) Teaching strategies to be used to develop these skills-

----

iii) Methods of assessment of student's psychomotor skills

4- Student Assessment Schedule

Serial	*Assessment tool (test, group project, examination etc.)*	*Week due*	*Weight*
1	Quiz 1 on Device fabrication	2	1%
2	HW 1 thin film deposition technologies	3	2%
3	Extended Quiz on patterning, etching, deposition techniques	4	3%
4	Quiz 2 on Electrical Characterization Techniques	5	1%
5	HW 2 on Electrical Characterization Techniques	5	1%
6	Quiz 3 on Electrical Characterization Techniques	6	1%

7	Extended Quiz on Electrical Characterization Techniques	7	**3%**
8	**Midterm Exam I**	7	**15%**
9	Quiz 4 on Magnetic characterization techniques	8	**1%**
10	HW4 on Magnetic characterization techniques	9	2%
11	Extended QUIZ on Magnetic characterization techniques	9	3%
12	Quiz 5 on SPM	10	**1%**
13	**HW 5** on SPM	11	**1%**
14	**Midterm Exam II**	11	**15%**
15	**Presentation** on Selected SPM Techniques	12	**4%**
16	Extended QUIZ on SPM	13	2%
17	Quiz 6 Data accusation	14	1%
18	**Project** on labview	14	3%
19	**Final**	15	40%

5- Student Support

1. Office hours per week are offered by the instructor to aid the students and support them.
2. Tutorial arranged to help in understanding the course material

6- Learning Resources

i) Essential Books (References)

1. Michael Wang, "Lithography", Intech, 2010
2. Yang Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods", JohnWiley & Sons (Asia) Pte Ltd, 2008.
3. "Characterization of materials", volume 1 and 2, John Wiley and Son Inc., 2007.
4. "Applied Scanning Probe Methods V: Scanning Probe Microscopy Techniques" by Springer, 2007.

ii) Course Notes

Lecture notes on semiconductor material physics, providing a deeper treatment than that available in lecture, will be distributed in class.

iii) Recommended Books

- LabVIEW for Engineers by RONALD W. LARSEN Prentice Hall 2011
- Scanning Probe Microscopy in Nanoscience and Nanotechnology by Bharat Bhushan, Springer, 2009.

iv) Electronic Books & Web Sites:

- Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films (Materials Characterization Series) by Charles Evans, Richard Brundle, Wilson 1992
- Nanotechnology: An Introduction to Nanostructuring Techniques, by Michael Köhler, Wolfgang Fritzsche, Second Edition JW Wilson, 2007

v) Periodicals

- Will be selected based on the research projects assigned during the course of study

7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Course related discussions with students at the end of each section
- Introduction of class representative who convey feed backs to the teacher which helps teacher to build an appropriate strategy to improve the teaching and learning process.
- Course evaluation and suggestions form filled after first midterm exam for teacher feedback
- Official course evaluation forms should be compiled and results should be shared with the professor.
- Observing the students opinions recorded in the college student site
- Appeal box
- Carrying out extensive questioners by a sample of the distinguished students just after the graduation from the college.

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

A key to effective teaching evaluation is to collect data from multiple sources (triangulation), making sure that all education-related activities are rated by the people best qualified to rate them.

Peer Ratings: A far more effective procedure is for two or more reviewers to use standardized checklists to rate instructional materials and at least two class observations independently and then to reconcile their ratings.[1-3]

Student Ratings: Faculty performance evaluations should take into account student ratings collected over a period of several years, with relatively little weight being attached to ratings of someone's first semester of teaching.

The Teaching Portfolio: Just as some performance assessment data can best be provided by students and some by peers, certain important information can only be supplied by the faculty member being reviewed. Instructors should assemble

materials summarizing all of their education-related activities, including developing new courses and redesigning old ones, developing and evaluating innovative instructional methods, advising and mentoring students, writing new texts and courseware, providing instructional development to faculty colleagues and graduate students, and carrying out educational research. All of these materials except those related to educational research should be incorporated into a teaching portfolio, along with summaries of student ratings over the past two or three years, peer ratings, and reference letters from alumni and colleagues at other institutions who are familiar with the instructor's educational activities. The portfolio provides a solid basis for evaluating the faculty member's teaching performance and contributions to education.[4–6] [7]

1. Brent, R., and R.M. Felder, "A Protocol for Peer Review of Teaching," Proc. 2004 An. ASEE Meet., ASEE, June (2004),
2. Chism, N. Van Note, Peer Review of Teaching, Anker Publishing, Bolton, MA (1999)
6. Weimer, M., J.L. Parrett, and M. Kerns, How am I Teaching? Magna Publications, Madison, WI (1988)
4. Seldin, P., The Teaching Portfolio: A Practical Guide to Improved Performance and Promotion/Tenure Decisions, 2nd ed., Anker Publishing
Co., Bolton, MA (1997)
5. Edgerton, R., P. Hutchings, and K. Quinlan, The Teaching Portfolio: Capturing the Scholarship in Teaching, American Association for
Higher Education, Washington, DC (1991)
6. Felder, R.M., "If You've Got It, Flaunt It: Uses and Abuses of Teaching Portfolios," Chem. Eng. Ed., 30(3), 188 (1996)
7. http://www.crlt.umich.edu/tstrategies/tseot.php

iii) Processes for Improvement of Teaching

- The following framework is one that you could use to document strategies you use and assess how they work. The framework follows the familiar "plan, do, check, act cycle" which is a continuous improvement process used in business, industry, government, and higher education.

Plan: Concept - The concept that you plan to teach
Strategy - The teaching strategy that you plan to use
Date - The day you plan to use the strategy
Materials Needed - The teaching materials that you will need
Time Needed - Plan your teaching activity so that you can accomplish all your goals
Feedback - Decide on a strategy to obtain student feedback. Consider fast feedback, written reports and observing students' reactions

Do: Execute your plan
Check: Review student evaluations
Act: Decide on what you would do next time. Stick with the strategy? Change?

iv) Processes for verifying standards of student achievement (e.g. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

- Not required

v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

As per procedure of academic council

- Assessment and evaluation of the level of achieving the course outcomes through a continuous improvement process (part of a quality assurance system established by the university),
- Consequently, actions are to be taken to improve the course delivery when necessary.
- Review of the course objectives, outcomes and curriculum each 2 years.