



Certified Energy Manager Instructions & Application

CEM Exam with Live Seminar Version

Note: As of July 1, 2009, all applicants must take a required approved preparatory seminar before sitting for the exam. Registration for seminars is separate. Applications received without first registering for a seminar will not be processed. Applicants taking the certification exam at a remote testing center should use the Remote Testing Center CEM Application.

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Part A: Information for Applicants

CERTIFIED ENERGY MANAGER (CEM[®])

Please read through the following important information before submitting your CEM[®] Application found in **part B** of this booklet.

1. CEM[®] OBJECTIVES

- To raise the professional standards of those engaged in energy management.
- To improve the practice of energy management by encouraging energy managers in a continuing program of professional development.
- To identify persons with acceptable knowledge of the principles and practices of energy management related disciplines and laws governing and affecting energy managers through completing an examination and fulfilling prescribed standards of performance and conduct.
- To award special recognition to those energy managers who have demonstrated a high level of competence and ethical fitness for energy management.

2. ELIGIBILITY

Energy managers with one the following prerequisites may apply to sit for exam:

2.1 A Four-Year Engineering or Architecture degree or P.E. or R.A. with at least three years of experience in energy engineering/management

OR

2.2 A Four-Year Business or related degree with at least five years of experience in energy engineering/management

OR

2.3. A Two-Year Technical Degree with eight years of experience in energy engineering/management

OR

2.4 Ten years or more verified experience in energy engineering/management

3. THE REQUIRED BODY OF KNOWLEDGE

The effective practice of energy management requires in-depth knowledge of a wide variety of subjects. All applicants must take a required approved preparatory seminar before sitting for the certification exam. For certification purposes, however, the candidate must also demonstrate to the satisfaction of the Certification Board the knowledge and ability to apply the essentials of energy management. To aid candidates in preparing for the examination, the Certification Board makes available a bibliography of suggested reference materials and a study guide (Refer to Part C of this booklet).

4. PROCEDURES

The first step in the CEM certification process is to register for a required approved preparatory seminar. After seminar registration has been completed, the certification application should be completed. Since certification is based on education, experience and passing the examination, it is important that the applicant understands the eligibility requirements (section 2 above), and has attained the prerequisite to qualify for certification.

The application should be received by the certification department four weeks prior to the desired exam date if the applicant feels confident he/she has the necessary prerequisite for certification.

Should applicants have questions about the experience prerequisite for certification, he/she can have

his/her application reviewed by the CEM Board prior to taking the exam. If this is the case, a **completed application** (including all references, official college transcripts and employment verification) must be received by AEE at least eight weeks prior to desired exam date, and the applicant must request in writing that he/she would like an initial review by of his/her application by the CEM Board.

It is very important that all applicants give clear and complete details concerning energy management experience so that the CEM Board can have a clear understanding of the applicant's energy management experience. Based on the eligibility requirement, the number of years required to be verified will vary. Past employers may need to be complete the employment verification form. If you are self-employed or are a principal owner of a company, three client verifications are required in the place of employment verification. **All references, employment verification and/or client verification forms should be completed by the reference, employers and/or clients before sending to AEE. AEE does not send requests to references.**

NOTE – CEM Exam Held with Live Seminar

Your CEM Application must be approved by AEE prior to sitting for the exam. You will receive a letter once AEE has approved your application with additional exam information. Once the application is complete and the CEM exam is passed, all applications are sent to the CEM Board for final approval. Only after Board approval is certification granted.

5. THE APPLICATION & POINT SCORING EVALUATION

The Application Form provides an organized method for documenting professional and educational background, achievements and community service.

The Personal Data Form is divided into the following three parts:

Division I – Education

Division II – Professional Registration (i.e. PE, Registered Architect)

Division III – Experience/Employment in Energy Management

The applicant is requested to list on the Application Form all pertinent information in these categories for evaluation by the CEM Board. All applicants must complete the application; a resume does not replace the four-page application.

The two areas of evaluation shall receive points as follows:

Application Form Data	Maximum Score 1400 points	Minimum Score Required 700
CEM Examination	Maximum Score 1040 points	Minimum Score Required 700
Total Required:	Maximum Score 2440 points	Minimum Score Required 1400

To be awarded the CEM designation, candidates must achieve the minimum total of 700 points on the CEM Application Data and minimum score of 700 points on the CEM examination individually for a minimum total of 1400 points.

If a candidate has failed to acquire sufficient points to be recommended for CEM, the candidate may be re-examined at a subsequent examination period and/or resubmit an updated Application Form. Examination scores will be kept on file by the Certification Director for a period of three years. Applicants have three

years to follow up and complete his/her CEM file; after three years, applicants must retake the CEM exam. A score can be resubmitted if the candidate so requests. High performance on the CEM examination portion of the certification process is crucial when the Application score is low.

It is essential that candidates devote considerable time and effort to completing the Application Form since certification by the CEM Board can be based only on the information provided. Inaccurate and/or incomplete data will only be a liability for the applicant. Documentation should be attached to the Application to substantiate the information presented.

6. THE CEM EXAMINATION

The applicant must complete a four-hour exam. Live Seminar dates and locations are available on our website at www.aeecenter.org/seminars. Applicants must register separately to attend the associated live seminar. An Examination Administrator will proctor the examination. This Administrator may be an Association associate, an educator, an approved testing expert or agency, or whomever the Certification Board deems appropriate based on pre-approval.

The examination questions are based on concepts and experiences basic to energy management, on recognized tests, and on supplemental reading. **The exam is Open Book!** Because of the diversity of background and experience of Energy Managers, the examination will permit the candidates some choice of subject areas. Three subject areas will be mandatory. Of the remaining 11 examination sections, the candidate will choose eight sections he/she feels best qualified to answer. The exam consists of multiple choice and true/false questions.

Grading is accomplished by members of the Certification Director and the CEM Board. Examinations are identified by number rather than by the candidate's name to assure confidentiality and objectivity in grading. Candidates are notified of exam results by mail within 30 days of the exam date.

The CEM Examination contains with the following mandatory subjects:

1. *Codes and Standards
2. *Energy Accounting and Economics
3. *Energy Audits and Instrumentation

The candidate will choose 8 of the remaining 14 sections. If more than 8 additional sections are marked, only the first 8 will be scored. Eleven Sections Total: three mandatory and eight chosen by candidate.

4. Electrical Systems
5. HVAC Systems
6. Motors & Drives
7. Industrial Systems
8. Building Envelope
9. Cogeneration & CHP Systems
10. Energy Procurement
11. Building Automation and Control Systems
12. Green Buildings, LEED and Energy Star
13. Thermal Energy Storage Systems
14. Lighting Systems
15. Boiler and Steam Systems
16. Maintenance & Commissioning
17. Alternative Financing

***Denotes Mandatory Sections**

7. MAINTAINING CERTIFICATION

The continuing education of Energy Managers is essential to cope with the rapidly changing field of energy management. A CEM must accumulate ten professional credits every three years and submit a completed Renewal Form to the Certification Director to remain certified. CEM renewal notices are mailed in the 3rd year of recertification six months prior to the expiration date, which falls on December 31 of that year.

Professional credits for recertification can be accumulated at any time, within the three year period. For example, Energy Managers receiving a CEM certification in 2009, must file a record of ten professional points with the Certification Director by December 31, 2012 to receive a CEM certificate for another 3-year period. *Credits are not maintained by AEE during the three year period. It is the responsibility of the individual to maintain a record and submit this information at the time of renewal.*

Activities for CEM Renewal Credits

- Continued employment in energy management/energy engineering activities:
1 credit per year
- Membership in a professional engineering society:
1 credit per year (3 max)
- Continuing education (CEU's) / professional activities (seminars or conferences):
2 credits per CEU, college credit hour or 10 contract hours for seminar
- Awards presented and/or papers published involving energy engineering/management:
2 credits each
- Offices held in a professional engineering society:
1 credit per year

8. LIFETIME CERTIFICATION

A CEM, upon retiring and reaching the age of sixty-two, is certified for life. No further reporting is necessary except to notify the Certification Secretary of meeting the age requirement by sending a copy of Driver's License.

9. SUSPENSION OF REVOCATION OF CERTIFICATION

If an Energy Manager does not accumulate the required professional credits, certification shall terminate, unless in the judgment of the Certification Board, extenuating circumstances exist and the deficiency can be readily overcome.

10. REINSTATEMENT OF CEM

Energy Managers who do not acquire sufficient CEM maintenance points to be recertified on recertification date will be notified in writing of suspension from using the CEM designation and will no longer be listed as a CEM in any AEE publication. A lapsed CEM has the following options to reinstate:

1. Resubmits to the certification process and successfully meets the criteria for certification by personal data information and examination or,
2. Acquires make-up points at a cumulative total equal to 3.5 per year for every year since date of expiration. This option is available one-time only. Certifications that have lapsed more than three renewal cycles must retake the CEM exam.

11. FEES:

Option A: CEM Exam held with Live Seminar

APPLICATION FEE (CEM Exam held with Live Seminar)

A fee of \$200.00 dollars is payable with the filing of the application. This includes the CEM application (\$100.00) and first-time CEM examination fee (\$100.00). *No application or examination fee refunds are allowed.*

Re-Examination Fee: For each re-examination (held with live seminar), a fee of \$100.00 will be required.

Option B: CEM Exam at Remote Testing Center

APPLICATION FEES (Testing Center Application Only)

A fee of \$300.00 dollars is payable with the filing of the application. This includes the CEM application (\$150.00) and first-time CEM examination fee (\$150.00). *No application or examination fee refunds are allowed.*

Re-Examination Fee (Remote Testing Center Location): For each re-examination, a fee of \$150.00 will be required.

RENEWAL FEE

Three-year renewal fee: \$200.00

Reinstatement fee: \$250.00

No refunds allowed.

12. USE OF CEM DESIGNATION

As a Certified Energy Manager (CEM[®]), the Energy Manager may use the designation with his/her name on organization letterheads, business cards, certain internet listings and forms of address. An official CEM[®] Stamp is available for purchase which authenticates your Certification and Certification validation. The official stamp is useful for proposals and official documents (see next page).

Certification is for individuals only. The CEM designation may not be used to imply that an organization, company or firm is certified. AEE does not endorse or recommend any individual CEM, product or service. Improper usage of CEM or AEE logo may result in suspension. If you have questions about usage of the CEM designation, please contact AEE. A Personalized CEM Stamp also available. CEM[®] Stamp (see Stamp Order Form).

Sample Correct Usage (Signature or Business Card):

John A. Smith, P.E., C.E.M. / Mary Jones, B.E.P., C.E.M.

Web Usage:

John A. Smith is an individual member of the Association of Energy Engineers ([AEE](#)) and is a [Certified Energy Manager](#) (CEM[®]).

Incorrect Usage:

ABC Company is Certified by AEE.

Correct Usage:

- ABC Company has many Certified Energy Managers -CEMs[®] on its staff.
- ABC Company is looking for a Certified Energy Manager candidate for a position.
- John Smith, President of ABC Company, is an individual member of the Association of Energy Engineers and is a Certified Energy Manager (CEM), Certified Carbon Reduction Professional (CRM) and Certified Sustainable Development Professional (CSDP).
- ABC Company is a Corporate Member of the Association of Energy Engineers (AEE) and has five current Certified Energy Managers (CEM) on staff including.....

John Smith is an individual:



Link to www.aeecenter.org/certification

Corporate Member of:



Link to www.aeecenter.org

CEM Applicant downloads and completes CEM application including Live Seminar info



Applicant sends completed CEM application to AEE for review



AEE Reviews - sends initial letter to applicant either accepting or requesting additional info



Upon initial acceptance, AEE sends the applicant information pertaining to taking the CEM exam held with a Live training seminar (applicant must register for seminar separately)



Applicant takes CEM test held with Live seminar. Certification test includes required CEM sections and applicant selected sections



Upon completion of test, the applicant returns to the exam proctor their exam booklet and answer sheet. The applicant will receive a letter from AEE within 30 days of test completion that includes the OFFICIAL test score and application status



If all required references are in place, application is in order, applicant has met all eligibility, passed the exam, then AEE will send the applicant's file to the CEM board for final approval



The board approval process usually takes 6-8 weeks. Once the approvals have been sent to AEE from the CEM Board, the applicant achieves CEM status and will receive their CEM Certification in the mail.



Congratulations on obtaining Certified Energy Manager (CEM®) status



CEM® Application, Testing and Review Process (CEM Exam with Live Seminar Version)

CEM[®]

OFFICIAL STAMP FOR
CERTIFIED ENERGY MANAGERS - CEM[®]

NOW AVAILABLE

As the CEM[®] designation becomes a requirement for more jobs and projects, AEE is pleased to announce the availability of an official stamp that will authenticate your status as a CEM[®] in good standing.

The stamp will include your name, your CEM[®] ID number, and the expiration date of your CEM[®].

(Actual Size - 1³/₄"



Stamp is self-inking with dark blue ink.

Please use the order form provided.

Price: \$50 (includes shipping)

Association of Energy Engineers
4025 Pleasantdale Road, Suite 420 / Atlanta, GA / 770-447-5083

ASSOCIATION OF ENERGY ENGINEERS

Attn: AEE - CEM Stamp
4025 Pleasantdale Road, Suite 420
Atlanta, GA 30340
770.447.5083 Phone
770.446.3969 Fax
Order may be e-mailed to aee@aeecenter.org

ORDER FORM CEM® STAMP

DATE: _____

SOLD / Ship To:

Name: _____

Company: _____

Street Address: _____

City/State/Zip: _____

E-Mail Address: _____

Phone No: _____

QUANTITY	DESCRIPTION			UNIT PRICE	TOTAL
	Name on Stamp (Clearly Print)	CEM Certification Number	Date of Expiration		
				\$50.00	
				\$50.00	
				\$50.00	
				\$50.00	
				\$50.00	
				\$50.00	
TOTAL DUE					

Check method of payment: Check: Make check payable to Association of Energy Engineers

Credit Card: American Express VISA MasterCard

CARD NO.

Expiration Date _____

Signature _____

Part B: CEM[®] APPLICATION

CEM Exam with Live Seminar Version & Study Guide

Please use this form only if you plan on taking the CEM Certification Exam held in-conjunction with one of the Live AEE Seminars

1) Seminar Name / Date / Location (REQUIRED): _____

NOTE: The following information is to be filled out as completely as possible. Please read the "Information for Applicants" very carefully, and also follow instructions for completing and forwarding forms. It is important that the AEE Certification Board have substantiating data for each criteria indicated in the application. APPLICATIONS MUST BE ACCOMPANIED BY THE \$200.00 FILING AND EXAMINATION FEE IN ORDER TO BE CONSIDERED. **THIS APPLICATION DOES NOT AUTOMATICALLY REGISTER YOU FOR THE REQUIRED TRAINING SEMINAR.** PLEASE COMPLETE SEPARATE SEMINAR REGISTRATION at www.aeecenter.org/seminars.

Mail application and payment to:

AEE – CEM Certification Dept.
4025 Pleasantdale Rd. Suite 420
Atlanta, GA 30340

OR fax to: 770-447-4354

Payment enclosed \$ _____ Ck# _____

Credit Card#: _____

Amex _____ Visa _____ Master card _____

Expiration Date: _____

Billing Address: _____

City: _____ State: _____ Zip: _____

Signature: _____

Personal Data (Please print or type)

File Number: _____ (AEE Internal Use Only)

Full legal name as it will appear on certificate:

Last Name: _____ Legal First Name: _____ Middle Initial: _____

Job Title: _____

Firm Name: _____

Address: _____

City: _____ State: _____ Zip: _____ Country: _____

Phone: _____ Fax: _____ E-mail: _____

Residence Address: _____

City: _____ State: _____ Zip: _____ Country: _____

Phone: _____ Address Requested for Correspondence: _____ Business _____ Residence

DIVISION I – EDUCATION
 (MAXIMUM 350 POINTS FOR DIVISION I)

List in chronological order the name and location of each college or university attended; also list other appropriate training. Points are based on degree obtained and substantiating documentation submitted. **Please arrange for Official College Transcripts where degree was issued to be forwarded to AEE, but do not delay filing of application for this reason.**

Name & Location Of Institution	Years From - To	Date Graduated	Degree Received	Field In Which Degree Was Issued

DIVISION II – PROFESSIONAL REGISTRATION
 (MAXIMUM 350 POINTS FOR DIVISION II)

I am a Registered Engineer: ___yes ___no
 I am a Registered Architect: ___yes ___no
 I am an Engineer in Training (E.I.T.): ___yes ___no
 I am a Certified Plant Engineer: ___yes ___no
 I am an Energy Auditor: ___yes ___no

If yes to any of the above, complete the following and **enclose copy registration. Registration must indicate that license is currently in force.** Points are based on substantiating documentation submitted.

State	Registration No.	Date	Now in Force
			___yes ___no
			___yes ___no
			___yes ___no
			___yes ___no
			___yes ___no

Have any states revoked or suspended your registration? ___yes ___no
 If yes, please explain:

DIVISION III – EXPERIENCE RECORD

(MAXIMUM 700 POINTS - 350 points for 3 years of full-time energy experience; 50 points per year thereafter)

Applicant should forward one copy of the Employment Verification Form to each employer for those periods which apply to Certification Eligibility. Forms may be completed by immediate superiors or personnel offices and must be returned directly to AEE.

Please complete the following in chronological order and list the most recent employer first. Include a description of job functions held for those periods of employment, which qualify you for specific category of certification as applied for. This form may be copied if additional space is needed.

Date: From-To	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		

REFERENCES

Furnish the names and addresses of two references. References should be CEM professionals, PEs, RAs, or other highly distinguished professional in the industry. **The official AEE Letter of Reference is to be forwarded by Applicant to the individuals listed below and returned directly to AEE by references.**

Name	Company and Address	Position

OBLIGATION

I _____ (Signature), having completed the aforementioned to the best of my ability, do hereby apply for AEE Energy Manager Certification and wish to take the CEM Examination.

Affidavit

I hereby agree (a) to be bound by terms and provisions of the Certificate of Incorporation of the Association of Energy Engineers, its by-laws and such other regulation as may from time to time be in force, so far as they may affect me; (b) to indemnify and hold harmless each and all of your members, Board of Directors, Certification Board, officers, examiners and agents from and against any liability whatsoever in respect to any act or omission by you or them or any of them in connection with this application, the examination, the grades given upon such examination, and/or the granting or issuance of a failure to grant or issue a certificate to me; (c) that any prescribed fee paid by me is not refundable; and (d) that any certificate granted or issued me shall remain the property of the Association. I certify that all the information contained in this application is correct to the best of my knowledge.

I further pledge myself hereby to the highest ethical standards in the practice of energy engineering/management.

Signature in Full _____

Date: _____

Certification Board Use only

The AEE Certification Board, acting at its regular meeting on _____ has
____ approved _____ disapproved this application as presented for certification.
Certification No. _____

Director, CEM Certification

Date



REQUEST FOR REFERENCE INFORMATION
Certified Energy Manager

From: _____

To: _____ Date: _____

Dear _____:

I am applying to the Association of Energy Engineers for Certification as an Energy Manager. In this regard, I hereby authorize your release of the requested information.

Please furnish the requested information as completely as possible, and ***return to AEE Certification Board.***

The receipt of replies will be reported by AEE, but under no circumstances will the information be divulged to me, or used for any purpose except to validate my application for Energy Manager Certification.

Sincerely,

Applicant Signature

NOTE: Applicant must submit two letters of reference.

APPLICANT COMPLETE / Attach to Cover Letter

Name:

Address:

City:

State:

Zip:

REFERRAL COMPLETE / LETTER OF REFERENCE

Name:

Company:

Telephone:

Address:

City:

State:

Zip:

The above named applicant I have known personally from:

_____ to _____

I am personally familiar with the professional work of the applicant:

____yes

____no

If yes, please state relationship and brief description of character of work.

Do you know any reason why candidate should be denied certification?

____yes

____no

If yes, please state reason.

To the best of my knowledge, I hereby attest that the above information is true and correct.

Name of person supply information: _____
(please type or print)

Official Title of Respondent: _____

Signature: _____ Date: _____

**Return to: AEE CERTIFICATION BOARD – CEM
4025 PLEASANTDALE RD. Suite 420
ATLANTA, GEORGIA 30340**



**REQUEST FOR EMPLOYMENT AND
JOB DUTIES VERIFICATION**
Certified Energy Manager

From: _____

To: _____ Date: _____

Dear _____:

I am applying to the Association of Energy Engineers for Certification as an Energy Manager. In this regard, I hereby authorize your release of the requested information enclosed which verifies my employment and duties from the period _____ to _____.

Please furnish the requested information as completely as possible, and ***return to AEE Certification Board.***

The receipt of replies will be reported by AEE, but under no circumstances will the information be divulged to me, or used for any purpose except to validate my application for Energy Manager Certification.

Applicant Signature

NOTE: *If self-employed, complete letter of client verification.*

APPLICANT COMPLETE / Attach to Cover Letter

Name: _____

Address: _____

City: _____

State: _____

Zip: _____

LETTER OF EMPLOYMENT and JOB DUTIES VERIFICATION

The following information verifies the employment and duties of the above applicant for AEE Certification.

Company: _____

Telephone: _____

Address: _____

City: _____

State: _____

Zip: _____

The above named applicant was (has been) employed by our company from _____ to _____ and has held the following positions:

_____	Dates: _____
_____	Dates: _____
_____	Dates: _____
_____	Dates: _____

Please fully describe the energy-related responsibilities of the applicant (REQUIRED). Attach descriptions if necessary to answer fully. **Forms with incomplete details will not be processed.**

To the best of my knowledge, and our employment records, I hereby attest that the above information is true and correct.

Name of person supply information: _____
(please type or print)

Official Title of Respondent: _____

Signature: _____ Date: _____

**Return to: AEE CERTIFICATION BOARD – CEM
4025 PLEASANTDALE RD. Suite 420
ATLANTA, GEORGIA 30340**



REQUEST FOR CLIENT VERIFICATION
Certified Energy Manager

From: _____

To: _____ Date: _____

Dear _____:

I am applying to the Association of Energy Engineers for Certification as an Energy Manager. In this regard, I hereby authorize your release of the requested information enclosed which verifies my employment and duties from the period _____ to _____.

Please furnish the requested information as completely as possible, and ***return to the AEE Certification Board.***

The receipt of replies will be reported by AEE, but under no circumstances will the information be divulged to me, or used for any purpose except to validate my application for Energy Manager Certification.

Applicant Signature

NOTE: Complete this form only if self-employed – furnish three (3) client verification letters.

NOTE: *If Self-Employed, furnish three (3) client verifications.*

APPLICANT COMPLETE / Attach to Cover Letter

Name: _____

Address: _____

City: _____

State: _____

Zip: _____

CLIENT COMPLETE / LETTER OF CLIENT VERIFICATION

The following information verifies the Contractor/Consultant and duties of the above applicant for AEE Certification.

Company: _____

Telephone: _____

Address: _____

City: _____

State: _____

Zip: _____

The above contractor/consultant has provided service(s) to our company from:

_____ to _____

Please fully describe the energy-related responsibilities of the applicant (REQUIRED). Attach descriptions if necessary to answer fully. **Forms with incomplete details will not be processed.**

To the best of my knowledge, I hereby attest that the above information is true and correct.

Name of person supply information: _____
(please type or print)

Official Title of Respondent: _____

Signature: _____ Date: _____

**Return to: AEE CERTIFICATION BOARD – CEM
4025 PLEASANTDALE RD. Suite 420
ATLANTA, GEORGIA 30340**

Part C: STUDY GUIDE

CERTIFIED ENERGY MANAGERS (CEM[®] EXAM)

[Online Practice CEM[®] Test Also Available.](#)

CEM Applicants now have access to an online version practice test of the CEM exam. There is an additional fee to take this online test and you may access the full details at [Vantage Learning](#):

Direct Link: <http://www.vantageonlinestore.com/home.php?cat=301>

The following is a list of the subjects for the CEM exam. Each subject covers a number of topics. Following the list of topics are suggested references with chapter numbers. The primary references are the Handbook of Energy Engineering, by D. Paul Mehta and Albert Thumann, the Energy Management Handbook, 6th Edition by Wayne C. Turner and Steve Doty, and Guide to Energy Management 6th Edition by Barney L. Capehart, Wayne C. Turner and William J. Kennedy. However, some other books are also referenced as appropriate.

The study guide will not lead you to answers to all of the questions, but it will certainly lead you to a very large number of correct answers. A person with the necessary experience who reviews the study guide should not have any problem passing the exam. The exam has recently been modified (and a new exam will be used after December 31, 2009) and is similar in difficulty to CEM examinations from 2003 through late 2009.

The exam will be open book and will last four hours. All questions are 8 points each. The maximum exam score is 1,040 points and passing score is 704. All candidates must answer Sections I, II, and III: Codes and Standards and Indoor Air Quality, Energy Accounting and Economics, and Energy Audits and Instrumentation. The candidate should choose 8 of the remaining 14 sections. If more than 8 additional sections are marked, only the first 8 will be scored. After the first three mandatory sections, the fourteen sections remaining are as follows:

Electrical Systems	HVAC Systems
Industrial Systems	Motors and Drives
Building Envelope	CHP Systems and Renewable Energy
Energy Procurement	Building Automation and Control Systems
Green Buildings, LEED and ENERGY STAR	Lighting Systems
Thermal Energy Storage Systems	Maintenance and Commissioning
Boiler and Steam Systems	
Alternative Financing	

STUDY GUIDE TOPICS & REFERNCES

I. CODES AND STANDARDS and INDOOR AIR QUALITY

CODES AND STANDARDS SUBJECT TOPICS

Federal Power Act
FERC
National Energy Act of 1978
Natural Gas Policy Act of 1978
Public Utility Regulatory Policies Act of 1978
Federal Energy Regulatory Commission Orders 436, 500, 636, 636A, 888, and 889
Energy Policy Act of 1992
Energy Policy Act of 2005 – Energy Efficiency Requirements and Tax Incentives
Executive Order 13423 of 2007
Energy Independence and Security Act of 2007
Energy Improvement and Extension Act of 2008
American Recovery and Reinvestment Act of 2009
ASHRAE/IESNA Standard 90.1-2004 and 2007
IEC and IEEC Codes
ASHRAE Standard 90.2

ASHRAE Standard 62.1 -2004 and 2007
Model Energy Code
ASHRAE Standard 135-2008
ANSI/MSE 2000:2008

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 1.
REF: Turner, **Energy Management Handbook**, Chapter 20.

INDOOR AIR QUALITY SUBJECT TOPICS

ASHRAE Standard 62.1 – 2004 and 2007
Acceptable Air Quality
Ventilation Rate Procedure
Alternate Air Quality Procedure
Typical Air Contaminants
VOCs and Bioaerosols
IAQ Problem Causes
CO2 Measurement and Control
Microbial Contamination

REF: **ASHRAE 62.1 2004 and 2007 Standard**
REF: Turner, **Energy Management Handbook**, 6th, Chapter 17

II. ENERGY ACCOUNTING AND ECONOMICS

SUBJECT TOPICS

Simple Payback Period	Life Cycle Cost Method
Time Value of Money	Interest Formulas and Tables
Present Worth	Project Life
Net Present Value	Annual Cost Method
Present Worth Method	Economic Performance Measures
After Tax Cash Flow Analysis	Depreciation Methods
Internal Rate of Return	Impact of Fuel Escalation Rates
Energy Accounting	Btu Reporting
Point of Use Costs	Efficiency Measures

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 2.
REF: Turner, **Energy Management Handbook**, Chapter 4.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 4.

III. ENERGY AUDITS AND INSTRUMENTATION

SUBJECT TOPICS

Role of Audits	Audit Equipment
Energy Management Measures	Load Factors
Combustion Analysis	Combustion Analyzers
Power Factor Correction	Electric Metering Equipment
Very Basic Thermodynamics	Temperature Measurement
Air Velocity Measurement	Pressure Measurement
Light Level Measurement	Humidity Measurement
Infrared Equipment	Energy and Power Measurement
Fuel Choices	HHV and LHV
Energy Use Index	Energy Cost Index

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 3.
REF: Turner, **Energy Management Handbook**, Chapter 3.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 2.

IV. ELECTRICAL SYSTEMS

SUBJECT TOPICS

Demand and Energy	Load Factors
Real Power	Reactive Power
Power Factor	Three Phase Systems
Power Factor Correction	Peak Demand Reduction
Rate Structure and Analysis	Motors and Motor Drives
Variable Speed Drives	Affinity Laws (Pump and Fan Laws)
Power Quality	Harmonics
Grounding	IEEE PQ Standard 519

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 11.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 3.

V. HVAC SYSTEMS

SUBJECT TOPICS

Heating, Ventilating, and Air Conditioning (HVAC)	
Affinity Laws	Performance Rating (COP, EER, kW/ton)
Psychrometric Chart	HVAC Economizers
HVAC Equipment Types	Air Distribution Systems (Reheat, Multizone, VAV)
Degree Days	Chillers
Heat Transfer	Energy Consumption Estimates
Vapor Compression Cycle	Absorption Cycle
Cooling Towers	Air and Water Based Heat Flow
ASHRAE Ventilation Standard	Demand Control Ventilation

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 7, 8.

REF: Turner, **Energy Management Handbook**, Chapter 10.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 6.

VI. MOTORS AND DRIVES

SUBJECT TOPICS

AC Induction Motors	AC Synchronous Motors
DC Motors	High Efficiency Motors
Load Factor and Slip	Power Factor and Efficiency
Motor Speed Control	Variable Frequency Drives
Fan and Pump Laws	Variable Flow Systems
Motor Selection Criteria	New vs. Rewound Motors
Motor Management Software	Power Factor Correction

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 11.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 12.

VII. INDUSTRIAL SYSTEMS

SUBJECT TOPICS

Waste Heat Recovery	Boilers and Thermal Systems
Industrial Energy Management	Fuel Choices
Steam Systems	Steam Tables
Heat Exchangers	Compressors
Turbines	Pumps and Pumping Systems
Compressed Air Systems	Air Compressors
Air Compressor Controls	Air Leaks

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 5, 6 & 15.

REF: Turner, **Energy Management Handbook**, Chapter 5, 6 & 8.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 7, 11.

VIII. BUILDING ENVELOPE

SUBJECT TOPICS

Thermal Resistance	Heat Transfer Coefficients
Insulation	Vapor Barriers
Solar Heat Gain	Solar Shading
Thermally Light Facilities	Thermally Heavy Facilities
Conduction Heat Loads	Psychrometric Chart
Air Heat Transfer	Water Heat Transfer

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 7.

REF: Turner, **Energy Management Handbook**, Chapter 9 & 15.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 6 & 11.

IX. CHP SYSTEMS and RENEWABLE ENERGY

SUBJECT TOPICS

Topping Cycles	Bottoming Cycles
Combined Cycles	Fuel Selection
Prime Movers	Operating Strategies
Regulations	Codes and Standards
Combined Heat and Power	Distributed Generation
HHV and LHV	Thermal Efficiencies
Solar, Wind, Biomass, and Hydropower	Wind Energy Systems
Solar Thermal and Solar Photovoltaic Systems	

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 9.

REF: Turner, **Energy Management Handbook**, Chapter 7.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, 6th, Chapters 13 and 14

X. ENERGY PROCUREMENT

SUBJECT TOPICS

Energy Policy Act of 2005	Energy Policy Act of 1992
Deregulated Natural Gas	Retail and Wholesale Wheeling
FERC Orders 888 and 889	Electric Deregulation
Utility Restructuring	Natural Gas Policy Act
Marketers and Brokers	HHV and LHV
LDC, ISO, PX, EWG	Distributed Generation

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 1.

REF: Turner, **Energy Management Handbook**, Chapter 21, 23, & 24.

XI. BUILDING AUTOMATION AND CONTROL SYSTEMS

SUBJECT TOPICS

Energy Management Strategies	Terminology
Basic Controls	PID Controls
BACnet & LON	Signal Carriers
Power Line Carriers	Direct Digital Control
Distributed Control	Central Control
Optimization Controls	Reset Controls
Building Control Strategies	Communication Protocols
Expert Systems	Artificial Intelligence
Self-Tuning Control Loops	Energy Information Systems
TCP/IP	Internet, Intranets and WWW
BAS Systems	Web Based Systems

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4 and 10.

REF: Turner, **Energy Management Handbook**, Chapter 12.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, 6th, Chapter 9 and 15.

XII. GREEN BUILDINGS, LEED, AND ENERGY STAR

SUBJECT TOPICS

Green Buildings	USGBC
Sustainable Design	LEED Certification
ASHRAE 90.1 Energy Cost Budget Method	LEED O&M
Certified, Silver, Gold, and Platinum	LEED NC
LEED CI	LEED CS
Water Efficiency	Energy and Atmosphere
Materials and Resources	Indoor Environmental Quality
ENERGY STAR Rating	Portfolio Manager
Energy Star Label	Green Globes
ASHRAE Standard 189	ASHRAE Green Guide

REF: **United States Green Buildings Council, website with LEED presentations, www.usgbc.org**

REF: **ENERGY STAR presentation, ENERGY STAR website, www.energystar.gov**

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, 6th, Chapter 16

XIII. THERMAL ENERGY STORAGE SYSTEMS

SUBJECT TOPICS

Design Strategies	Operating Strategies
Storage Media	Advantages and Limitations
Chilled Water Storage	Ice Storage
Sizing	Volume Requirements
Full Storage Systems	Partial Storage Systems

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 12.

REF: Turner, **Energy Management Handbook**, Chapter 19.

XIV. LIGHTING SYSTEMS

SUBJECT TOPICS

Light Sources	Efficiency and Efficacy
Lamp Life	Strike and Restrike
Lumens	Footcandles
Zonal Cavity Design Method	Inverse Square Law
Coefficient of Utilization	Room Cavity Ratios
Lamp Lumen Depreciation	Light Loss Factors
Dimming	Lighting Controls
Color Temperature	Color Rendering Index
Visual Comfort Factor	Reflectors
Ballasts	Ballast Factor
Lighting Retrofits	IES Lighting Standards
EPACT 2005 Lighting Efficiency	LED Lighting

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 13.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 5.

XV. BOILER AND STEAM SYSTEMS

SUBJECT TOPICS

Combustion Efficiency	Air to Fuel Ratio
Excess Air	Boiler Economizers
Steam Traps	Steam Leaks
Condensate Return	Boiler Blowdown
Waste Heat Recovery	Flash Steam
Scaling and Fouling	Turbulators
HHV and LHV	Condensing Boilers

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 6.

REF: Turner, **Energy Management Handbook**, Chapter 5 and 6.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 7 and 8.

XVI. MAINTENANCE AND COMMISSIONING

MAINTENANCE SUBJECT TOPICS

Combustion Control	Compressed Air Leaks
Steam Leaks	Steam Traps
Insulation	Outside Air Ventilation
Group Relamping	Scheduled Maintenance
Preventive Maintenance	Proactive Maintenance
Boiler Scale	Water Treatment

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 14.

REF: Turner, **Energy Management Handbook**, Chapter 14.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 10 and 11.

COMMISSIONING SUBJECT TOPICS

Purpose of Commissioning	Benefits of Commissioning
Need for Commissioning	Commissioning New Buildings
Retro-Commissioning	Real Time and Continuous Commissioning
Measurement and Verification	Commissioning Agent
Phases of Commissioning	Facility Design Intent
Commissioning Documentation	Re-commissioning

REF: Turner, **Energy Management Handbook**, 5th, Chapter 26

XVII. ALTERNATIVE FINANCING

SUBJECT TOPICS

Energy Service Companies	Energy Savings Performance Contracting
Utility Financing	Shared Savings Contracts
Demand Side Management	Contracting and Leasing
Measurement and Verification Protocols	Savings Determination
Risk Assessment	Energy Policy Act of 1992, 2005
Loans, Stocks and Bonds	Federal Facility Requirements
EISA 2007	

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 16.

REF: Turner, **Energy Management Handbook**, Chapter 25.



CEM EXAM REVIEW QUESTIONS (Sample Only)

Some of these review questions may be more complex or difficult than the exam but will be good practice problems.

1. ASHRAE 90.1 is used as the basis for Commercial Building Codes by most states?
 - i. True
 - ii. False

2. Commercial building lighting requirements are specified by IESNA and are included in ASHRAE 90.1 by reference?
 - i. True
 - ii. False

3. If electricity is selling for \$0.06 per kilowatt-hour and is used for electric heating with an efficiency of 90%, what is the equivalent price of natural gas per therm if it can be burned with an efficiency of 80%?
 - i. \$1.33/therm
 - ii. \$1.47/therm
 - iii. \$1.56/therm
 - iv. \$1.65/therm
 - v. \$1.780/therm

4. An energy saving device will save \$25,000 per year for 8 years. How much can a company pay for this device if the interest rate (discount rate) is 15%?
 - i. \$10,000
 - ii. \$173,000
 - iii. \$112,000
 - iv. \$77,000

5. What would be used to find hot spots or phase imbalances in an AC circuit?
 - i. Ohmmeter
 - ii. Infrared Camera
 - iii. Wattmeter
 - iv. All of the above

6. An audit for one firm showed that the power factor is almost always 70% and that the demand is 1000kW. What capacitor size is needed to correct power factor to 90%?
 - i. 266 kVAR
 - ii. 536 kVAR
 - iii. 1000 kVAR
 - iv. 618 kVAR
 - v. 1214 kVAR

7. The amount of reactive power that must be supplied by capacitors to correct a power factor of 84% to 95% in a 400 HP motor at 75% load and 98% efficiency is:
- 72.4 kVAR
 - 82.5 kVAR
 - 92.4 kVAR
 - 90.0 kVAR
 - 123.5 kVAR
8. Power factor correcting capacitors may be located:
- At the inductive load
 - At load control centers
 - At the customer side of the service transformer
 - All of the above
 - i & ii
9. You find that you can replace a 50 HP motor with a 5 HP motor by cutting the total air flow requirements. Both motors operate at full load. Calculate the total dollar savings, given the information below: {Hint: savings of 45 HP}
- | | |
|-----------------------|-------------------|
| Runtime: | 8,760 hours/year |
| Motor Efficiency: | 90% (both motors) |
| Electrical Rate: | \$9.00/kW/mo |
| | \$0.05/kWh |
| Fuel Cost Adjustment: | \$0.005/kWh |
- \$22,000
 - \$12,710
 - \$18,798
 - \$15,650
 - \$9,874
10. An absorption system with a COP of 0.8 is powered by hot water that enters at 200 F and exits at 180 F at a rate of 25 gpm. The chilled water operates on a 10 F temperature difference and the condenser cooling water on a 22 F temperature difference. Calculate the Chilled water flow.
- 10 gpm
 - 20 gpm
 - 40 gpm
 - 45 gpm
 - 30 gpm
11. 10,000 cfm of air leaves an air handler at 50 F; it is delivered to a room at 65 F. No air was lost in the duct. No water was added or taken away from the air in the duct. How many BTU/hr was lost in the ductwork due to conduction?
- 162,000 BTU/hr
 - 75,000 BTU/hr
 - 126,550 BTU/hr
 - 256,000 BTU/hr
 - 10,000 BTU/hr
12. An investment tax credit of 10% for a single project at a large company:
- Reduces the company's overall taxes by 10%
 - Increases depreciation rate by 10%
 - Effectively reduces first cost of the project by 10%
 - i & iii

13. Air at 69 F dry bulb and 50% relative humidity flows at 6750 cubic feet per minute and is heated to 90 F dry bulb. How many BTU/hr is required in this process?
- 50,000 BTU/hr
 - 75,000 BTU/hr
 - 152,000 BTU/hr
 - 10,000 BTU/hr
14. Estimate the seasonal energy consumption for a building if its design-heating load has been determined to be 350,000 BTU/hr for a design temperature difference of 70 F if the heating season has 3,500-degree days. The heating unit efficiency is 80%. Assume 1 MCF = 10^6 BTU.
- 625 MCF/year
 - 350 MCF/year
 - 420 MCF/year
 - 656 MCF/year
 - 525 MCF/year
15. A wall has a total R-value of 15. Determine the annual cost of the heat loss per square foot in a climate having 5,000 heating degree-days. The heating unit efficiency is 70% and the fuel cost is \$5.00/million BTUs.
- \$0.057/yr/ft²
 - \$0.040/yr/ft²
 - \$0.129/yr/ft²
 - \$0.200/yr/ft²
 - \$0.029/yr/ft²
16. A 10,000 square foot building consumed the following amounts of energy last year. What is the Energy Use Index of the building in BTU per square foot per year?
- Natural Gas 5,000 therms/year
 - Electricity 60,000 kWh/year
- 7,500 BTU/square foot/yr
 - 88,000 BTU/square foot/yr
 - 81,500 BTU/square foot/yr
 - 70,500 BTU/square foot/yr
 - 700,000 BTU/square foot/yr
17. Assuming that adding 2 inches of fiberglass insulation drops the U-value of a building from 0.24 to 0.098, calculate the annual cooling savings per square foot from the data given below:
- 2,000 cooling degree days; Cooling COP = 2.5; Electrical cost \$0.05/kWh
- \$0.10/ft²-yr
 - \$0.25/ft²-yr
 - \$0.04/ft²-yr
 - \$0.59/ft²-yr
 - \$0.02/ft²-yr
18. How much fuel is wasted if 100 pounds per hour of condensate at 30 psia saturated liquid is drained to the sewer and is made up with water at 60 F. Assume the boiler is 80% efficient and ignore blowdown effects.
- 12,090 BTU/hr
 - 15,200 BTU/hr
 - 18,000 BTU/hr
 - 23,850 BTU/hr
 - 21,800 BTU/hr

19. Select the equipment best suited to efficient air-to-air heat exchange and humidity control in the HVAC system of a large office building:
- Heat pipe
 - Radiation recuperator
 - Rotary sensible heat wheel
 - Plate and frame heat exchanger
 - Run around heat exchanger loop
20. Select the equipment best suited to extract heat from the exhaust (temperature over 2,000 deg F) of a glass melting furnace:
- Radiation recuperator
 - Heat pump
 - Shell and tube heat exchanger
 - Rotary heat wheel
 - Heat pipe bundle
21. Chilled water reset saves energy because the energy required in refrigeration compressors is a function of the chilled water's leaving temperature.
- True
 - False
22. The difference between the setting at which the controller operates to one position and the setting at which it changes to the other is known as the:
- Throttling range
 - Offset
 - Differential
 - Control Point
23. An all-electric facility pays \$100,000 annually for energy. The compressed air system has energy costs of \$20,000 per year. The system air pressure can be lowered by 10 psi. Approximately how much will be saved annually?
- \$20,000
 - \$10,000
 - \$5,000
 - \$2,000
 - \$1,000
24. With a load leveling TES strategy, a building manager will
- Not operate the chiller during peak hours
 - Essentially base load the chiller (i.e., operate at high load most of the time)
 - Operate only during the peaking times
 - Operate in the "off" season
25. A large commercial building will be retrofitted with a closed-loop water to air heat pump system. Individual meters will show costs to each department. Demand billing is a small part of the total electrical cost. Would you recommend a TES?
- Yes
 - No

26. A building presently has the following lighting system:

Present System

Type: 196 mercury vapor light fixtures
Size: 250 watt/lamp (285 watt/fixture, including ballast)
Lamp Life: 20,000 hours/lamp
Lamp Cost: \$44.00/lamp
Output: 10,000 lumens/lamp

You have chosen to replace the existing system with the following:

Proposed System

Type: 140 high pressure sodium fixtures
Size: 150 watt/lamp (185 watt/fixture)
Lamp Life: 24,000 hours/lamps
Lamp Cost: \$54.00/lamp
Output: 15,000 lumens/lamp

The facility operates 24 hours/day. Approximate the heating effect if the heating system efficiency is 80%, fuel costs \$5.00 per million BTUs and there are 200 heating days (not heating degree days) per year.

- i. \$4,445/year
- ii. \$2,548/year
- iii. \$6,986/year
- iv. \$5,289/year
- v. \$3,070/year

27. A program available at no-cost from a US Department of Energy website that displays cost and efficiency data on electric motors is:

- i. Freeware
- ii. Building Life Cycle Cost
- iii. MotorMaster
- iv. 3EPlus
- v. QuickPEP

28. Given the same amount of excess air and the same flue gas temperature, which fuel provides the highest combustion efficiency?

- i. Natural Gas
- ii. No. 2 Fuel Oil
- iii. No. 6 Fuel Oil

29. A boiler is rated at 30 boiler horsepower and 80% efficient. What is the input rating?

- i. 1,005,000 BTU/hr
- ii. 1,255,000 BTU/hr
- iii. 502, 500 BTU/hr
- iv. 3,628,750 BTU/hr
- v. 13,400,000 BTU/hr

30. In a steam system, several things can happen to the condensate. Which of these is the best from the standpoint of energy expense?

- i. Drain condensate to sewer
- ii. Recover condensate in insulated system at atmospheric pressure
- iii. Recover condensate in un-insulated system at boiler pressure
- iv. Recover condensate in insulated system at or near boiler pressure

31. Select the item from the list below which would most likely have the shortest payback with energy savings.
- Replacing asbestos boiler insulation
 - Installing condensate return system
 - Repairing air leaks or steam leaks
 - Installing heat wheel
 - Installing combustion air preheater
32. Estimate the waste heat available in Btu/minute from a refinery flare gas leaving a process unit at 800 deg F if it is flowing at 1,000 cfm and weighs 0.08 lb/cubic foot. Its specific heat or heat content over the temperature range is 0.3 Btu/lb·°F and you should assume the waste gas could be reduced in temperature to 250 deg F.
- 178,000 Btu/min
 - 165,000 Btu/min
 - 44,000 Btu/min
 - 19,200 Btu/min
 - 13,200 Btu/min
33. In calculating heat flows, metal generally provides little resistance to heat flow compared to insulation or even air films.
- True
 - False
34. Water at 72 deg F is supplied to a 100 psia boiler. 1000 lb/hr of steam from the boiler is supplied to a process and the condensate is sent to the sewer drain. What fraction of the energy added in the boiler is lost with the condensate, relative to the 72 F water entering the boiler?
- 100%
 - 75%
 - 34%
 - 29%
 - 23%
35. A 100 HP rotary screw air-compressor generates heat equivalent to about :
- 1000 Btu/hr
 - 12,000 Btu/hr
 - 100,000 Btu/hr
 - 250,000 Btu/hr
36. An optimum start is a control function that:
- shuts off the outside ventilation air during start up of the building
 - shuts off equipment for duty cycling purpose
 - senses outdoor and indoor temperatures to determine the start time needed to heat or cool down a building to desired temperatures
 - starts randomly
37. Which of the following could be used to detect failed steam traps?
- Ultrasonic equipment to listen to the steam trap operation
 - Infrared camera to detect the change in temperature
 - Real time MMS using conductance probes
 - All of the above

38. Calculate the group re-lamping interval for T12 lamp fixtures that annually operate for 4,160 hrs with rated life of 15,000 hrs (assuming replacements at 70% of rated life).
- i. 3.5 years
 - ii. 4.0 years
 - iii. 1.0 year
 - iv. 2.5 years

CEM Exam Review Answers

Questions - Answers

- 1. (i)
- 2. (i)
- 3. (iii)
- 4. (iii)
- 5. (ii)
- 6. (ii)
- 7. (i)
- 8. (iv)
- 9. (i)
- 10. (iii)
- 11. (i)
- 12. (iii)
- 13. (iii)

Questions - Answers

- 14. (v)
- 15. (i)
- 16. (iv)
- 17. (iii)
- 18. (iv)
- 19. (i)
- 20. (i)
- 21. (i)
- 22. (iii)
- 23. (v)
- 24. (ii)
- 25. (ii)
- 26. (v)

Questions - Answers

- 27. (iii)
- 28. (iii)
- 29. (ii)
- 30. (iv)
- 31. (iii)
- 32. (v)
- 33. (i)
- 34. (v)
- 35. (iv)
- 36. (iii)
- 37. (iv)
- 38. (iv)

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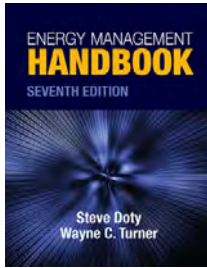
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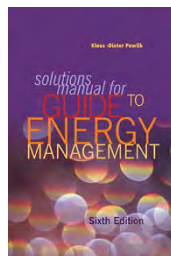
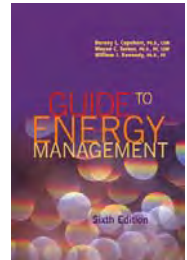
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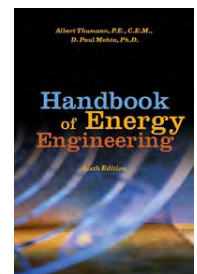
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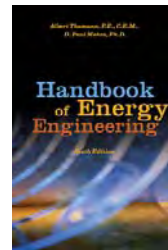
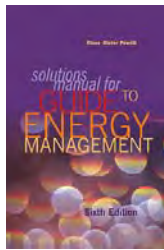
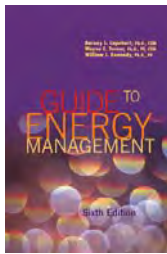
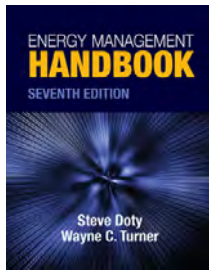
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