IBFES

International Board of Forensic Engineering Sciences

FORENSIC ENGINEERING SCIENCES SCREENING EXAMINATION

Candidate Study Guide

International Board of Forensic Engineering Sciences

Updated August 2021

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Introduction

Congratulations on your decision to pursue certification!

The IBFES examinations are in three parts: Multi Choice Exam, Ethics and Oral

The Multi choice exam was created through the Developing a Curriculum (DACUM) process. Using a panel of Subject Matter Experts (SME), a job analysis was completed to define the profession of Forensic Engineering Scientist.

The tasks listed in the job description were aligned to Knowledge-Skill (K-S) categories, and these categories were grouped into larger Domains (e.g., Science and Math, Laboratory or Site Visit, Quality Assurance/ Quality, etc.) to create the Forensic Engineering Scientist Examination Blueprint. This blueprint was subsequently used to determine the number of questions in each of the larger domains.

References listed in this Study Guide were used to write examination questions. However not all questions were written using these references.

I. The best preparation for the 40-question multiple choice exam is a 4 year ABET accredited Engineering School and the Engineering Licensure testing program. This is very rigorous and generally puts the candidate in the top 2 % of engineers and is a very well-rounded engineering background. Some engineering disciplines do not have a specific Professional Engineering exam, but a Masters or PHD program is also a very good background to take this exam. A well-rounded engineer will more likely than not find the engineering exam challenging and fun!

II. For the Ethics examination it is recommended that the applicant study carefully the IBFES Code of Ethics and the IBFES Rules of Professional Conduct.

The ethics examination will consist of two parts, each a situation wherein the applicant might find ethical hazards, problems, and/or questions. The applicant is asked to analyze the situation, and in written form define the ethical problems, offer possible solutions and ways in which they might be avoided in the future.

These situations are intended to be representative of actual cases which the applicant might actually encounter. Therefore, the applicant is at liberty to use whatever resources available at the time to assist in analysis.

The purpose is to determine that the applicant can recognize ethical hazards and has an idea of how to deal with them. It is believed that in order to have an ethical practice the person must understand ethics.

It is strongly recommended the applicant do a detailed analysis of own practice by applying each of the items in the IBFES Code of Ethics and the Rules of Professional Conduct. For each item list the points wherein your

practice may be at risk and what you would do to prevent a complaint, and deal with a complaint. Also, list what you can do to reduce and/or minimize the potential hazard.

It is recommended a web search of the subject of ethics, and specifically forensic ethics to update impressions and beliefs about ethical practice.

III. The Oral examination is actually a "cross-examination" of the written report submitted by the applicant. The report is one that was prepared for deposition or trial in an actual case. The examiners are two experienced forensic engineering science persons and an attorney, usually a judge, well experienced in such matters.

It is recommended the applicant study several subjects: the rules for the submission of scientific evidence (e.g. Federal Rules of Evidence 702 or equivalent in other jurisdictions), including the Daubert/Joiner/Krumho criteria, the scientific method, duces tecum subpoenas, and the continuity of possession.

The applicant is advised to prepare for the oral examination in the same manner as in preparation for a very tough deposition or trial testimony. Specifically, read the report at least one time, and review in detail any supporting information immediately before the examination. This should include any special legal protocols, etc. essentially unique to your specific technical field of expertise. Applicant should be prepared to reproduce any calculations included in the report, justify that procedure and interpretation of results.

The examiners will seek to determine the depth of the applicant's technical knowledge, communication skills, skill in analyzing complex technical situations, skill in using the scientific method, analytical skills, interpretation of analytical results, and any other parameter that might influence the decisions of the court. They will also seek to measure applicant's understanding of basic points of evidence and testimony, Daubert questions, and other points frequently encountered in the litigation process.

Question: Were you subjected to a Daubert hearing on the matter which is the subject of this examination? If so, what was your defense?

Question: If you did not have a Daubert hearing, what would have been your defense if one had been required?

RULES OF PROFESSIONAL CONDUCT

With regard to the forensic nature of the activities of persons accredited by the IBFES, the following are principles of ethics to which all applicants must accept and agrees to abide by these Rules of Professional Conduct.

1. Be aware of one's own professional and technical qualifications in dealing with each case, and address only those factors that are within one's own expertise and competence. Seek the assistance of other qualified experts whenever necessary.

2. Treat one's own personal integrity with great respect, and never do or say anything that might compromise that personal integrity. This entails not only saying the truth at all times, but also giving due weight to all pertinent observations and facts.

3. Treat all information from a client, agency, or any other exclusive source with the confidentiality required.

4. Treat every object or specimen of potential evidential value with the care and control necessary to preserve its integrity.

5. Utilize the appropriate standards and controls in conducting examinations and analysis.

6. Render opinions and conclusions strictly in accordance with the evidence in the case and only to the extent justified by that evidence.

7. Maintain an attitude of independence and impartiality in order to ensure an unbiased analysis and presentation of the evidence.

8. Carry out the duties of this profession in such a manner as to inspire the confidence of the public.

9. Respect one's peers in this profession and regard them with the same standards that one holds for oneself.

10. Report to the IBFES Board of Trustees any violation of these rules by any other person who is certified by the IBFES.

11. Refuse to accept, on a contingency fee basis, any assignment involving opinions, conclusions, or expert testimony intended for use in arbitration and/or litigation.

Examination Outline

Domain	Knowledge-Skill	% of Exam
Science and Math		**10%**
	Physics	
	Chemistry	
	Math	
Process		**10%**
	Organizational (e.g., time management, multi-tasking)	
	Critical thinking (e.g., analytical, decision making, problem solving)	
	Scientific method	
Laboratory or Site Visit		**15%**
	Working with other consultants and evidence handling	
	PHR – Process Hazards Review and Site safety	
Computer		**10%**
	Computer	
	AutoCAD and computer modeling software	
Quality Assurance/Quality Control		**20%**
	10%	
	Chain of Custody	
	10%	
Communication		**10%**
	Communication (e.g., oral, written, presentation, listening, interpersonal)	
Forensic Disciplines		**10%**
	Other forensic disciplines	
Legal		**15%**
	Legal system	

Science and Math

The Science and Math domain makes up 10% of the examination. The knowledge and skills needed to succeed in this domain are:

- Scientific concepts in the field of physics
  - Forensic Engineering Sciences
  - Characteristics of materials
  - Thermodynamics
- Scientific concept in the field of chemistry
  - Scientific units
  - Scientific nomenclature
  - Basic definitions of scientific concepts
- Mathematical concepts and their application to the fields of
  - Basic calculations and SI unit conversions
  - Advanced math
- Statistical definitions and concepts
  - Mean, median, mode, etc.
  - Confidence interval, standard deviation, and variability

Process

The Process domain makes up 10% of the examination. The knowledge and skills needed to succeed in this domain are:

- Organizational
  - Testing plans
  - Technical and administrative reviews
  - Recommendations, guidelines, and best practices from national and international organizations (e.g., ASB, ANSI, ASHRAE, ASTM, NIJ, NIST, OSAC, etc.)
- Critical thinking
  - Opinions based on scientific methods
  - Opinions supported or based on peer-reviewed sciences and peer-reviewed publications

Process (Continued)

- Scientific Method
    - Types of evidence and methods of transfer
    - Handling and storage of evidence
    - Analysis of evidence, including order of analysis for evidence with multiple disciplines requested
    - Sample collection from evidence, especially for downstream processing
    - Adequate note taking and documentation
    - Interpretation of results
    - Report writing

Laboratory or Site Visit

The Laboratory or Site Visit domain makes up 15% of the examination. The knowledge and skills needed to succeed in this domain are:

- Site Visit
    - Site safety plan
    - PHR – Process hazards review
    - LiDAR/other measuring technique
    - Verify correct site data collection

Computer

The Computer domain makes up 10% of the examination. The knowledge and skills needed to succeed in this domain are:

- Use of computer software in forensic engineering science
    - Documentation and analysis of evidence
    - Proficiency testing
    - Draft and final reports
    - Court testimony
- Computer Formulas
    - Supported by peer-reviewed publication
    - Scientifically valid mathematically modeling
    - Strategically relevant testing and sampling methodology

Quality Assurance/Quality Control

The Quality Assurance/Quality Control domain makes up 20% of the examination. The knowledge and skills needed to succeed in this domain are:

- Quality assurance and quality control in the workspace
  - Validation and verification
  - Different types of controls, performance checks
  - Training programs
  - Note taking
  - Report writing
  - Technical and administrative reviews
  - Proficiency testing
  - Expert testimony
- ISO Accreditation
  - Accreditation process
  - Guiding Principles of Professional Responsibility
  - Statistically relevant models
- Quality Assurance Standards (QAS)
  - Chain of Custody
  - QC- Quality Control

Communication

The Communication domain makes up 10% of the examination. The knowledge and skills needed to succeed in this domain are:

- Ways to effectively communicate in forensic engineering science
  - Technical and administrative documentation
  - Adequate note taking
  - Writing and reviewing reports

Communication (Continued)

- Courtroom testimony and avoiding Daubert challenges
  - The dreaded *ipse dixit*
    - The fallacy of defending a proposition by baldly asserting "because I said so" or "that's how it is."
  - Frye
    - Hierarchy of evidence ("Scientific" vs. "Expert")
  - Daubert trilogy
    - FRE 702 amended
    - FRE 703 amended
    - FRCP 26(a)
    - Subsequent applications
  - The Daubert evaluation did not necessarily replace the Frye evaluation at the state level so it is important to be aware of the standards for your jurisdiction
  - Know the jurisdiction's licensing requirements for forensic engineers

Forensic Disciplines

The Forensic Disciplines domain makes up 10% of the examination. The knowledge and skills needed to succeed in this domain are:

- Basic knowledge of different types of forensic evidence
- Basic knowledge of common forensic analyses performed on different types of evidence
- Collection of samples from evidence
- Preservation of evidence for testing in other disciplines
- Coordination of testing with other disciplines

Legal

The Legal domain makes up 15% of the examination. The knowledge and skills needed to succeed in this domain are:

- Case file documentation for legal proceedings (e.g., administrative, technical, supporting, etc.)
- Knowledge of proper expert testimony
- Basic understanding of the Federal Rules of Evidence
- Basic understanding of different types of warrants, subpoenas, etc.
- Court cases important to the field of forensic engineering sciences
- Understanding the difference between Daubert and Frye

References

Title	Edition	Author
• Building Construction Costs with RSMeans data	77th	The Gordian Group Inc.
• Contractor's Pricing Guide: Residential Repair & Remodeling Costs with RSMeans data	2019	The Gordian Group Inc.
• Engineering Standards for Forensic Application		Richard W. McLay and Robert N. Anderson
• Handbook of Energy Audits	9th	Albert Thumann, Terry Niehus, and William J. Younger
• Heating Systems Troubleshooting & Repair		John Certuse
• Mechanics of Materials	2nd	E.P. Popov
• The Architect		Spiro Kostof
• Guidelines for Forensic Engineering Practice	2nd	Sponsored by the Technical Council on Forensic Engineering of ASCE, Edited by Joshua B. Kardon, Ph.D., S.E., F.ASCE
• Forensic Structural Engineering Handbook	2nd	Robert Ratay
• Forensic Engineering: Damage Assessments for Residential and Commercial Structures	1st	Stephen E. Petty
•		Rebecca A. Bowman, Esq., P.E., D.F.E., Executive Director of NAFE

Example Questions

Below are 10 questions that represent the structure of questions on the examination. The primary Knowledge-Skill (K-S) Category and Associated Job Task(s) are also included. Refer to the Introduction for additional information regarding K-S and Job Tasks.

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

1. Define Forensic Engineering and what it does except:
    a. Uses engineering skills
    b. Uses force to solve issues
    c. Writes clear informative reports that are easy to understand by a layperson
    d. Verbally explains complicated issues in a clear manner

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

2. Define a net opinion:
    a. Opinion that is well supported by peer reviewed literature
    b. Only you have that opinion that cannot be supported with peer reviewed literature
    c. A good opinion
    d. A wrong opinion

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

3. What does to a reasonable degree of engineering certainty mean?
    a. Pretty sure
    b. Very sure
    c. More likely than not
    d. A wrong opinion

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

4. What does to a reasonable degree of engineering probability mean?
    a. Pretty sure
    b. Very sure
    c. More likely than not or 51% probability
    d. A wrong opinion

Knowledge-Skill: 1.6 – Math

Job Task: B1 – Forensic Engineering

5. What is 20% of 50 units?
    a. 5 units
    b. 10 units
    c. 20 units
    d. 25 units

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

6. What element is added to steel to produce stainless steel?
    a. Nickel
    b. Sulphur
    c. Carbon
    d. Chromium

Knowledge-Skill: 1.6 – Math

Job Task: B1 – Forensic Engineering

7. If you have a mass m traveling at velocity v how would you calculate its kinetic energy?
    a. m.v
    b. 1/2 m.v
    c. m.v.v
    d. 1/2 m.v.v

Knowledge-Skill: 1.6 – Math

Job Task: B1 – Forensic Engineering

8. Zero degrees on the Kelvin scale is known as absolute zero. What is absolute zero on the Celsius scale?
    a. Minus 459.67 degrees
    b. Minus 273.15 degrees
    c. 212 degrees
    d. Minus 100 degrees

Knowledge-Skill: 1.6 – Math

Job Task: B1 – Forensic Engineering

9. The Rankine temperature scale is often used in non-metric thermodynamic calculations, 'absolute zero' being zero on this scale. What is the boiling point of pure water in degrees Rankine?
    a. 212
    b. 100
    c. 671.67
    d. 459.67

Knowledge-Skill: 1.1 – Basic Forensic

Job Task: B1 – Forensic Engineering

10. You arrive home on a hot day to find that your air conditioning has broken down. Your spouse opens the fridge door to cool down the kitchen. You come back in 3 hours; what would you expect to find?
    a. The kitchen has cooled by several degrees.
    b. The kitchen is the same temperature.
    c. The kitchen has warmed by several degrees.
    d. The kitchen has cooled to the same temperature that the fridge is set to.

Example Questions Key

1. B
2. B
3. C
4. C
5. B
6. D
7. D
8. A
9. B
10. B