



# Students Manual for the Exam

*General Engineering  
And  
Industrial 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 Industrial 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 Industrial 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:

- Operations Research
- Operations Management
- Manufacturing Materials
- Manufacturing Processes
- Engineering Economics

- Engineering Reliability and Maintenance
- Quality Engineering
- Human Factors Engineering
- Work Design and Analysis
- Optimization
- Decision Making
- Design of Experiments
- Automatic Control Systems
- Industrial Information Systems
- Industrial Facility Design
- Computer Integrated Manufacturing
- CAD / CAM
- Safety Engineering
- Quality and Maintenance

### 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.

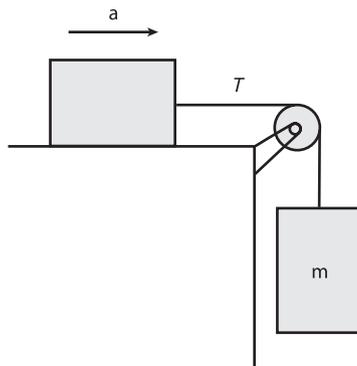
### Question #4

#### 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

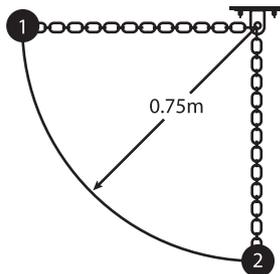
**Remarks:** This question tests the examinee ability to apply the Newton law and the understanding of the gravity force.

## 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  $5 \times 10^{-8} \Omega \cdot \text{m}$  is:

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

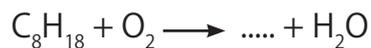
**Reference Sheet:** None

**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.

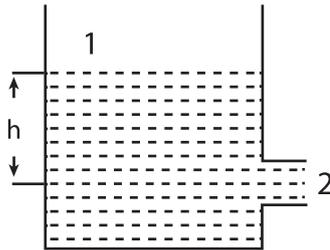
## Question #9

### 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

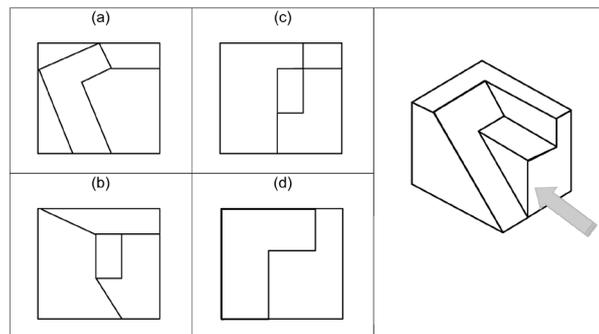
**Remarks:** This question is intended to test the examinee ability to recognize the properties of materials.

## 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 Industrial Engineering (session 2)

### Question #1

#### Question Statement:

Value-adding elements in a given process are described as:

- A) Essential to the process and physically change the product or service.
- B) Time consuming and high in cost.
- C) Requiring sophisticated technology and highly skilled workers to accomplish.
- D) Having no impact on the process.

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to effectively differentiate between effective and ineffective task elements for the purpose of re-engineering a method of performing a task.

## Question #2

### Question Statement:

A factory has 3 machines (M1, M2 and M3) and it manufactures two products (P and Q). The demand for both the products is far greater than the capacity of the factory. Market price for P is \$30 per unit, and \$40 per unit for Q. Raw Material cost of P is \$5 per unit, and \$10 per unit for Q.

Making one unit of P takes 20 minutes on M1, 20 minutes on M2 and 30 minutes on M3. Making one unit of Q takes 15 minutes on M1, 15 minutes on M2 and 30 minutes on M3. The factory works 8 hours a day, 5 days a week. It costs \$100 per day to run the factory (including wages, rent, utilities, etc).

Assume a steady state operation, the maximum profit (\$) that the company can make in one day is:

- A) 320
- B) 380
- C) 480
- D) 520

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to do cost accounting and optimize for profitability.

## Question #3

### Question Statement:

In a manufacturing facility, when the maintenance department decides to take an operating machine down for maintenance because of its health condition to avoid breakdown, this type of maintenance is called:

- A) "breakdown maintenance".
- B) "proactive maintenance".
- C) "predictive maintenance".
- D) "preventive maintenance"

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to differentiate between the various types of maintenance.

## Question #4

### Question Statement:

Motion economy principles that apply to the use of the human body recommend that the methods for performing manual tasks should:

- A) consist of smooth continuous curved motions.
- B) consist of straight motions with abrupt changes in direction.
- C) use highest classification of hand and arm motion.
- D) not achieve a natural rhythm of the motions involved.

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to apply motion economy principles to workplace design while considering the human operator capabilities and limitations in the process.

## Question #5

### Question Statement:

A total of 32 cycles have been observed during a direct time study. The mean for the largest element time was 128.5 min, and the corresponding sample standard deviation was 6.2 min. Based on these data, the 99% confidence interval on the 128.5 min element time is:

- A) 111.5 and 145.5.
- B) 112.8 and 146.4.
- C) 113.4 and 144.5.
- D) 114.6 and 156.5

**Reference Sheet:** t-distribution table

**Remarks:** This question is intended to ensure that examinees are able to effectively apply principles of statistics in order to obtain reliable interpretation of results.

## Question #6

### Question Statement:

Which facility layout is suitable to produce make-to-order home windows?

- A) Cellular Layout
- B) Job-Shop Layout
- C) Fixed position Layout
- D) Flow Line Layout

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to effectively relate a product to its production system layout.

## Question #7

### Question Statement:

Which of the following is true regarding the batch production systems?

- A) The job is a unique product
- B) Respond quickly to customer orders
- C) Less need for storage space
- D) Less physical handling of items

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees understand the characteristics of different production systems.

## Question #8

### Question Statement:

To produce adequate quality, the process capability target should be:

- A) Tighter than process control limits.
- B) The same as process control limits.
- C) Tighter than product specifications.
- D) Not related to product specifications.

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to understand the basics of quality control.

## Question #9

### Question Statement:

A maintenance diagnostic technique based on monitoring the movement of a mass from its point of rest through all positions back to the point of rest where the severity of the movement can be considered as an indicator for the performance of the equipment is:

- A) Oil Analysis
- B) Electrical Effect Analysis
- C) Ultrasound Analysis
- D) Vibration Analysis

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees are able to understand the different types of maintenance diagnostic techniques.

## Question #10

### Question Statement:

When the austenite is rapidly cooled in a process known as quenching, the resulting structure is called:

- A) Ferrite
- B) Cementite
- C) Pearlite
- D) Martensite

**Reference Sheet:** None

**Remarks:** This question is intended to ensure that examinees remember the basic structure terminology of materials.

## TABLE of CRITICAL VALUES for STUDENT'S *t* DISTRIBUTIONS

Column headings denote probabilities ( $\alpha$ ) *above* tabulated values.

d.f.	0.40	0.25	0.10	0.05	0.04	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	7.916	12.706	15.894	31.821	63.656	127.321	318.289	636.578
2	0.289	0.816	1.886	2.920	3.320	4.303	4.849	6.965	9.925	14.089	22.328	31.600
3	0.277	0.765	1.638	2.353	2.605	3.182	3.482	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.333	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.191	2.571	2.757	3.365	4.032	4.773	5.894	6.869
6	0.265	0.718	1.440	1.943	2.104	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.046	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.004	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	1.973	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	1.948	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	1.928	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	1.912	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	1.899	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	1.887	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	1.878	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	1.869	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	1.862	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	1.855	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	1.850	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	1.844	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	1.840	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	1.835	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	1.832	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.256	0.685	1.318	1.711	1.828	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	1.825	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	1.822	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	1.819	2.052	2.158	2.473	2.771	3.057	3.421	3.689
28	0.256	0.683	1.313	1.701	1.817	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	1.814	2.045	2.150	2.462	2.756	3.038	3.396	3.660
30	0.256	0.683	1.310	1.697	1.812	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.256	0.682	1.309	1.696	1.810	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.255	0.682	1.309	1.694	1.808	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.255	0.682	1.308	1.692	1.806	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.255	0.682	1.307	1.691	1.805	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.255	0.682	1.306	1.690	1.803	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.255	0.681	1.306	1.688	1.802	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.255	0.681	1.305	1.687	1.800	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.255	0.681	1.304	1.686	1.799	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.255	0.681	1.304	1.685	1.798	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.255	0.681	1.303	1.684	1.796	2.021	2.123	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	1.781	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.254	0.678	1.292	1.664	1.773	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.254	0.677	1.290	1.660	1.769	1.984	2.081	2.364	2.626	2.871	3.174	3.390
120	0.254	0.677	1.289	1.658	1.766	1.980	2.076	2.358	2.617	2.860	3.160	3.373
140	0.254	0.676	1.288	1.656	1.763	1.977	2.073	2.353	2.611	2.852	3.149	3.361
160	0.254	0.676	1.287	1.654	1.762	1.975	2.071	2.350	2.607	2.847	3.142	3.352
180	0.254	0.676	1.286	1.653	1.761	1.973	2.069	2.347	2.603	2.842	3.136	3.345
200	0.254	0.676	1.286	1.653	1.760	1.972	2.067	2.345	2.601	2.838	3.131	3.340
250	0.254	0.675	1.285	1.651	1.758	1.969	2.065	2.341	2.596	2.832	3.123	3.330
inf	0.253	0.674	1.282	1.645	1.751	1.960	2.054	2.326	2.576	2.807	3.090	3.290



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