



# Students Manual for the Exam

*General Engineering  
and  
Electrical Engineering Discipline*

- March 2014 -



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## 1. Aim of Manual

The aim of this Manual is to provide information to the students about the exam objective, structure, timing, and general rules.

## 2. Overview of Exam

- This engineering exam is planned by the ministry of higher education and administered by Qiyas center.
- It is aimed at examining engineering students in all Saudi Engineering Colleges in their last year of study.
- The exam is Multiple Choice Questions (MCQ) and is divided into two sessions: a morning session devoted to General Skills and General Engineering, and an evening session devoted to disciplines (chemical, civil, computer, electrical, industrial, mechanical and architecture).
- One purpose of the exam is to assess the educational learning outcomes in various programs across the engineering colleges in Saudi Arabia.
- The exam tests the students in the General Skills and also in the four key learning areas:
  - Basic Sciences and Engineering Fundamentals
  - Engineering Analysis and Investigation
  - Engineering Design
  - Engineering Practice
- The results of the students in this exam are kept confidential and are used for statistical analysis.

## 3. Exam Structure and Organization

### 3.1 Eligibility for Exam

Bachelor degree holders in Electrical Engineering and those who are in the final year of such program are eligible to take the exam.

### 3.2 Exam Structure

The exam consists of two sessions (3-hours each) during one day (one session in the morning and the other in the afternoon) with two hours break between the two sessions, as follows:

#### Session 1:

The 3-hours morning session consists of 1 hour (44 questions) for General Skills and 2 hours (60 questions) for General Engineering Skills.

The General Skills consist of:

- Communication skills
- Numeracy and calculation skills
- Computer literacy skills
- Interpersonal skills
- Problem solving skills
- Learning and performance improvement skills

The General Engineering Skills cover the following topics:

- Mathematics
- Numerical Techniques
- Probability and Statistics
- Physics
- Statics and Dynamics
- Electricity and Magnetism
- Chemistry
- Thermodynamics
- Fluid mechanics
- Materials Science
- Engineering Drawing
- Process Economics
- Project management
- Codes, Ethics, Environment and Social issues

Each question is a multiple choice question with 4 choices for the answer.

## Session 2:

The 3-hours evening session is devoted to subjects of Electrical Engineering Discipline. The session consists of 50 questions carrying a maximum of 100 marks. Each question is a multiple choice question with 4 choices for the answer. In this session, the following subjects are covered:

- Power
- Machines
- Control
- Communication
- Electronics

### 3.3 Exam Type

The exam is paper based and all questions are multiple choice questions. Each question has 4 choices for the answer. There is no negative marking for wrong answers.

### 3.4 Exam Rules

- Books, lecture notes, or another type of material are not allowed in the exam
- Approved calculators are allowed to do the necessary calculations
- Admission in the examination center will be only through authorities admit card issued by examination authority
- Necessary reference sheets, monographs, equations and/or relevant data will be provided during the exam.

## 4. Sample Questions for General Engineering (session 1)

### Question #1

#### Question Statement:

The inverse (if it exists) of the matrix  $\begin{pmatrix} \alpha & -\beta \\ \beta & \alpha \end{pmatrix}$  is:

A)  $\begin{pmatrix} \alpha & -\beta \\ \beta & \alpha \end{pmatrix}$

B)  $\frac{1}{\alpha^2+\beta^2} \begin{pmatrix} \alpha & -\beta \\ \beta & \alpha \end{pmatrix}$

C)  $\frac{1}{\alpha^2+\beta^2} \begin{pmatrix} \alpha & \beta \\ -\beta & \alpha \end{pmatrix}$

D)  $\frac{1}{\alpha^2-\beta^2} \begin{pmatrix} \alpha & -\beta \\ \beta & \alpha \end{pmatrix}$

**Reference Sheet:** None

**Remarks:** The objective of this question is to test the examinee ability to solve a simple linear algebra problem involving a 2x2 matrix inversion.

## Question #2

### Question Statement:

Consider the following instructions:

1. Start
2. Set  $x = 10, y = 5$
3. If  $x > y$  then go to step 4; otherwise go to step 6
4. Replace  $x$  by  $x + 1$  and  $y$  by  $2(y - 1)$
5. Go to step 3
6. Print  $y, x$
7. End

After executing these instructions, the numbers that are printed are:

- A) 8, 11
- B) 8, 12
- C) 12, 14
- D) 14, 12

**Reference Sheet:** None

**Remarks:** The objective of this question is to test the examinee ability to solve an iteration-based problem.

### Question #3

#### Question Statement:

Consider the following data:  $-1, 1, 2, 3$  and  $7$ . The mean and the standard deviation of the data are:

- A) 2.4 and 2.653
- B) 2.4 and 7.040
- C) 2.4 and 5.931
- D) 12 and 2.653

**Reference Sheet:** None

**Remarks:** The objective of this question is to test the examinee ability to understand the basic concepts of mean and standard deviation.

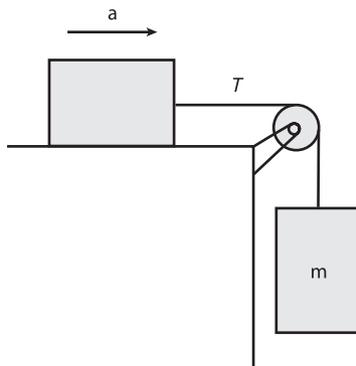
### Question #4

#### Question Statement:

If the tension,  $T$ , is  $14\text{ N}$  and the magnitude of the acceleration,  $a$ , is  $3.0\text{ m/s}^2$ , the mass,  $m$  (kg) of the suspended object is :

(Assume that all surfaces and the pulley are frictionless. Take  $g = 10\text{ m/s}^2$ )

- A) 3.1
- B) 2.8
- C) 2.0
- D) 1.2



**Reference Sheet:** None

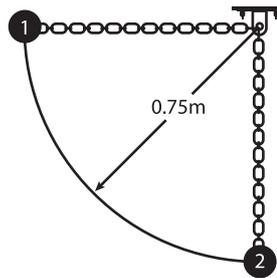
**Remarks:** This question tests the examinee ability to apply the Newton law and the understanding of the gravity force.

## Question #5

**Question Statement:**

If the pendulum is released from position 1, its velocity (m/s) in position 2 is:

- A) 3.8
- B) 6.9
- C) 14.7
- D) 21.0



**Reference Sheet:** None

**Remarks:** This question is an illustration of the application of conservation of energy.

## Question #6

### Question Statement:

The resistance ( $\Omega$ ) of a 2 meter wire having a cross sectional area of  $2 \text{ mm}^2$  and a resistivity of  $5 \times 10^{-8} \text{ } \Omega \cdot \text{m}$  is:

- A) 0.001
- B) 0.03
- C) 0.05
- D) 1000

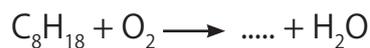
**Reference Sheet:** None

**Remarks:** This question is to test the examinee knowledge of basic laws of electricity.

## Question #7

### Question Statement:

Consider the complete oxidation of  $\text{C}_8\text{H}_{18}$ .



The missing product and the coefficients of the balanced reaction are:

- A) The product is CO and the coefficients are 2, 17, 16, and 18
- B) The product is CO and the coefficients are 4, 34, 16, and 36
- C) The product is  $\text{CO}_2$  and the coefficients are 4, 4, 32, and 36
- D) The product is  $\text{CO}_2$  and the coefficients are 2, 25, 16, and 18

**Reference Sheet:** None

**Remarks:** This question tests the examinee ability to understand the complete oxidation of hydrocarbons and balance it accordingly.

## Question #8

### Question Statement:

A heat engine operates between  $260^{\circ}\text{C}$  and  $110^{\circ}\text{C}$ . The maximum (Carnot) efficiency (%) of this heat engine is:

- A) 28.1
- B) 42.3
- C) 57.7
- D) 71.8

**Reference Sheet:** None

**Remarks:** This question is to test the examinee ability to recall and use the theoretical efficiency of a Carnot heat engine.

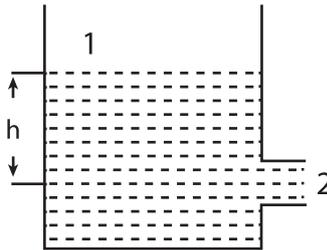
## Question #9

### Question Statement:

Consider the liquid flowing in the tank shown in the figure. The height (h) of the liquid is 3 m. Assume the tank to be open to the atmosphere. The velocity (m/s) of the liquid at point (2) is:

- A) 0
- B) 5.42
- C) 7.67
- D) 58.8

Take  $g=9.8 \text{ m/s}^2$



**Reference Sheet:** The Bernoulli equation applied between two points (1) and (2) is:

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

(P) denotes the pressure, (V) the velocity and (z) the height.

**Remarks:** This question aims to test the examinee ability to apply Bernoulli equation.

## Question #10

### Question Statement:

What is the group of materials that are hard and brittle, but they are good insulators?:

- A) metals
- B) polymers
- C) ceramics
- D) composites

**Reference Sheet:** None

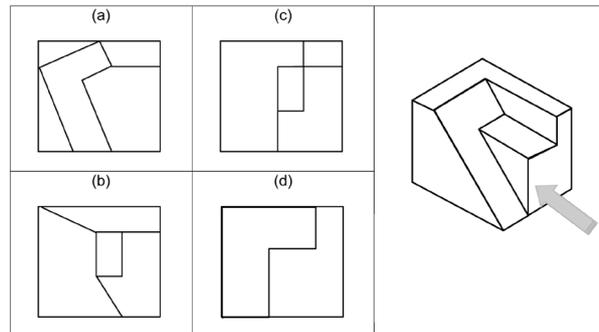
**Remarks:** This question is intended to test the examinee ability to recognize the properties of materials.

## Question #11

### Question Statement:

The orthogonal projection according to the arrow's direction would be:

- A) a
- B) b
- C) c
- D) d



**Reference Sheet:** None

**Remarks:** This question is intended to test the examinee skills in engineering drawing.

## Question #12

### Question Statement:

Which of the following devices converts chemical energy directly into electrical energy?

- A) A battery.
- B) An electrical power plant.
- C) A solar cell
- D) A car engine.

**Reference Sheet:** None

**Remarks:** This question is intended to test the examinee recognition of the basics of other engineering disciplines.

## Question #13

### Question Statement:

Professional engineers are first obliged to:

- A) The welfare of the community.
- B) The engineering profession.
- C) Their employer.
- D) Their customer.

**Reference Sheet:** None

**Remarks:** This question is intended to test the examinee understanding of the priority they should give, when they become engineers, to the public welfare.

## **Question #14**

### **Question Statement:**

The objective of Project Management is to finish the project

- A) within budget, time and required quality.
- B) having high safety record.
- C) as required by the contract specifications.
- D) having profit for the project.

**Reference Sheet:** None

**Remarks:** This question is intended to test the examinee understanding of the objective of project management.

## Question #15

### Question Statement:

A machine shop is considering the purchase of a new machine. The new machine price is \$4,000 and has useful life of 10 years. The estimated value of the machine at the end of its useful life is zero. Hence, the annual depreciation amounts (\$), using the straight line method is:

- A) 400
- B) 512
- C) 640
- D) 800

**Reference Sheet:** None

**Remarks:** This question is intended to test the examinee ability to perform engineering economics analysis.

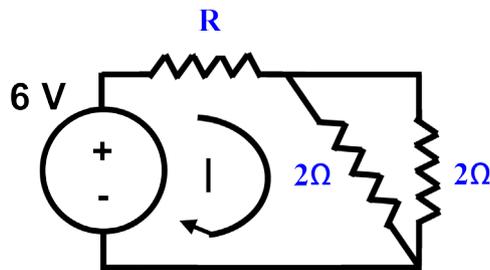
## 5. Sample Questions for Electrical Engineering (session 2)

### Question #1

#### Question Statement:

The power loss in the resistance R in the electrical circuit shown below is 8 W. A possible value of R ( $\Omega$ ) is:

- A) 0.5
- B) 1
- C) 1.5
- D) 3



**Reference Sheet:** See Reference Sheet #1

**Remarks:** The objective of this question is to ensure that the examinee can solve an electrical circuit and is aware of certain associated terms such as power loss.

## Reference sheet # 1

Solution of Second Degree Algebraic Equation:

$$ax^2 + bx + c = 0$$

First Root:

$$x = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Second Root:

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

## Question #2

### Question Statement:

An inductive load takes 4 MW. A 2 MVAR shunt capacitor is connected across the load to improve the load-end power factor to 0.97 lagging. If the capacitor is disconnected (or trips), the load-end power factor will be:

- A) 1
- B) 0.85 lead
- C) 0.80 lag
- D) 0.90 lag

**Reference Sheet:** None

**Remarks:** This question is an illustration of how an end-user requirement (namely “power factor correction”) is met in a real life electrical engineering application using “capacitor installation”.

### Question #3

#### Question Statement:

The bit size of a digital-to-analog converter (DAC) having a full scale output voltage of 3.5 V and resolution of 14 mV is close to:

- A) 4
- B) 8
- C) 16
- D) 32

**Reference Sheet:** Reference sheet #1

**Remarks:** The objective of this question is to probe the examinee’s knowledge of practicalities surrounding DAC performance using one of the often encountered parameters, namely the “resolution”.

### Question #4

#### Question Statement:

The equation  $S^3 - 4S^2 + S + 6 = 0$  has a number of roots in the left-half of s-plane equal to

- A) 0
- B) 1
- C) 2
- D) 3

**Reference Sheet:** See Reference Sheet #1 (optional)

**Remarks:** This question combines mathematical knowledge (namely, finding roots of an algebraic equation) and physical meaning (impact of location of roots on stability) of electrical systems.

## Question #5

### Question Statement:

The per-phase inductance and capacitance of an overhead power transmission line operating at 800 kV are 1.1 mH/km and 11.68 nF/km, respectively. If the length of the line is ignored, the ideal line power transfer capability (or the Surge Impedance Loading limit of this line) in GW is:

- A) 0.752
- B) 1.303
- C) 1.408
- D) 2.085

**Reference Sheet:** None

**Remarks:** The objective of this question is to ensure that the examinee is aware of the physical limitations on practical electrical installations (namely, power transfer capability of lines) and their dependence on electrical system parameters (namely, line series inductance and shunt capacitance).

## Question #6

### Question Statement:

The phase margin (in degrees) of a closed loop control system for which the Nyquist plot of the loop transfer function  $G(s)H(s)$  passes through the point  $(-1, j0)$  in the  $G(s)H(s)$  plane is:

- A) 45
- B) 90
- C) 135
- D) 180

**Reference Sheet:** Reference #2

**Remarks:** The objective of this question is to probe the knowledge of the examinee regarding a key performance aspect (namely stability) in electrical systems' design and performance assessment using an important technique (namely, Nyquist plot)

## Question #7

### Question Statement:

The total instantaneous power supplied by a 3-phase ac supply to a balanced, three phase, R-L load is:

- A) zero
- B) constant
- C) sinusoidal with zero average
- D) sinusoidal with non-zero average

**Reference Sheet:** None

**Remarks:** This question measures the extent-to-which physical meanings and practical notions associated with three-phase electrical systems are comprehended by the engineering graduate.

## Question #8

### Question Statement:

A unity feedback control system has an open loop transfer function  $G(s) = (As + 1)/s^2$ . Then, the value of A which produces a phase margin of 45 degrees is

- A) 1.141
- B) 0.841
- C) 0.441
- D) 0.141

**Reference Sheet:** None

**Remarks:** This question measures the ability of the engineering graduate to calculate important performance factors and criteria (namely “phase margin”) and their relationship to the system transfer function.

## Question #9

### Question Statement:

Consider ADC0804 which is a CMOS 8-Bit, successive-approximation analog-to-digital (ADC) converter. Suppose a speech signal of bandwidth 4 kHz is applied for ADC conversion at the input of ADC0804 and it is sampled at Nyquist rate. Using this ADC, the data-rate, in bits/s, for this speech signal is:

- A) 50000
- B) 58000
- C) 60000
- D) 64000

**Reference Sheet:** None

**Remarks:** The objective of this question is to ensure that the examinee can recognize, in practice, the functional/processing behavior of actual analog/digital converters, along with sampling process.

## Question #10

### Question Statement:

Consider a transformer of primary voltage 220 V and turns ratio of 11:1. The secondary of the transformer is connected to a  $30\ \Omega$  inductive reactance in series with a load resistance (R). If the current flowing in (R) must not be below 0.4 A, then the value of (R) should be:

- A) At least  $40\ \Omega$
- B) At most  $40\ \Omega$
- C) Exactly  $20\ \Omega$
- D) Exactly  $50\ \Omega$

**Reference Sheet:** None

**Remarks:** The objective of this question is to ensure that the examinee can solve simple electrical circuit containing a transformer and is aware of certain associated terms such as primary, and secondary of the transformer.



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