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| University: | Benha University |
| Faculty: | Faculty of Engineering at Shoubra |
| Department offering the program: | Electrical Engineering Department |
| Department offering the course: | Communications and Computer Engineering Program |

1- Course Data (Basic Information)

| | |
|------------------------------------|--|
| Course Code: CCE304 | Course Title: Measurements and Instrumentations |
| Prerequisite Course: CCE204 | Semester/Year: First / 2022-2023 |
| Credit Hours: 3 | Lecture: 2 Tutorial: 2 Lab: 0 |

2- Course Aims

For students undertaking this course, they will be able to recognize and write the resultant error for various calculations involving instrument and component error combinations. Evaluate the basic concepts of electrical measurements as oscilloscopes, graphical instruments, and electromechanical instruments. Describe principles of analog measuring instrument design and analyzing and design of digital electronic circuits. Demonstrate characteristics of engineering materials related to analog multimeter, digital multimeter, oscillators and signal generators. Moreover, analyze and design the basic types of signal generators and basic transducer circuits.

3- Course Contents (As indicated in the program Bylaw)

Classification, Categories, Parameters. Fundamentals of Electrical and Electronic Measurements. Types of different measurements and parameter measured for each type. Analog multimeter, digital multimeter, Oscilloscopes, and signal generators. Electric units, Error in measurements, Measurements of DC voltage and currents- Measurements of AC voltage and currents. Transducers and sensors.

4- Program Competences Served by the Course (A1, A2, A6, B2, B4)

Level (A) General Engineering Competences

- A.1 Identify and define concepts of electrical measurements, appropriate to oscilloscopes, graphical instruments, Electromechanical, digital multimeter. solve electrical and electronic measurements problems by applying engineering fundamentals, basic science and mathematics.
- A.2 Develop and conduct appropriate experimentation. Then analyze and evaluate findings using engineering judgment to draw conclusions about the measurement systems stability and performance.
- A.6 Plan, supervise and monitor implementation of engineering projects rated to sensors, transducers, and signal generators, taking into consideration other trades requirements.

Level (B) Electrical Engineering Competences

- B.2 Design, model and analyze electrical and electronic measurements system and analog electronic circuits.
- B.4 Estimate and measure the performance of electronic systems using the right equipment for a specific application.

Level (C) Communications and Computer Engineering Competences

None

5- Learning Outcomes (LO's)

At the end of the course, the student will be able to:

| Cognitive Domain | |
|--------------------|---|
| LO1 | Define concepts of electrical measurements, sensors, appropriate to oscilloscopes, graphical instruments, and Electromechanical instruments |
| LO2 | Demonstrate characteristics of engineering materials related to oscillators and signal generators. |
| LO3 | Describe principles of analog measuring instrument design |
| LO4 | Describe principles of analyzing and design of digital electronic circuits |
| Psychomotor Domain | |
| LO5 | Think in a creative and innovative way in solving and design of different analog electronic circuits. |
| LO6 | Combine, exchange, and assess different ideas, views, and knowledge from a range of sources to design analog and digital voltmeters |
| LO7 | Synthesize and integrate electronic systems for voltage and current measurements using the right equipment. |
| Affective Domain | |
| LO8 | Use oscilloscope and multimeters to measure system performance |
| LO9 | Write technical reports and presentation |

6- Mapping Learning Outcomes (LO's) with competences

| LO's NARS | A1 | A2 | A6 | B2 | B4 |
|--------------------|----|----|----|----|----|
| Cognitive Domain | | | | | |
| LO1 | ■ | | | | |
| LO2 | | ■ | | | |
| LO3 | ■ | | | | |
| LO4 | | | | ■ | |
| Psychomotor Domain | | | | | |
| LO5 | | ■ | | | |
| LO6 | | | | ■ | |
| LO7 | | | ■ | | |
| Affective Domain | | | | | |
| LO8 | | | | | ■ |
| LO9 | | | ■ | | |

7- Lecture Plan

a) Topics to be Covered weekly & Matrix of LO's

| Week | Topics | Planned Hours | Learning Outcomes | | | | | | | | |
|------|--|---------------|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | | LO1 A1-1 | LO2 A2-1 | LO3 A1-2 | LO4 B2-1 | LO5 A2-2 | LO6 B2-2 | LO7 A6-1 | LO8 B4-1 | LO9 A6-2 |
| W1 | <ul style="list-style-type: none"> Measurement Systems, Units, and Standards, Types of Measurement Errors, Absolute and Relative Errors, Measurements Characteristics, Measurement Error Combinations | 4 | ■ | | | | | ■ | | | |
| W2 | <ul style="list-style-type: none"> Introduction to Electromechanical Instruments, Permanent Magnet Moving Coil (PMMC), Galvanometer, DC Ammeters | 4 | ■ | | ■ | | | ■ | | | |
| W3 | <ul style="list-style-type: none"> DC Voltmeters, Ohmmeters AC Ammeters AC Voltmeters | 4 | | | ■ | | ■ | | | | |
| W4 | <ul style="list-style-type: none"> Analog Electronic Voltmeters Multimeter Probes Quiz | 4 | ■ | | | | | | ■ | ■ | |
| W5 | <ul style="list-style-type: none"> Introduction to Digital Voltmeters (DVM) Types of Digital Voltmeters. Range Changing and accuracy of DVM, Types of Digital Multi-meters. | 4 | ■ | ■ | | | | | | | |
| W6 | <ul style="list-style-type: none"> Basic Digital Frequency Meters (DFM). Frequency Range Changing. Frequency Meter Accuracy. Reciprocal Digital Frequency Meters (DFM). | 4 | | | ■ | | | | ■ | ■ | ■ |
| W7 | <ul style="list-style-type: none"> Introduction to Sensors and Transducers. Analog vs. Digital Sensors. Displacement, Position and Proximity, velocity, temperature Sensors. Thirty exam | 4 | ■ | ■ | ■ | | | ■ | | ■ | ■ |
| W8 | <ul style="list-style-type: none"> Analog Oscilloscope. Cathode Ray Tube (CRT). Sweep Generator. Triggering-Distortion. | 4 | ■ | ■ | | | | | | ■ | |

| Week | Topics | Planned Hours | Learning Outcomes | | | | | | | | |
|------|--|---------------|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | | LO1 A1-1 | LO2 A2-1 | LO3 A1-2 | LO4 B2-1 | LO5 A2-2 | LO6 B2-2 | LO7 A6-1 | LO8 B4-1 | LO9 A6-2 |
| | <ul style="list-style-type: none"> Lissajous Figures. | | | | | | | | | | |
| W9 | <ul style="list-style-type: none"> Pulse measurements. Digital Oscilloscope. Special Oscilloscopes. | 4 | | ■ | | | | | | ■ | |
| W10 | <ul style="list-style-type: none"> LF function Generators. Square/Triangle Generators. | 4 | ■ | ■ | | | ■ | | | | |
| W11 | <ul style="list-style-type: none"> Pulse Generators. Sweep Frequency Generators. RF Oscillators. | 4 | ■ | | | | | ■ | ■ | | |
| W12 | <ul style="list-style-type: none"> Graphical instruments. Printers and Plotters. | 4 | ■ | | | | | | ■ | | ■ |
| W13 | <ul style="list-style-type: none"> Miscellaneous Instruments. Spectrum Analyzers. | | | | ■ | | | | | | ■ |
| W14 | <ul style="list-style-type: none"> Data Acquisition and Microcontroller Applications in Measurements. | 4 | ■ | ■ | | | ■ | | | | |

b) Additional private study/learning hours expected for students per week is **FOUR** hours

8) Teaching and Learning Methods

| | | Teaching and Learning Methods | | | | | | | | | |
|--------------------|-----|-------------------------------|-----------------|---------------------|-------------------|------------|--------------|--------------|-------------------------------------|------------------------|----------------|
| | | Face-to-face Lecture | Online Lectures | Tutorial / Exercise | Group Discussions | Laboratory | Self-Reading | Presentation | Collaborate Learning (Team Project) | Research and Reporting | Brain Storming |
| Cognitive Domain | LO1 | ❖ | | ❖ | | | | | | | |
| | LO2 | ❖ | | ❖ | | | | | | | |
| | LO3 | ❖ | | ❖ | | | | | | | |
| | LO4 | ❖ | | ❖ | | | | | | | |
| Psychomotor Domain | LO5 | ❖ | | ❖ | | | | | | | |
| | LO6 | ❖ | | ❖ | | | | | | | |
| | LO7 | ❖ | | ❖ | | | | | | | |

| | | Teaching and Learning Methods | | | | | | | | | | |
|------------------|-----|-------------------------------|-----------------|---------------------|-------------------|------------|--------------|--------------|-------------------------------------|------------------------|----------------|---|
| | | Face-to-face Lecture | Online Lectures | Tutorial / Exercise | Group Discussions | Laboratory | Self-Reading | Presentation | Collaborate Learning (Team Project) | Research and Reporting | Brain Storming | |
| Affective Domain | LO8 | | | ❖ | ❖ | | | | | | | |
| | LO9 | | | ❖ | ❖ | | | ❖ | | | | ❖ |
| | | | | | | | | | | | | |

Student Academic Counseling and Support

- Students are directed to contact teaching staff for academic support during specific office hours.
- Regarding this course, Instructor and TA will be available two hours a week as indicated on the time table declared for students from the beginning of the semester.
- A WhatsApp group as well as Microsoft Team group are created where students can attend online lecture / tutorial, ask questions and share files with teaching staff. Moreover, these groups are used to announce the student marks, changes to the timetable, exam days ... etc.
- There are no disabled students in the programs, so no special support is needed.

9- Student Assessment

a) Student Assessment Methods

| | | Assessment Methods* | | | | | | | | | |
|------------------|-----|---------------------|--------------|-----------|-------------|--------------------------|----------------|----------------------|-----------------------|---------------------|--------------------|
| | | Written Exams | Online Exams | Oral Exam | Pop Quizzes | In-class Problem Solving | Take-Home Exam | Research Assignments | Reporting Assignments | Project Assignments | In-class Questions |
| Cognitive Domain | LO1 | ● | | ● | | | | | | | ● |
| | LO2 | ● | | ● | | | | | | | ● |
| | LO3 | ● | ● | ● | | | | | | | ● |
| | LO4 | ● | | ● | | | | | | | |

| Learning Outcomes | | Assessment Methods* | | | | | | | | | |
|--------------------|-----|---------------------|--------------|-----------|-------------|--------------------------|----------------|----------------------|-----------------------|---------------------|--------------------|
| | | Written Exams | Online Exams | Oral Exam | Pop Quizzes | In-class Problem Solving | Take-Home Exam | Research Assignments | Reporting Assignments | Project Assignments | In-class Questions |
| Psychomotor Domain | LO5 | ● | | ● | | | | | | | ● |
| | LO6 | ● | | ● | | | | | | | |
| | LO7 | ● | | ● | | | | | | | |
| Affective Domain | LO8 | | | | | | | ● | | ● | |
| | LO9 | | | | | | | ● | | ● | |
| | | | | | | | | | | | |

*There is one formative assessment (writing Exam), and all other assessments are summative.

b- Assessment Schedule and Weight

| Assessment | Week | Weight/ marks |
|--|---------------|------------------|
| Midterm Examination1 | 7 | 30 % |
| Midterm Examination2 | 12 | 20% |
| Home assignments, Quizzes, Mini Project, and Reports | 4 & 14 | 10% |
| Final Examination | (As Schedule) | 40 % |
| Total | | 100 % |

10- Facilities

The following facilities are needed for this course:

- Classroom
- Lecture Hall
- Sound and Microphone
- Other:
- Smart Board
- White Board
- Data Show
- Computer with software
- MIS system
- Internet Access

11- List of References

a- Course Notes

Lectures Notes in PDF

https://fengbuedu-my.sharepoint.com/:f:/g/personal/ahmed_saied_feng_bu_edu_eg/EktI0ZARCCrKueAN6tu5OicB8dWPO0HAuOSReg0JmsafVw?e=iLAf4Y

b- Books

1. David A. Bell “**Electronic Instrumentation and Measurements**”, Oxford Higher Education/Oxford University Press, Third edition, 2013.
2. Ian Hickman, “**Digital Storage Oscilloscopes**”, First edition, 1997
3. Waldemar Nawrocki, “**Measurement Systems and Sensors**”, Second edition, 2015.
4. W. Bolton, “**Mechatronics: Electronic Control Systems in Mechanical Engineering**”, seventh edition, 2019.

c- Recommended Books

1. Robert B Northrop, “**introduction to instrumentation and Measurements**”, Taylor & Francis, Third edition, 2014.

d- Web Sites

https://fengbuedu-my.sharepoint.com/:f:/g/personal/ahmed_saied_feng_bu_edu_eg/EktI0ZARCCrKueAN6tu5OicB8dWPO0HAuOSReg0JmsafVw?e=iLAf4Y

- **Course Coordinator:** Assoc. Prof. Mohamed Tarek Elewa

Signature:

Dr. Ahmed Samir Mohamed

Signature:

- **Program Coordinator:** Prof. Dr. Hala Abd Elkadr

Signature: