

<p>Kingdom of Saudi Arabia Ministry of Higher Education Qassim University College of Engineering</p>		<p>المملكة العربية السعودية وزارة التعليم العالي جامعة القصيم كلية الهندسة</p>
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Introduction to Bionanotechnology and Biosensors

College: Engineering

Department: Electrical Engineering

First: Course Definition

1- Course Code: EE685

2- Units (3)

3 – Semester (2)

4 -Prerequisite - Nanoelectronics and Nanotechnology

5- Co-requisite- None

6- Location (if not on main Campus):

Second: Course Objectives

Upon completion of this course, the student will be able to:

- 1- Provide an overview of the theory and practice of biosensor design with emphasis on biomolecule-nanostructure interactions that apply to all bionanotechnology applications,
- 2- Calculate analyte concentration from primary biosensor output,
- 3- Design new biosensors based on the bimolecular electrical properties,
- 4- Assess the validity of biosensor performance claims.

Third: Course Specifications

1- Topics to be covered

Subject	No of Weeks	Hours
- Introduction to course outlines	1	2
- Introduction to Biotechnology and Biosensors		2
Biomolecular	4	
- Detection,		4
- Biomolecular recognition themes,		4
- DNA,		4
- Protein-antibody interactions		4
Nanotechnological transduction schemes:	3	

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<ul style="list-style-type: none"> - Electrical methods, - Electrochemical methods, - Absorption/transmission visible light spectroscopy 		<p>4 4 4</p>
<p>Surface chemistry of nanofabricated structures:</p> <ul style="list-style-type: none"> - The parameters that affect the biofunctionalization of nanofabricated material - Enzyme-based biosensors - Antibody-based biosensors - DNA-based biosensors 	<p>2</p>	<p>2 2 2 2</p>
<p>Surface immobilization of:</p> <ul style="list-style-type: none"> - biomolecules, - passivation of biofunctionalized surfaces, - assessment of retention of biomolecular activity. 	<p>2</p>	<p>2 3 3</p>
<p style="text-align: center;">Parameter Extractions Examples:</p> <ul style="list-style-type: none"> - Parameters modeling equations, - Simulate parameters. - Writing results in form of technical report/paper. 	<p>2</p>	<p>4 2 2</p>

2- Course components (Total hrs in the Semester)

Lecture	Lab	Other
42	14	

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

a. Knowledge

i) Description of the knowledge to be acquired:

- Assess the validity of biosensor performance claims
- Familiarization with the literature on biosensors, including up to date knowledge of the state of the art, and gain experience in the preparation and presentation of technical information
- Apply your knowledge to resolving problems in new or relatively unknown environments and in multidisciplinary contexts related to your field of study.
- Develop learning skills that enable you to continue studying autonomously
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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

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- **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.

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- Having successfully completed the module, you will be able to evaluate cross-disciplinary research
- Calculate analyte concentration from primary biosensor output
- Design new biosensors
- Write critical reports addressing engineering problems, including assessment of the impact of new technologies
- ***ii) Teaching strategies to be used to develop these cognitive skills***
- Lectures
- Assignments, at home
- Discussions in the Class
- Case study Report (data collection, Internet search, and reporting)

iii) Methods of assessment of students cognitive skills

- **Quizzes:** to assess the ability to solve quickly some problems.
- **Assignment reports:** to assess the ability to solve and analyze some comprehensive problems.
- **Midterm Exams:** to assess the ability to discuss, analyze, and solve the associated problems.
- **Final Exam:** to assess the intellectual skills such as analytical skills and ability to solve machine problems

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)

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iii) Methods of assessment of students 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

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

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iii) Methods of assessment of student's psychomotor skills

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4- Student Assessment Schedule

Serial	Assessment tool (test, group project, examination etc.)	Week due	Weight
1	Quiz (1)	4	2%
2	Mid-Term(1)	6	15%
3	Quiz (2)	8	2%
4	Mid-Term Exam (2)	12	15%
5	Attendance		2%

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6	Home work-Mini-project	13	14%
6	Final Exam	16	50%

5- Student Support

Four office hours per week are offered by the instructor to aid the students and support them.

6- Learning Resources

Essential Books (References)

- 1- Cooper MA, *Label-Free Biosensors: Techniques and Applications*, Cambridge University Press 2009 (ISBN 0521711517)
- 2- Eggins BR, *Chemical Sensors and Biosensors*, Wiley 2002 (ISBN 0471899143)
- 3- Gizeli E and Lowe CR, *Biomolecular Sensors*, Taylor and Francis 2002 (ISBN 074840791X)
- 4- Kumar S, *Nanomaterials for Biosensors*, Nanotechnologies for the Life Sciences series, Wiley 2007 (ISBN 3527313885)
- 5- Gorton L, *Biosensors and Modern Biospecific Analytical Techniques*, Comprehensive Analytical Chemistry series, Elsevier 2005 (ISBN 0444507159)
- 6- Hames D and Hooper NM, *Biochemistry*, 3rd Ed, BIOS Instant Notes series, Taylor

ii) Course Notes

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iii) Recommended Books

- 1- Gizeli E and Lowe CR, *Biomolecular Sensors*, Taylor and Francis 2002 (ISBN 074840791X)

iv) Electronic Books & Web Sites:

- Journal of nanobiotechnology <http://www.jnanobiotechnology.com/>

v) Essential Tools

Laboratory space and equipment required:

- 1- The E-CAD room or equivalent is required to teach the simulation software and to allow students to do the first piece of course work.
- 2- MATLAB with Applications to Engineering, Physics and Finance, David Baez-Lopez, CRC Press. This shows how to solve engineering and similar problems using Matlab and Simulink.

Software requirements

- 1- Silvaco simulation package University license
- 2- MATLAB software license
- 3- CADENCE for analog applications software licensed

7- Course Evaluation and Improvement Processes

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<p>i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching</p> <ul style="list-style-type: none"> • Questionnaire, • 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.
<p>ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department</p> <ul style="list-style-type: none"> • Periodical review of the teaching methods by both the department council and the education affairs vice dean.- • Questionnaire, • Observing the students opinions recorded in the college student site • Appeal box
<p>iii) Processes for Improvement of Teaching</p> <ul style="list-style-type: none"> • Evaluation of the course outlines by external staff member from outside the university • Periodical contact with the different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines.
<p>iv) Processes for Verifying Standards of Student Achievement</p> <p>It is planned to:</p> <ul style="list-style-type: none"> • Check marking of a sample of student work by an independent faculty member. • Exchange periodically, and remark a sample of assignments with a faculty member in King Saud University (KSU).
<p>v) The planning arrangements for periodically reviewing course effectiveness and planning for improvement.</p> <ul style="list-style-type: none"> - 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.